

# COMPENDIUM KANGAROO

Math Kangaroo Competition 2003-2023

**Gerard Romo Garrido**

Toomates Colección vol. 38



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Versión de este documento: **20/02/2024**

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Este documento forma parte de los recopilatorios siguientes:

**Compendium Kangaroo** (Internacional, en inglés)

<http://www.toomates.net/biblioteca/CompendiumKangaroo.pdf>

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<http://www.toomates.net/biblioteca/Canguro.pdf>

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<http://www.toomates.net/biblioteca/Cangur.pdf>

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## Tabla de correspondencia Canguro/Cangur/Kangaroo/Kangourou.

EDAD	ESPAÑA			KANGAROO		KANGOUROU (FRANCIA)	
	CURSO	CANGURO	CANGUR (Catalunya)	Grado USA		Curso	Prueba
6/7	1º Prim.			1th			
7/8	2º Prim.			2nd	Felix		
8/9	3º Prim.			3th		CE2	
9/10	4º Prim.			4th	Ecolier	CM1	
10/11	5º Prim.		5è EP	5th		CM2	<b>E</b> Écoliers
11/12	6º Prim.		6è EP	6th	Benjamin	6ème	
12/13	1º ESO	Nivel 1	1r ESO	7th		5ème	<b>B</b> Benjamins
13/14	2º ESO	Nivel 2	2n ESO	8th	Cadet	4ème	
14/15	3º ESO	Nivel 3	3r ESO	9th		3ème	<b>C</b> Cadets
15/16	4º ESO	Nivel 4	4t ESO	10th	Junior	2ème	
16/17	1º BAT	Nivel 5	1r batx. CFGM	11th		1ème	
17/18	2º BAT	Nivel 6	2n bat. CFGS	12th	Student	T	<b>J</b> Juniors (Lycées) <b>P</b> Lycées Professionnels <b>S</b> 1 reS, TS, Bac+

Fuente de estos documentos:

<https://www.matematica.pt/en/useful/kangaroo-questions.php>

# Questions of Kangaroo 2003

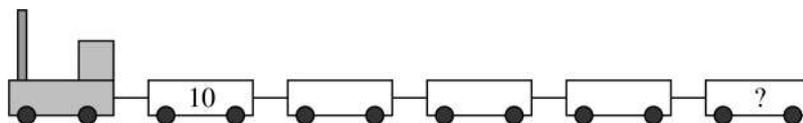
## MINOR (grades 3 and 4)

### 3-POINT QUESTIONS

M1. How much is  $0 + 1 + 2 + 3 + 4 - 3 - 2 - 1 - 0$ ?

A 0 B 2 C 4 D 10 E 16

M2. There are 10 boxes in the first van. Every further van contains twice as many boxes as the previous one. How many boxes are there in the fifth van?



A 100 B 120 C 140 D 160 E 180

M3. Sophie draws kangaroos: a blue one, then a green, then a red, then a black, then a yellow, a blue, a green, a red, a black, and so on. What colour is the 17<sup>th</sup> kangaroo?

A Blue B Green C Red D Black E Yellow

M4. In the teachers' room there are 6 tables with 4 chairs each, 4 tables with 2 chairs each, and 3 tables with 6 chairs each. How many chairs are there altogether?

A 40 B 25 C 50 D 36 E 44

M5. A coin is lying on the table. What is the maximum number of such coins which can be put on the table in such a way that each of them touches this coin?

A 4 B 5 C 6 D 7 E 8

M6. In the picture the distance  $KM = 10$ ,  $LN = 15$ ,  $KN = 22$ . Find the distance  $LM$ .



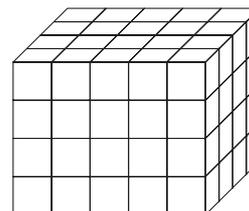
A 1 B 2 C 3 D 4 E 5

M7. Hedgehog Mark complained to his friends: "If I had picked twice as many apples as I really did, I would have 24 apples more than I have now." How many apples did Mark pick?

A 48 B 24 C 42 D 12 E 36

M8. Chris constructed the brick on the picture using red and blue cubes of the same size. The outside of the brick is completely red, but all cubes used inside are blue. How many blue cubes did Chris use?

A 12 B 24 C 36 D 40 E 48



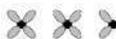
## 4-POINT QUESTIONS

**M9.** A rectangle of size  $4 \times 7$  is drawn on a squared sheet of paper. How many squares of the size  $1 \times 1$  are cut into two parts by the diagonal of that rectangle?

**A** 8 **B** 9 **C** 10 **D** 11 **E** 12

**M10.** This table shows the quantity of different types of flowers in the botanical garden. Ted was told by the gardener that there were 35 azaleas, 50 irises and 85 roses in the garden. What is the number of gerberas growing in the garden?

**A** 95 **B** 100 **C** 105 **D** 110 **E** 115

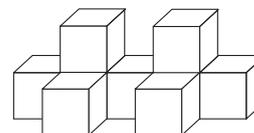
Azaleas	
Irises	
Roses	
Gerberas	

**M11.** Annie fell asleep at 9:30 pm and woke up at 6:45 am. Her brother Martin slept 1 hour 50 min longer. How many hours and minutes did Martin sleep?

**A** 30 h 5 min **B** 11 h 35 min **C** 11 h 5 min **D** 9 h 5 min **E** 8 h 35 min

**M12.** The construction in the picture is built of cubes of the same size and weighs 189 grams. How many grams does one cube weigh?

**A** 29 **B** 25 **C** 21 **D** 19 **E** 17

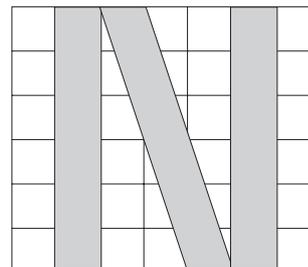


**M13.** Kangaroo Jumpy was training for the Animal Olympiad. His longest jump during the training was 50 dm 50 cm 50 mm long. In the end he won the gold medal at the Olympiad with a jump that was 123 cm longer. How long was Jumpy's winning jump?

**A** 6 m 78 cm **B** 5 m 73 cm **C** 5 m 55 cm **D** 11 m 28 cm **E** 7 m 23 cm

**M14.** If the length of the side of a little square is 1, what is the area of the letter N?

**A** 15 **B** 16 **C** 17 **D** 18 **E** 19



**M15.** Betty likes calculating the sum of the digits that she sees on her digital clock (for instance, if the clock shows 21:37, then Betty gets  $2 + 1 + 3 + 7 = 13$ ). What is the maximum sum she can get?

**A** 24 **B** 36 **C** 19 **D** 25 **E** 23

**M16.** In the class there are 29 children. 12 children have a sister and 18 children have a brother. Tina, Bert, and Ann have no brother and no sister. How many children in that class have both a brother and sister?

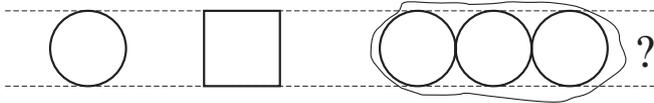
**A** No one **B** 1 **C** 3 **D** 4 **E** 6

## 5-POINT QUESTIONS

**M17.** Joe wants to buy some balls. If he bought five balls, he would still have 10 dollars left in his wallet. If he wanted to buy seven balls, he would have to borrow 22 dollars. How much is one ball (the price of a ball is an integer number)?

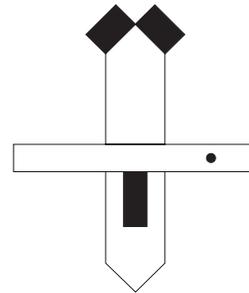
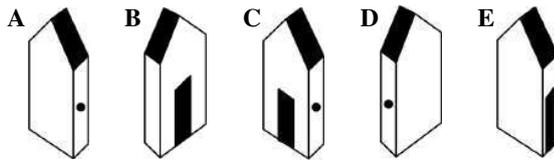
**A** 11 **B** 16 **C** 22 **D** 26 **E** 32

- M18.** I surrounded the wooden circle (see picture) using  $a$  cm of thread. After that I surrounded by thread the wooden square —  $b$  cm of thread was enough for that. How much thread (in cm) would be enough to surround the three wooden circles without moving them?



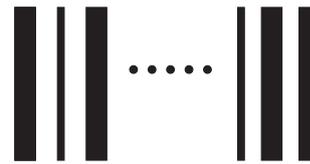
- A**  $3a$    **B**  $2a + b$    **C**  $a + 2b$    **D**  $3b$    **E**  $a + b$

- M19.** The picture on the right has been drawn on paper and cut out to make a house. Which of the houses does it make?

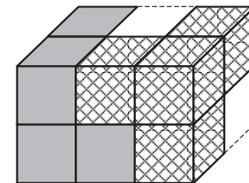


- M20.** Kangaroo bought 3 types of sweets: big, medium and small ones. Big sweets cost 4 coins per 1, medium — 2 coins per 1, small — 1 coin per 1. Kangaroo bought 10 sweets and he paid 16 coins. How many big sweets did kangaroo buy?  
**A** 5   **B** 4   **C** 3   **D** 2   **E** 1

- M21.** A bar-code is formed by 17 alternating black and white bars (the first and the last bars are black). The black bars are of two types: wide and narrow. The number of white bars is greater by 3 than the number of wide black bars. Then the number of narrow black bars is  
**A** 1   **B** 2   **C** 3   **D** 4   **E** 5

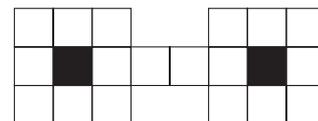


- M22.** A rectangular parallelepiped was composed of 3 pieces, each consisting of 4 little cubes. Then one piece was removed (see picture). Which one?



- M23.** In the toy shop the price for one dog and three bears is the same as for four kangaroos. Three dogs and two bears together also have the same price as four kangaroos. What is more expensive and how many times — the dog or the bear?  
**A** The dog is two times more expensive  
**B** The bear is two times more expensive  
**C** The same price  
**D** The bear is three times more expensive  
**E** The dog is three times more expensive

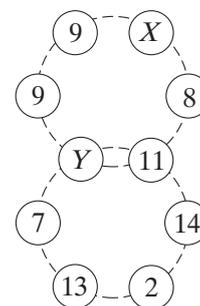
- M24.** The composite board shown in the picture consists of 20 fields  $1 \times 1$ . How many possibilities are there to cover all 18 white fields with 9 rectangular stones  $1 \times 2$ ? (The board cannot be turned. Two possibilities are different if at least one stone lies in another way.)  
**A** 2   **B** 4   **C** 6   **D** 8   **E** 16



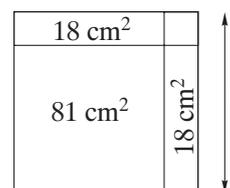
## BENJAMIN (grades 5 and 6)

### 3-POINT QUESTIONS

- B1.** Which number is the greatest?  
**A**  $2+0+0+3$    **B**  $2 \times 0 \times 0 \times 3$    **C**  $(2+0) \times (0+3)$    **D**  $20 \times 0 \times 3$    **E**  $(2 \times 0) + (0 \times 3)$
- B2.** Sophie draws kangaroos: a blue one, then a green, then a red, then a black, then a yellow, a blue, a green, a red, a black, and so on. What colour is the 17<sup>th</sup> kangaroo?  
**A** Blue   **B** Green   **C** Red   **D** Black   **E** Yellow
- B3.** How many integers can one find in the interval from 2.09 to 15.3?  
**A** 13   **B** 14   **C** 11   **D** 12   **E** Infinitely many
- B4.** Which is the smallest positive integer divisible by 2, 3, and 4?  
**A** 1   **B** 6   **C** 12   **D** 24   **E** 36
- B5.** The sum of the numbers in each of the rings should be 55. Which number is  $X$ ?  
**A** 9   **B** 10   **C** 13   **D** 16   **E** 18



- B6.** Tom has 9 banknotes of 100 dollars each, 9 banknotes of 10 dollars each, and 10 banknotes of 1 dollar each. How many dollars has he?  
**A** 1000   **B** 991   **C** 9910   **D** 9901   **E** 99010
- B7.** The square in the picture consists of two smaller squares and two rectangles of area  $18 \text{ cm}^2$  each. The area of one of smaller rectangles is  $81 \text{ cm}^2$ . What is the length (in cm) of side of the biggest square?  
**A** 9   **B** 2   **C** 7   **D** 11   **E** 10
- B8.** Betty likes calculating the sum of the digits that she sees on her digital clock (for instance, if the clock shows 21:37, then Betty gets  $2 + 1 + 3 + 7 = 13$ ). What is the maximum sum she can get?  
**A** 24   **B** 36   **C** 19   **D** 25   **E** 23
- B9.** In the picture the distance  $KM = 10$ ,  $LN = 15$ ,  $KN = 22$ . Find the distance  $LM$ .

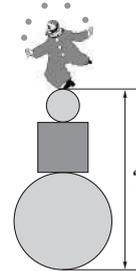


- A** 1   **B** 2   **C** 3   **D** 4   **E** 5
- B10.** The number 24 has eight divisors: 1, 2, 3, 4, 6, 8, 12 and 24. Find the smallest number having four divisors.  
**A** 4   **B** 6   **C** 8   **D** 9   **E** 10

## 4-POINT QUESTIONS

- B11.** The picture shows the clown Dave dancing on top of two balls and one cubic box. The radius of the lower ball is 6 dm, the radius of the upper ball is three times less. The side of the cubic box is 4 dm longer than the radius of the upper ball. At what height (in dm) above the ground is the clown Dave standing?

A 14 B 20 C 22 D 24 E 28

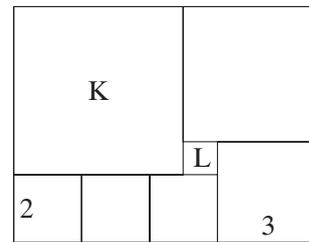


- B12.** We take two different numbers from 1, 2, 3, 4, 5 and find their sum. How many different sums can we obtain?

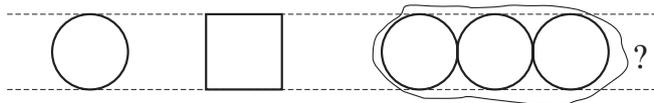
A 5 B 6 C 7 D 8 E 9

- B13.** The rectangle in the picture consists of 7 squares. The lengths of the sides of some of the squares are shown. Square K is the biggest one, square L — the smallest one. How many times is the area of K bigger than the area of L?

A 16 B 25 C 36 D 49 E Impossible to find



- B14.** I surrounded the wooden circle (see picture) using  $a$  cm of thread. After that I surrounded by thread the wooden square —  $b$  cm of thread was enough for that. How much thread (in cm) would be enough to surround the three wooden circles without moving them?



A  $3a$  B  $2a + b$  C  $a + 2b$  D  $3b$  E  $a + b$

- B15.** Benito has 20 small balls of different colours: yellow, green, blue and black. 17 of the balls are not green, 5 are black, 12 are not yellow. How many blue balls does Benito have?

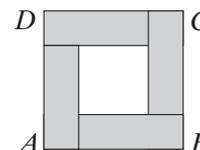
A 3 B 4 C 5 D 8 E 15

- B16.** There are 17 trees along the road from Basil's home to a pool. Basil marked some trees with a red strip as follows. On his way to bathe he marked the first tree and then each second tree, and on his way back he marked the first tree and then each third tree. How many trees have no mark after that?

A 4 B 5 C 6 D 7 E 8

- B17.** Square  $ABCD$  is comprised of one inner square (white) and four shaded congruent rectangles. Each shaded rectangle has a perimeter of 40 cm. What is the area (in  $\text{cm}^2$ ) of square  $ABCD$ ?

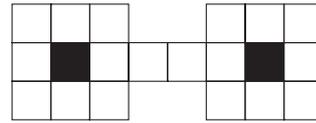
A 400 B 200 C 160 D 100 E 80



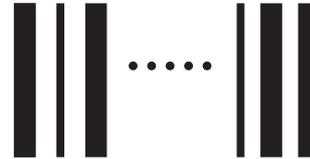
- B18.** Today's date is 20.03.2003. What date will it be 2003 minutes after the hour 20:03?

A 21.03.2003 B 22.03.2003 C 23.03.2003 D 21.04.2003 E 22.04.2003

- B19.** The composite board shown in the picture consists of 20 fields  $1 \times 1$ . How many possibilities are there exist to cover all 18 white fields with 9 rectangular stones  $1 \times 2$ ? (The board cannot be turned. Two possibilities are called different if at least one stone lies in another way.)  
**A 2 B 4 C 6 D 8 E 16**

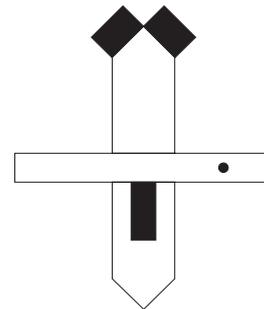
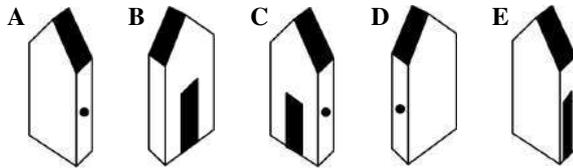


- B20.** A bar-code is formed by 17 alternating black and white bars (the first and the last bars are black). The black bars are of two types: wide and narrow. The number of white bars is greater by 3 than the number of wide black bars. Then the number of narrow black bars is  
**A 1 B 2 C 3 D 4 E 5**

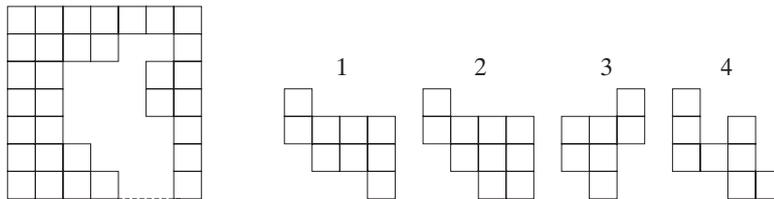


5-POINT QUESTIONS

- B21.** The picture on the right has been drawn on paper and cut out to make a house. Which of the houses does it make?



- B22.** The square was cut out from a page in a squared exercise book. Then two figures in the picture were cut out from the square. Which ones?



- A 1 and 3 B 2 and 4 C 2 and 3 D 1 and 4 E Impossible to cut out**

- B23.** Walter displayed all the integers from 0 to 109 according to some simple rule. Here is the beginning of his 5-column numeral chart. Which of the following elements could not be the a part of Walter's chart?

0	2	4	6	8
1	3	5	7	9
10	12	14	16	18
11	13	15	17	19
20	22	24	26	28
⋮	⋮	⋮	⋮	⋮

- A**

65	68

**B**

67	78

**C**

45	59

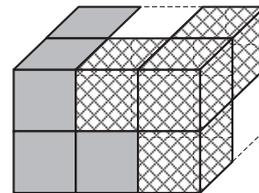
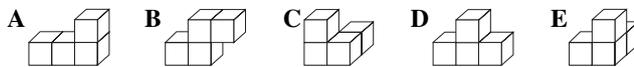
**D**

59	63

**E**

43	56

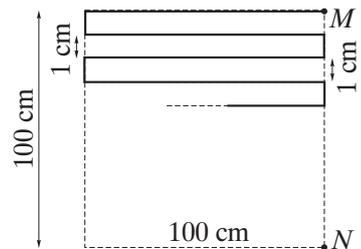
- B24.** A rectangular parallelepiped was composed of 3 pieces, each consisting of 4 little cubes. Then one piece was removed (see picture). Which one?



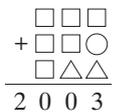
**B25.** You have six line segments of lengths 1 cm, 2 cm, 3 cm, 2001 cm, 2002 cm and 2003 cm. You have to choose three of these segments to form a triangle. How many different choices of three segments are there which work?  
**A 1 B 3 C 5 D 6 E More than 10**

**B26.** There were completely red and completely green dragons in the dungeon. Each red dragon had 6 heads, 8 legs and 2 tails. Each green dragon had 8 heads, 6 legs and 4 tails. In all the dragons had 44 tails. The number of green legs was 6 fewer than of red heads. How many red dragons were there in the dungeon?  
**A 6 B 7 C 8 D 9 E 10**

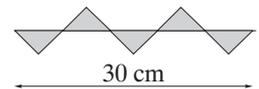
**B27.** What is the length (in cm) of the line (see picture) connecting vertices *M* and *N* of the square?  
**A 10200 B 2500 C 909 D 10100 E 9900**



**B28.** Every figure in the picture replaces some digit. What is the sum  $\square + \circ$ ?  
**A 6 B 7 C 8 D 9 E 13**



**B29.** The figure in the drawing consists of five isosceles right triangles of the same size. Find the area (in  $\text{cm}^2$ ) of the shaded figure.  
**A 20 B 25 C 35 D 45 E Cannot be found**



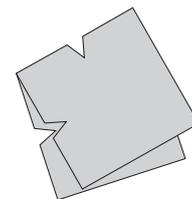
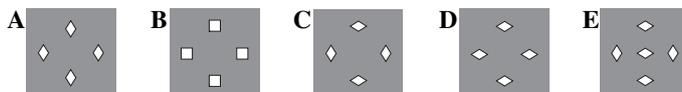
**B30.** Ann has the box containing 9 pencils. At least one of them is blue. Among every 4 of the pencils at least two have the same colour, and among every 5 of the pencils at most three have the same colour. What is the number of blue pencils?  
**A 2 B 3 C 4 D 1 E Impossible to determine**

### CADET (grades 7 and 8)

#### 3-POINT QUESTIONS

**C1.** There were 5 parrots in a pet shop. Their average price was 6000 dollars. One day the most expensive parrot was sold. The average price of the remaining four parrots was 5000 dollars. What was the price (in dollars) of the parrot sold?  
**A 1000 B 2000 C 5500 D 6000 E 10000**

**C2.** A folded napkin was cut through (see picture). What does it look like when unfolded?



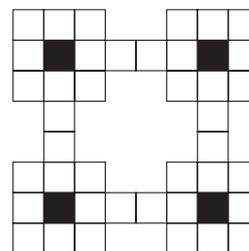
**C3.** A straight line is drawn across a  $4 \times 4$  chessboard. What is the greatest number of  $1 \times 1$  squares which can be cut into two pieces by the line?  
**A 3 B 4 C 6 D 7 E 8**

- C4.** The area of the wooden square equals  $a$ . The area of each wooden circle equals  $b$ . Three circles are lined up as shown in the picture. If we tie together the three circles with a thread as short as possible, without moving them, what is the area inside the thread?



- A**  $3b$    **B**  $2a + b$    **C**  $a + 2b$    **D**  $3a$    **E**  $a + b$
- C5.** For a hexagon (not necessarily convex), the maximum possible number of interior right angles is  
**A** 2   **B** 3   **C** 4   **D** 5   **E** 6
- C6.** A bottle and a glass together have the same volume as a jug. A bottle has the same volume as a glass and a tankard. Three tankards have the same volume as two jugs. How many glasses of water equal one tankard?  
**A** 3   **B** 4   **C** 5   **D** 6   **E** 7

- C7.** The composite board shown in the picture consists of 44 fields  $1 \times 1$ . How many possibilities are there to cover all 40 white fields with 20 rectangular stones  $1 \times 2$ ? (The board cannot be turned. Two possibilities are different if at least one stone lies in another way.)  
**A** 8   **B** 16   **C** 32   **D** 64   **E** 100

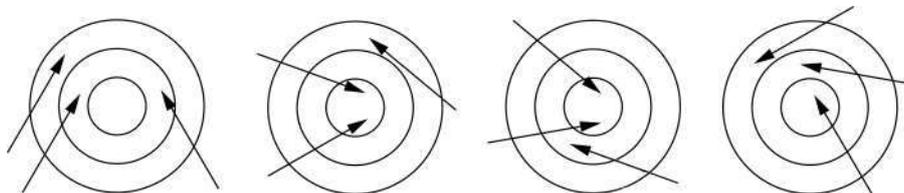


- C8.** In a positive integer consisting of at least 2 digits, the last digit has been crossed out, so that the number has been decreased  $n$  times. What is the maximum value of  $n$ ?  
**A** 9   **B** 10   **C** 11   **D** 19   **E** 20
- C9.** There are four line segments drawn. Which number of intersection points is *impossible*?  
**A** 2   **B** 3   **C** 5   **D** 6   **E** 7
- C10.** Which of the following numbers gives, when multiplied by 768, the product ending with the highest number of zeroes?  
**A** 7500   **B** 5000   **C** 3125   **D** 2500   **E** 10000

#### 4-POINT QUESTIONS

- C11.** Lying on a table, there is a transparent square sheet of film with the letter **Y** written on it. We turn the sheet  $90^\circ$  clockwise, then turn it over from its right side, then turn it  $180^\circ$  counterclockwise. What do we now see?  
**A**  $\lt$    **B**  $\gt$    **C**  $\wedge$    **D**  $\llcorner$    **E**  $\sphericalangle$
- C12.** Mike has 42 identical cubes, each with the edge 1 cm long. He used all of the cubes to construct a cuboid. The perimeter of the base of that cuboid is 18 cm. What is its height?  
**A** 1 cm   **B** 2 cm   **C** 3 cm   **D** 4 cm   **E** 5 cm

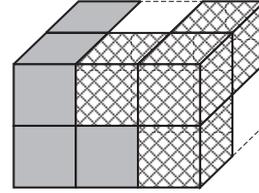
- C13.** Jeffrey shoots three arrows at each of four identical targets. He scores 29 points on the first target, 43 on the second and 47 on the third. How many points does Jeffrey score on the last target?



- A 31 B 33 C 36 D 38 E 39**
- C14.** The weight of a truck without a load is 2000 kg. Today the load initially comprised 80% of the total weight. At the first stop, a quarter of the load was left. What percentage of the total weight does the load then comprise?  
**A 20% B 25% C 55% D 60% E 75%**
- C15.** Two quadrates with the same size cover a circle, the radius of which is 3 cm. Find the total area (in  $\text{cm}^2$ ) of the shaded figure.  
**A  $8(\pi - 1)$  B  $6(2\pi - 1)$  C  $9\pi - 25$  D  $9(\pi - 2)$  E  $\frac{6\pi}{5}$**
- 
- C16.** You have six line segments of lengths 1 cm, 2 cm, 3 cm, 2001 cm, 2002 cm and 2003 cm. You have to choose three of these segments to form a triangle. How many different choices of three segments are there which work?  
**A 1 B 3 C 5 D 6 E More than 10**
- C17.** How many positive integers  $n$  possess the following property: among the positive divisors of  $n$  different from 1 and  $n$  itself, the largest is 15 times the smallest.  
**A 0 B 1 C 2 D 3 E Infinitely many**
- C18.** Six points  $K, L, M, N, P, R$  are marked on a line from left to right, in the same order as listed. It is known that  $KN = MR$  and  $LN = NR$ . Then, necessarily  
**A  $KL = LM$  B  $LM = NP$  C  $LN = PR$  D  $KL = MN$  E  $MN = PR$**
- C19.** Mary has 6 cards with natural numbers written on them (one number on each card). She chooses 3 cards and calculates the sum of the corresponding numbers. Having done this for all 20 possible combinations of 3 cards, she discovers that 10 sums are equal to 16, and the other 10 sums are equal to 18. Then the smallest number on the cards is  
**A 2 B 3 C 4 D 5 E 6**
- C20.** Paul, Bill, John, Nick and Tim stood in a circle, the distances between any two neighbours being different. Each of them said the name of the boy standing closest to him. The names Paul and Bill were said two times each, and the name John was said once. Then  
**A Paul and Bill were not neighbours**  
**B Nick and Tim were not neighbours**  
**C Nick and Tim were neighbours**  
**D The situation described is impossible**  
**E None of the above**

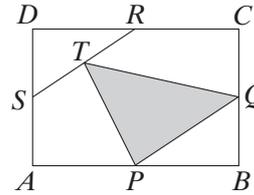
5-POINT QUESTIONS

**C21.** A rectangular parallelepiped was composed of 3 pieces, each consisting of 4 little cubes. Then one piece was removed (see picture). Which one?



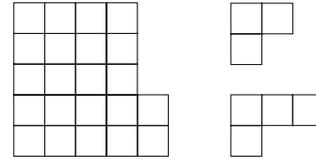
**C22.** In a rectangle  $ABCD$ , let  $P$ ,  $Q$ ,  $R$  and  $S$  be the midpoints of sides  $AB$ ,  $BC$ ,  $CD$  and  $AD$ , respectively, and let  $T$  be the midpoint of segment  $RS$ . Which fraction of the area of  $ABCD$  does triangle  $PQT$  cover?

- A  $\frac{5}{16}$  B  $\frac{1}{4}$  C  $\frac{1}{5}$  D  $\frac{1}{6}$  E  $\frac{3}{8}$



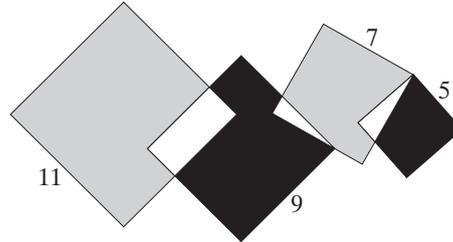
**C23.** Carl composed the figure shown on the left side of the drawing from the smaller three-square and four-square figures shown on the right side. The smaller figures can be turned around, but not turned over. What is the smallest number of three-square figures needed for that?

- A 1 B 2 C 3 D 6 E Impossible to compose



**C24.** In the picture there are four overlapping squares with sides 11, 9, 7 and 5 long. How much greater is the sum of the two grey areas than the sum of the two black areas?

- A 25 B 36 C 49 D 64 E 0

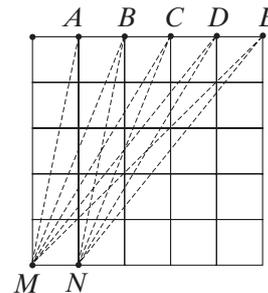


**C25.** On a bookshelf there are 50 math and physics books. No two physics books stand side by side, but every math book has a math neighbour. Which of the following statements *may turn out to be false*?

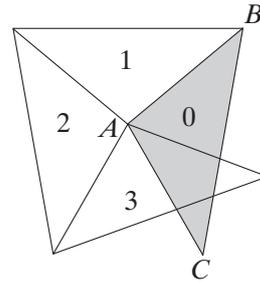
- A The number of math books is at least 32  
 B The number of physics books is at most 17  
 C There are 3 math books standing in succession  
 D If the number of physics books is 17, then at least one of them is the first or the last on the bookshelf  
 E Among any 9 successive books, at least 6 are math books

**C26.** A square is divided into 25 small squares (see the picture). Find the measure of the angle which is the sum of the angles  $MAN$ ,  $MBN$ ,  $MCN$ ,  $MDN$ ,  $MEN$ .

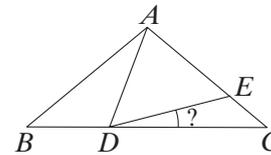
- A  $30^\circ$  B  $45^\circ$  C  $60^\circ$  D  $75^\circ$  E  $90^\circ$



- C27.** We are going to make a spiral of isosceles triangles. We'll start with the shaded triangle  $BAC$ , which has a top angle  $\angle BAC = 100^\circ$ , and move counterclockwise. Let  $\triangle ABC$  have number 0. Every of the next triangles (with numbers 1, 2, 3, ...) will have exactly one edge adjoining the previous one (see the picture). What will be the number of the first triangle which precisely covers triangle nr. 0?  
**A** 10 **B** 12 **C** 14 **D** 16 **E** 18



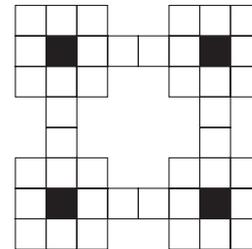
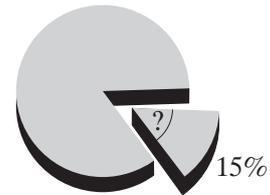
- C28.** How many positive integers  $n$  can be found such that 2003 divided by  $n$  leaves a remainder of 23?  
**A** 22 **B** 19 **C** 13 **D** 12 **E** 36
- C29.** There are some 10 points on the area, and there are no three points on the same line. Every two points are connected by a segment. What is the largest possible number of these segments, which can be crossed by another line that doesn't pass through any of these points?  
**A** 20 **B** 25 **C** 30 **D** 35 **E** 45
- C30.** In triangle  $ABC$  (see picture)  $AB = AC$ ,  $AE = AD$ , and  $\angle BAD = 30^\circ$ . What is the measure of angle  $CDE$ ?  
**A**  $10^\circ$  **B**  $15^\circ$  **C**  $20^\circ$  **D**  $25^\circ$  **E**  $30^\circ$



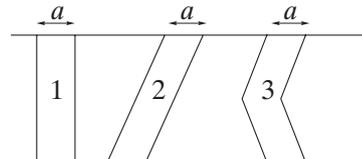
### JUNIOR (grades 9 and 10)

#### 3-POINT QUESTIONS

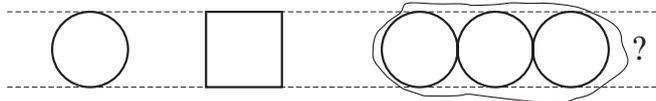
- J1.** 15% of a round cake is cut as shown in the figure. How many degrees is the angle denoted by the question mark?  
**A**  $30^\circ$  **B**  $45^\circ$  **C**  $54^\circ$  **D**  $15^\circ$  **E**  $20^\circ$
- J2.** The composite board shown in the picture consists of 44 fields  $1 \times 1$ . How many possibilities are there to cover all 40 white fields with 20 rectangular stones  $1 \times 2$ ? (The board cannot be turned. Two possibilities are different if at least one stone lies in another way.)  
**A** 8 **B** 16 **C** 32 **D** 64 **E** 100



- J3.** In the picture, three strips of the same horizontal width  $a$  are marked 1, 2, 3. These strips connect the two parallel lines. Which strip has the biggest area?  
**A** All three strips have the same area  
**B** Strip 1 **C** Strip 2 **D** Strip 3  
**E** Impossible to answer without knowing  $a$



- J4.** Which of the following numbers is odd for every integer  $n$ ?  
**A**  $2003n$  **B**  $n^2 + 2003$  **C**  $n^3$  **D**  $n + 2004$  **E**  $2n^2 + 2003$
- J5.** In a triangle  $ABC$  the angle  $C$  is three times bigger than the angle  $A$ , the angle  $B$  is two times bigger than the angle  $A$ . Then the triangle  $ABC$   
**A** is equilateral **B** is isosceles **C** has an obtuse angle **D** has a right angle  
**E** has only acute angles
- J6.** Three singers take part in a musical round of 4 equal lines, each finishing after singing the round 3 times. The second singer begins the first line when the first singer begins the second line, the third singer begins the first line when the first singer begins the third line. The fraction of the total singing time that all three are singing at the same time is  
**A**  $\frac{3}{5}$  **B**  $\frac{4}{5}$  **C**  $\frac{4}{7}$  **D**  $\frac{5}{7}$  **E**  $\frac{7}{11}$
- J7.** The number  $a = 111 \dots 111$  consists of 2003 digits, each equal to 1. What is the sum of the digits of the product  $2003 \cdot a$ ?  
**A** 10 000 **B** 10 015 **C** 10 020 **D** 10 030 **E**  $2003^2$
- J8.** The area of the wooden square equals  $a$ . The area of each wooden circle equals  $b$ . Three circles are lined up as shown in the picture. If we tie together the three circles with a thread as short as possible, without moving them, what is the area inside the thread?

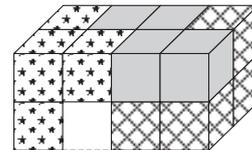
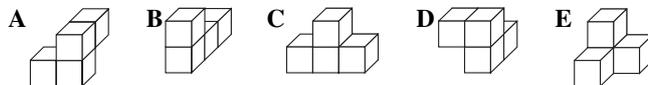


- A**  $3b$  **B**  $2a + b$  **C**  $a + 2b$  **D**  $3a$  **E**  $a + b$
- J9.** How many of the functions  $f(x) = 0$ ,  $f(x) = \frac{1}{2}$ ,  $f(x) = 1$ ,  $f(x) = x$ ,  $f(x) = -x$  satisfy the equation  $f(x^2 + y^2) = f^2(x) + f^2(y)$ ?  
**A** 1 **B** 2 **C** 3 **D** 4 **E** 5
- J10.** In this addition each of the letters  $X$ ,  $Y$  and  $Z$  represents a different non-zero digit. The letter  $X$  will then have to stand for
- $$\begin{array}{r} XX \\ + YY \\ \hline ZZ \\ \hline ZYX \end{array}$$
- A** 1 **B** 2 **C** 7 **D** 8 **E** 9

4-POINT QUESTIONS

- J11.** Ann has a box containing 9 pencils. At least one of them is blue. Among every 4 of the pencils at least two have the same colour, and among every 5 of the pencils at most three have the same colour. What is the number of blue pencils?  
**A** 2 **B** 3 **C** 4 **D** 1 **E** Impossible to determine

- J12.** A rectangular parallelepiped was composed of 4 pieces, each consisting of 4 little cubes. Then one piece was removed (see picture). Which one?



**J13.** When a barrel is 30% empty it contains 30 litres more when it is 30% full. How many litres does the barrel hold when full?

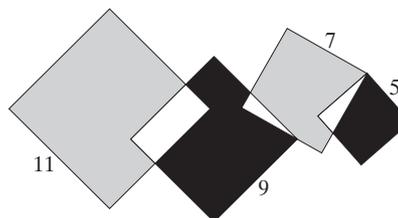
- A 60 B 75 C 90 D 100 E 120

**J14.** Each of two pupils changed two of the digits of 3-digit number 888 and got a new 3-digit number which is still divisible by 8. What is the biggest possible difference of their numbers?

- A 800 B 840 C 856 D 864 E 904

**J15.** In the picture there are four overlapping squares with sides 11, 9, 7 and 5 long. How much greater is the sum of the two grey areas than the sum of the two black areas?

- A 25 B 36 C 49 D 64 E 0



**J16.** The value of the product

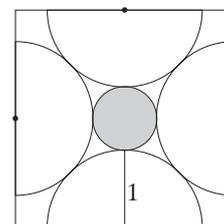
$$\left(1 + \frac{1}{2}\right) \cdot \left(1 + \frac{1}{3}\right) \cdot \left(1 + \frac{1}{4}\right) \cdots \left(1 + \frac{1}{2003}\right)$$

is equal to

- A 2004 B 2003 C 2002 D 1002 E 1001

**J17.** The diagram shows four semicircles with radius 1. The centres of the semicircles are at the mid-points of the sides of a square. What is the radius of the circle which touches all four semicircles?

- A  $\sqrt{2} - 1$  B  $\frac{\pi}{2} - 1$  C  $\sqrt{3} - 1$  D  $\sqrt{5} - 2$  E  $\sqrt{7} - 2$



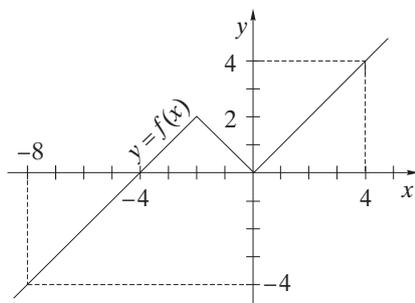
**J18.** Consider all the different four-digit numbers that you can form by using the four digits of the number 2003. Summing up all them (including 2003 itself) you get:

- A 5 005 B 5 555 C 16 665 D 1 110 E 15 555

**J19.** The first two terms of a sequence are 1 and 2. Each next term is obtained by dividing the term before the previous one by the previous term. What is the tenth term of this sequence?

- A  $2^{-10}$  B 256 C  $2^{-13}$  D 1024 E  $2^{34}$

**J20.** The graph of the function  $f(x)$ , defined for all real numbers, is formed by two half-lines and one segment, as illustrated in the picture.



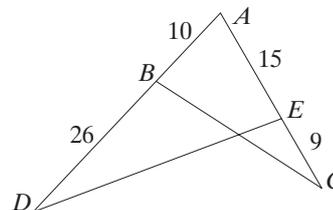
Clearly,  $-8$  is a solution of the equation  $f(f(x)) = 0$ , because  $f(f(-8)) = f(-4) = 0$ . Find all the solutions of the equation  $f(f(f(x))) = 0$ .

- A  $-4; 0$  B  $-8; -4; 0$  C  $-12; -8; -4; 0$  D  $-16; -12; -8; -4; 0$  E No solutions

## 5-POINT QUESTIONS

- J21.** What is the ratio of the areas of the triangles  $ADE$  and  $ABC$  in the picture?

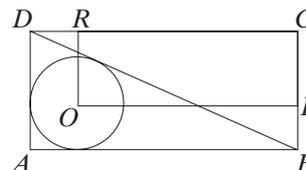
**A**  $\frac{9}{4}$    **B**  $\frac{7}{3}$    **C**  $\frac{4}{5}$    **D**  $\frac{15}{10}$    **E**  $\frac{26}{9}$



- J22.** The rectangle  $ABCD$  has area 36. A circle with center in point  $O$  is inscribed in the triangle  $ABD$ . What is the area of the rectangle  $OPCR$ ?

**A** 24   **B**  $6\pi$    **C** 18   **D**  $12\sqrt{2}$

**E** It depends on the ratio of the sides  $AB$  and  $AD$



- J23.** The children K, L, M and N made the following assertions:

K: L, M and N are girls;   L: K, M and N are boys;

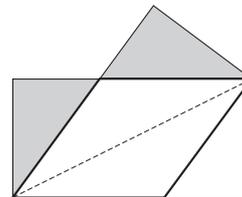
M: K and L are lying;   N: K, L and M are telling the truth.

How many of the children were telling the truth?

**A** 0   **B** 1   **C** 2   **D** 3   **E** Impossible to determine

- J24.** A rectangular sheet of paper with measures  $6 \times 12$  is folded along its diagonal. The shaded parts sticking out over the edge of the overlapping area are cut off and the sheet is unfolded. Now it has the shape of a rhombus. Find the length of the side of the rhombus.

**A**  $\frac{7\sqrt{5}}{2}$    **B** 7.35   **C** 7.5   **D** 7.85   **E** 8.1



- J25.** How many distinct pairs  $(x; y)$  satisfy the equation  $(x + y)^2 = xy$ ?

**A** 0   **B** 1   **C** 2   **D** 3   **E** Infinitely many

- J26.** What is the greatest number of consecutive integers such that the sum of the digits of none of them is divisible by 5?

**A** 5   **B** 6   **C** 7   **D** 8   **E** 9

- J27.** On a bookshelf there are 50 math and physics books. No two physics books stand side by side, but every math book has a math neighbour. Which of the following statements *may turn out to be false*?

**A** The number of math books is at least 32

**B** The number of physics books is at most 17

**C** There are 3 math books standing in succession

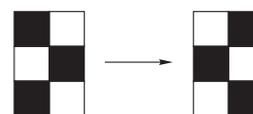
**D** If the number of physics books is 17, then at least one of them is the first or the last on the bookshelf

**E** Among any 9 successive books, at least 6 are math books

- J28.** We take three different numbers from the numbers 1, 4, 7, 10, 13, 16, 19, 22, 25, 28 and find their sum. How many different sums can we obtain?

**A** 13   **B** 21   **C** 22   **D** 30   **E** 120

- J29.** Unit squares of a squared board  $2 \times 3$  are coloured black and white like a chessboard (see picture). Determine the minimum number of steps necessary to achieve the reverse of the left board, following the rule: in each step, we must repaint two unit squares that have a joint edge, but we must repaint a black square with green, a green square with white and a white square with black.  
**A 3 B 5 C 6 D 8 E 9**



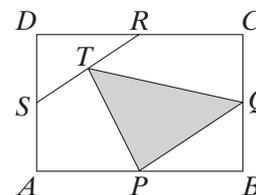
- J30.** We wrote down all the integers of 1 to 5 digits we could, using only the two digits 0 and 1. How many 1's did we write?  
**A 36 B 48 C 80 D 160 E 320**

### STUDENT (grades 11 and 12)

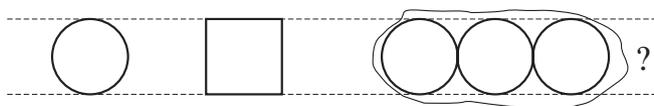
#### 3-POINT QUESTIONS

- S1.** Ann has a box containing 9 pencils. At least one of them is blue. Among every 4 of the pencils at least two have the same colour, and among every 5 of the pencils at most three have the same colour. What is the number of blue pencils?  
**A 2 B 3 C 4 D 1 E Impossible to determine**

- S2.** In a rectangle  $ABCD$ , let  $P$ ,  $Q$ ,  $R$  and  $S$  be the midpoints of sides  $AB$ ,  $BC$ ,  $CD$  and  $AD$ , respectively, and let  $T$  be the midpoint of segment  $RS$ . Which fraction of the area of  $ABCD$  does triangle  $PQT$  cover?  
**A  $\frac{5}{16}$  B  $\frac{1}{4}$  C  $\frac{1}{5}$  D  $\frac{1}{6}$  E  $\frac{3}{8}$**



- S3.** The area of the wooden square equals  $a$ . The area of each wooden circle equals  $b$ . Three circles are lined up as shown in the picture. If we tie together the three circles with a thread as short as possible, without moving them, what is the area inside the thread?



- A  $3b$  B  $2a + b$  C  $a + 2b$  D  $3a$  E  $a + b$**
- S4.** Alan was calculating the volume of a sphere, but in the calculation he mistakenly used the value of the diameter instead of the radius of the sphere. What should he do with his result to get the correct answer?  
**A Divide it by 2 B Divide it by 4 C Multiply it by 6 D Divide it by 8 E Multiply it by 8**
- S5.** If  $n$  is a positive integer, then  $2^{n+2003} + 2^{n+2003}$  is equal to  
**A  $2^{n+2004}$  B  $2^{2n+4006}$  C  $4^{2n+4006}$  D  $4^{2n+2003}$  E  $4^{n+2003}$**
- S6.** For which of the following settings does a triangle  $ABC$  exist?  
**A  $AB = 11$  cm,  $BC = 19$  cm,  $CA = 7$  cm**  
**B  $AB = 11$  cm,  $BC = 7$  cm,  $\angle BAC = 60^\circ$**   
**C  $AB = 11$  cm,  $CA = 7$  cm,  $\angle CBA = 128^\circ$**   
**D  $AB = 11$  cm,  $\angle BAC = 60^\circ$ ,  $\angle CBA = 128^\circ$**   
**E For none of them**

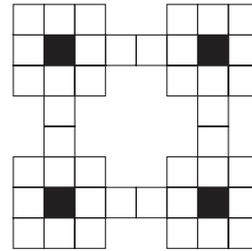
- S7.** The average number of students accepted by a school in the four years 1998–2001 was 325 students per year. The average number of students accepted by the school in the five years 1998–2002 is 20% higher. How many students did this school accept in 2002?  
**A** 650 **B** 600 **C** 455 **D** 390 **E** 345

- S8.** Find all values of the parameter  $m$  for which the curves  $x^2 + y^2 = 1$  and  $y = x^2 + m$  have exactly one common point.

**A**  $-\frac{5}{4}; -1; 1$  **B**  $-\frac{5}{4}; 1$  **C**  $-1; 1$  **D**  $-\frac{5}{4}$  **E** 1

- S9.** The composite board shown in the picture consists of 44 fields  $1 \times 1$ . How many possibilities are there to cover all 40 white fields with 20 rectangular stones  $1 \times 2$ ? (The board cannot be turned. Two possibilities are different if at least one stone lies in another way.)

**A** 8 **B** 16 **C** 32 **D** 64 **E** 100



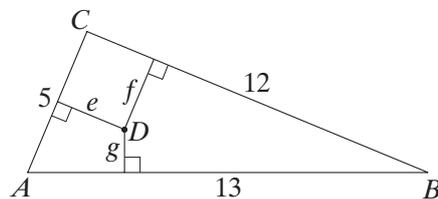
- S10.** According to the rule given in the left picture below, we construct a numerical triangle with an integer number greater than 1 in each cell. Which of the numbers given in the answers cannot appear in the shaded cell?



**A** 154 **B** 100 **C** 90 **D** 88 **E** 60

4-POINT QUESTIONS

- S11.** Let  $ABC$  be a triangle with area 30. Let  $D$  be any point in its interior and let  $e, f$  and  $g$  denote the distances from  $D$  to the sides of the triangle.

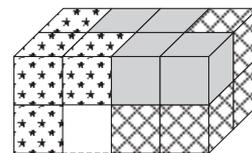
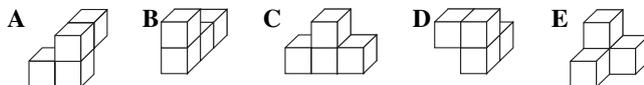


What is the value of the expression  $5e + 12f + 13g$ ?

**A** 120 **B** 90 **C** 60 **D** 30

**E** Impossible to find the value without knowing the exact location of  $D$

- S12.** A rectangular parallelepiped was composed of 4 pieces, each consisting of 4 little cubes. Then one piece was removed (see picture). Which one?



- S13.** Two white and eight gray seagulls were flying over a river. Suddenly, they all randomly sat down at the bank forming a line. What is the probability that the two white seagulls were sitting side by side?

**A**  $\frac{1}{5}$    **B**  $\frac{1}{6}$    **C**  $\frac{1}{7}$    **D**  $\frac{1}{8}$    **E**  $\frac{1}{9}$

- S14.** The value of

$$\sqrt{1 + 2000\sqrt{1 + 2001\sqrt{1 + 2002\sqrt{1 + 2003 \cdot 2005}}}}$$

is equal to

**A** 2000   **B** 2001   **C** 2002   **D** 2003   **E** 2004

- S15.** Numbers 12, 13 and 15 are the lengths (perhaps not in order) of two sides of an acute-angled triangle and of the height over the third side of this triangle. Find the area of the triangle.  
**A** 168   **B** 80   **C** 84   **D**  $6\sqrt{65}$    **E** Impossible to find

- S16.** The sequence  $1^7, 2^7, 3^7, \dots$  is constructed of the seventh powers of all positive integers. How many terms of this sequence lie between the numbers  $5^{21}$  and  $2^{49}$ ?

**A** 13   **B** 8   **C** 5   **D** 3   **E** 2

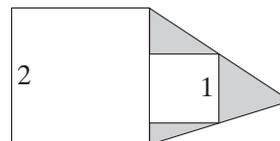
- S17.** We know that  $10^n + 1$  is a multiple of 101, and  $n$  is a 2-digit number. What is the largest possible value of  $n$ ?

**A** 92   **B** 94   **C** 96   **D** 98   **E** 99

- S18.** The diagram shows two squares: one has a side with a length of 2 and the other (abut on the first square) has a side with a length of 1. What is the area of the shaded zone?

**A** 1   **B** 2   **C**  $2\sqrt{2}$    **D** 4

**E** It depends on the position of the smaller square



- S19.** How many of the functions  $f(x) = 0$ ,  $f(x) = \frac{1}{2}$ ,  $f(x) = 1$ ,  $f(x) = x$ ,  $f(x) = -x$  satisfy the equation  $f(x^2 + y^2) = f^2(x) + f^2(y)$ ?

**A** 1   **B** 2   **C** 3   **D** 4   **E** 5

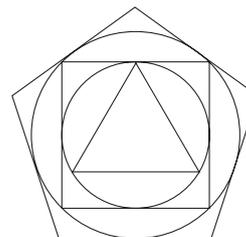
- S20.** If  $a^4 + \frac{1}{a^4} = 4$ , then  $a^6 + \frac{1}{a^6}$  is equal to

**A**  $4\sqrt{6}$    **B**  $3\sqrt{6}$    **C** 6   **D**  $5\sqrt{6}$    **E**  $6\sqrt{6}$

### 5-POINT QUESTIONS

- S21.** We first draw an equilateral triangle, then draw the circumcircle of this triangle, then circumscribe a square to this circle. After drawing another circumcircle, we circumscribe a regular pentagon to this circle, and so on. We repeat this construction with new circles and new regular polygons (each with one side more than the preceding one) until we draw a 16-sided regular polygon. How many disjoint regions are there inside the last polygon?

**A** 232   **B** 240   **C** 248   **D** 264   **E** 272



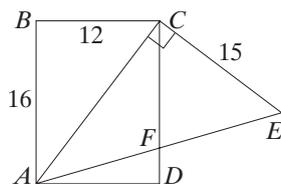
- S22.** A point  $P(x; y)$  lies on a circle with center  $M(2; 2)$  and radius  $r$ . We know that  $y = r > 2$  and  $x, y$  and  $r$  are all positive integers. What is the smallest possible value of  $x$ ?  
**A** 2 **B** 4 **C** 6 **D** 8 **E** 10
- S23.** The four positive integers  $A, B, A - B, A + B$  are all prime. Then the sum of them  
**A** is even **B** is a multiple of 3 **C** is a multiple of 5 **D** is a multiple of 7 **E** is prime
- S24.** A manager in a store has to determine the price of a sweater. Market research gives him the following information: If the price is \$75 then 100 teens will buy the sweaters. The price can be increased or decreased several times by units of \$5. Each time the price is increased by \$5, 20 fewer teens will buy the sweaters. However, each time the price is decreased by \$5, 20 sweaters more will be sold. The sweater costs the company \$30 apiece. What is the sale price that maximizes profits?  
**A** 85 **B** 80 **C** 75 **D** 70 **E** 65
- S25.** How many distinct pairs  $(x; y)$  satisfy the equation  $(x + y)^2 = (x + 3)(y - 3)$ ?  
**A** 0 **B** 1 **C** 2 **D** 3 **E** Infinitely many
- S26.** A sequence  $a_0, a_1, a_2, \dots$  is defined in the following way:

$$a_0 = 4, \quad a_1 = 6, \quad a_{n+1} = \frac{a_n}{a_{n-1}} \quad (n \geq 1).$$

Then  $a_{2003}$  is equal to

- A**  $\frac{3}{2}$  **B**  $\frac{2}{3}$  **C** 4 **D**  $\frac{1}{4}$  **E**  $\frac{1}{6}$

- S27.** In the picture  $ABCD$  is a rectangle with  $AB = 16, BC = 12$ . Let  $E$  be such a point that  $AC \perp CE, CE = 15$ .



If  $F$  is the point of intersection of segments  $AE$  and  $CD$ , then the area of the triangle  $ACF$  is equal to

- A** 75 **B** 80 **C** 96 **D** 72 **E** 48
- S28.** We can put an arrow on one end of the edge of a cube, defining a vector, and put an arrow on the other end of the edge, defining the opposite vector. We put an arrow on each edge and then add up all 12 vectors obtained. How many different values of sum of vectors can we obtain in this way?  
**A** 25 **B** 27 **C** 64 **D** 100 **E** 125
- S29.** We are given the 6 vertices of a regular hexagon and all line segments joining any two of these points. We call two such segments *strangers* if they have no common point (including end points). How many pairs of strangers are there?  
**A** 26 **B** 28 **C** 30 **D** 34 **E** 36
- S30.** Let  $f$  be a polynomial such that  $f(x^2 + 1) = x^4 + 4x^2$ . Determine  $f(x^2 - 1)$ .  
**A**  $x^4 - 4x^2$  **B**  $x^4$  **C**  $x^4 + 4x^2 - 4$  **D**  $x^4 - 4$  **E** Another answer

# Questions of Kangaroo 2004

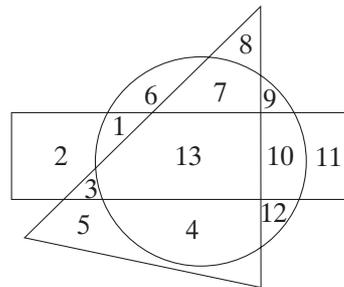
## MINOR (grades 3 and 4)

### 3-POINT QUESTIONS

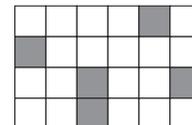
- M1.** How much is  $2001 + 2002 + 2003 + 2004 + 2005$ ?  
**A** 1015 **B** 5010 **C** 10,150 **D** 11,005 **E** 10,015
- M2.** Jerome was 4 years old when his sister was born. Today he blows out 9 birthday candles. What is the age difference between him and his sister?  
**A** 4 years **B** 5 years **C** 9 years **D** 13 years **E** 14 years
- M3.** In the picture below you can see a road from town  $M$  to town  $N$  (a solid line) and a detour (a dashed line) of segment  $KL$ , which is under repair. How many more kilometers does one have to travel from  $M$  to  $N$  using the detour?



- A** 3 **B** 5 **C** 6 **D** 10 **E** Impossible to calculate
- M4.** There were some swallows on a telegraph line. All at once 5 of them flew away, and a while later 3 swallows came back. Then there were 12 swallows on the line. How many swallows were there on the line at the very beginning?  
**A** 8 **B** 9 **C** 10 **D** 12 **E** 14
- M5.** Which numbers are written in the area that belongs to the rectangle and to the circle but doesn't belong to the triangle?  
**A** 5 and 11 **B** 1 and 10 **C** 13  
**D** 3 and 9 **E** 6, 7, and 4

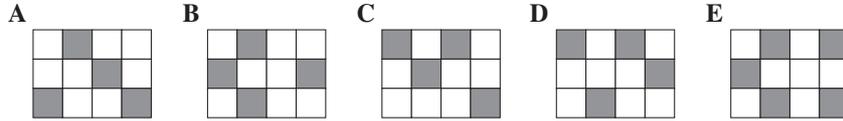
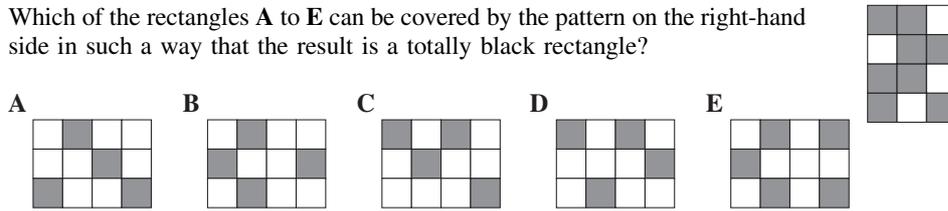


- M6.** How many white squares must you paint grey so that the number of grey squares is exactly half that of the white squares?  
**A** 2 **B** 3 **C** 4 **D** 6 **E** It cannot be done



- M7.** Mary and Peter's classmates are standing in line. Mary has 16 students in back of her, including Peter. Peter has 14 students in front of him including Mary. Between Mary and Peter there are 7 students. How many students are there, altogether, in Mary and Peter's class?  
**A** 37 **B** 30 **C** 23 **D** 22 **E** 16

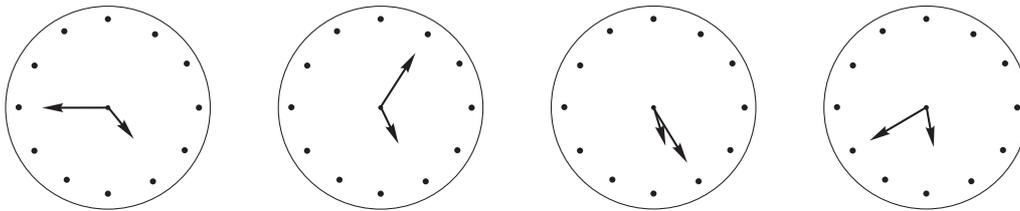
**M8.** Which of the rectangles **A** to **E** can be covered by the pattern on the right-hand side in such a way that the result is a totally black rectangle?



**4-POINT QUESTIONS**

**M9.** The weight of 3 apples and 2 oranges is 255 g. The weight of 2 apples and 3 oranges is 285 g. Each apple has the same weight, and each orange has the same weight. What is the weight in grams of 1 apple and 1 orange together?  
**A** 110 **B** 108 **C** 105 **D** 104 **E** 102

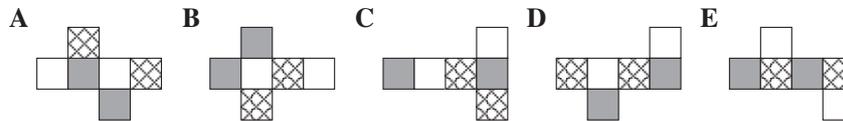
**M10.** In this picture there is what I saw on four different clocks at the same time. Only one of them had the right time. One was 20 minutes fast. Another 20 minutes slow. One had stopped some time ago.



What was the right time?  
**A** 4:45 **B** 5:05 **C** 5:25 **D** 5:40 **E** 12:00

**M11.** Gabriella brought Joseph a basket of apples and oranges. Joseph ate half of all the apples and one third of all the oranges. How much of the fruit could still be left in the basket?  
**A** Half of all the fruit **B** More than half of all the fruit  
**C** Less than half of all the fruit **D** One third of all the fruit  
**E** Less than one third of all the fruit

**M12.** A cube (on the right) is colored in three colors so that each face has exactly one color and the opposite face has the same color. Which of the following developments is the development of this cube?



**M13.** Karen has found an old book with some missing pages. On a left-hand page the page number is 24, and the following right-hand page is numbered 45. How many leaves are missing in between?  
**A** 9 **B** 10 **C** 11 **D** 20 **E** 21

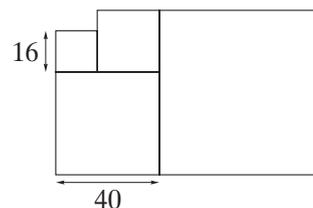
**M14.** Ruby is 52 days older than her classmate Irene. Last year Ruby celebrated her birthday on a Tuesday in March. On which day of the week did Irene celebrate her birthday last year?  
**A** Monday **B** Tuesday **C** Wednesday **D** Thursday **E** Friday

- M15.** Which difference is not equal to  $671 - 389$ ?  
**A**  $771 - 489$  **B**  $681 - 399$  **C**  $669 - 391$  **D**  $1871 - 1589$  **E**  $600 - 318$

- M16.** Inside each of the four squares of a  $2 \times 2$  grid there is a number. If the sum of the numbers of the first line is 3, the sum of the numbers of the second line is 8, and the sum of the numbers of the first column is 4, what is the sum of the numbers in the second column?  
**A** 4 **B** 6 **C** 7 **D** 8 **E** 11

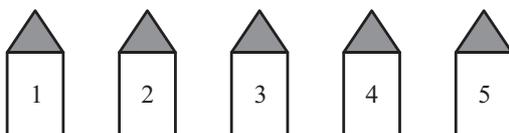
5-POINT QUESTIONS

- M17.** This figure is made of squares. What is the side of the biggest square?  
**A** 24 **B** 56 **C** 64 **D** 81 **E** 100



- M18.** Robert has 147 euros, and Lisa has 57 euros. How many euros must Robert give to Lisa so that Robert has twice as much as Lisa?  
**A** 11 **B** 19 **C** 30 **D** 45 **E** 49

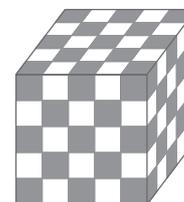
- M19.** There are five houses on Color Street: a blue, a red, a yellow, a pink, and a green one. The houses are numbered from 1 to 5 (see picture). The red house is the neighbor of the blue house only. The blue house stands between the green and red houses.



- Which color is the house with number 3?  
**A** Blue **B** Red **C** Yellow **D** Pink **E** Green

- M20.** The sum of the digits of a ten-digit number is equal to 9. What is the product of the digits of this number?  
**A** 0 **B** 1 **C** 45 **D**  $9 \cdot 8 \cdot 7 \cdot 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2$  **E** Depends on the given number

- M21.** A large cube consists of 125 small black and white cubes, such that any two adjacent faces of the small cubes have different colors, the corner cubes being black. How many small black cubes are used?  
**A** 62 **B** 63 **C** 64 **D** 65 **E** 68



- M22.** One lottery ticket costs 4 euros. Three boys – Paul, Peter, and Robert – pooled their money for two tickets. Paul gave 1 euro, Peter – 3 euros, Robert – 4 euros. One of the tickets they bought won 1000 euros. The boys shared the prize fairly, i.e., according to how much money each of them had contributed. How many euros did Peter get?  
**A** 300 **B** 375 **C** 250 **D** 750 **E** 425

- M23.** After three games of the soccer championship, Platypus United has scored three goals and let one past them. They get three points for a win, one point for a draw, and no points for a loss. How many points can they not have right now?

**A** 7 **B** 6 **C** 5 **D** 4 **E** 3

- M24.** This is a multiplication table. Which two letters represent the same number?

**A**  $L$  and  $M$  **B**  $P$  and  $N$  **C**  $R$  and  $S$   
**D**  $K$  and  $R$  **E**  $M$  and  $T$

$\times$				7
	$J$	$K$	$L$	56
	$M$	36	8	$N$
	$P$	27	6	$R$
6	18	$S$	$T$	42

## BENJAMIN (grades 5 and 6)

### 3-POINT QUESTIONS

- B1.** How much is  $1000 - 100 + 10 - 1$ ?

**A** 111 **B** 900 **C** 909 **D** 990 **E** 999

- B2.** Caroline wants to write the numbers 1, 2, 3, 4 in the square  $4 \times 4$  in such a way that every row and every column has each number. You see how she started. What number must be put in the place of  $x$ ?

**A** 1 **B** 2 **C** 3 **D** 4 **E** Impossible to determine

1		$x$	2
4	1		
	3		
	2		

- B3.** The product  $(10 \times 100) \times (20 \times 80)$  is equal to

**A**  $20,000 \times 80,000$  **B**  $2000 \times 8000$  **C**  $2000 \times 80,000$  **D**  $20,000 \times 8000$  **E**  $2000 \times 800$

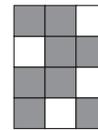
- B4.** How many hours is 360,000 seconds?

**A** 3 **B** 6 **C** 8.5 **D** 10 **E** More than 90

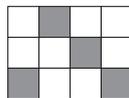
- B5.** If 20042003 is divided by 2004, the remainder is

**A** 0 **B** 1 **C** 2 **D** 3 **E** 2003

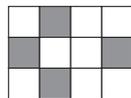
- B6.** Which of the rectangles **A** to **E** can be covered by the pattern on the right-hand side in such a way that the result is a totally black rectangle?



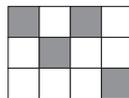
**A**



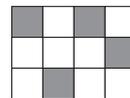
**B**



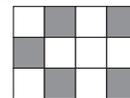
**C**



**D**



**E**



- B7.** Which of the following is not a factor of 2004?

**A** 3 **B** 4 **C** 6 **D** 8 **E** 12

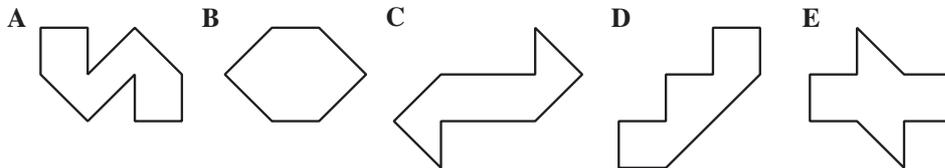
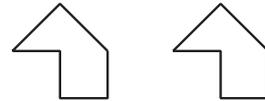
- B8.** The three members of a rabbit family have altogether eaten 73 carrots. The father has eaten five carrots more than the mother. The son Bunny has eaten 12 carrots. How many carrots has the mother eaten?

**A** 27 **B** 28 **C** 31 **D** 33 **E** 56

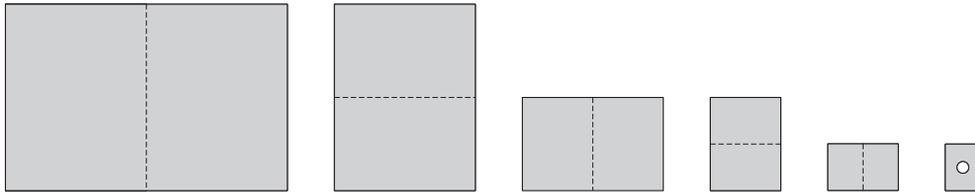
- B9.** Nine bus stops are equally spaced along a bus route. The distance from the first stop to the third stop is 600 m. How many meters is it from the first to the last?  
**A** 1800 **B** 2100 **C** 2400 **D** 2700 **E** 3000
- B10.** The sum of the digits of a ten-digit number is equal to 9. What is the product of the digits of this number?  
**A** 0 **B** 1 **C** 45 **D**  $9 \cdot 8 \cdot 7 \cdot 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2$  **E** Depends of the given number

## 4-POINT QUESTIONS

- B11.** You have two identical pieces that you can turn around but not upside down. Which picture can you not make with these two pieces?



- B12.** Harry folds a sheet of paper five times. Then he makes a hole in the folded paper, after which he unfolds it.



How many holes has the unfolded paper?

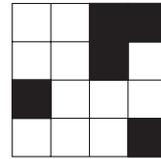
- A** 6 **B** 10 **C** 16 **D** 20 **E** 32
- B13.** Different figures represent different digits. Find the digit corresponding to the square.

$$\begin{array}{r} \square \\ + \square \\ \hline \bigcirc \bigcirc \\ \triangle \triangle \triangle \end{array}$$

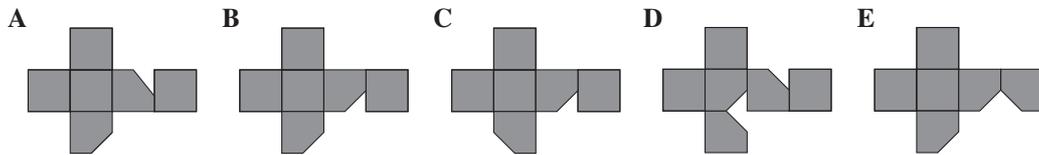
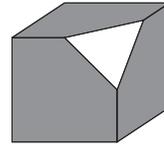
- B14.** The weight of 3 apples and 2 oranges is 255 g. The weight of 2 apples and 3 oranges is 285 g. Each apple has the same weight, and each orange has the same weight. What is the weight in grams of 1 apple and 1 orange together?  
**A** 110 **B** 108 **C** 105 **D** 104 **E** 102

- B15.** The best mathematician in the 7th grade was asked to guess the positive integer about which his friends made the following statements:  
 Thomas: "This number is 9."  
 Ronald: "This number is prime."  
 Andrew: "This number is even."  
 Michael: "This number is 15."  
 Ronald and Thomas together made one true statement, as well as Andrew and Michael. This number is:  
**A** 1 **B** 2 **C** 3 **D** 9 **E** 15

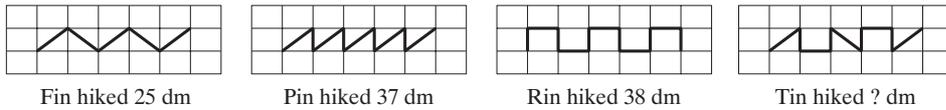
- B16.** What is the smallest number of little squares that need to be painted to get at least one axis of symmetry in the picture?  
**A** 1 **B** 2 **C** 3 **D** 4 **E** 5



- B17.** We have cut off one corner of a cube. Which of the developments below is the development of the remaining part?



- B18.** Snail quadruplets have gone hiking on a path paved with identical rectangular tiles. The shape and length of each snail's trip is shown below.



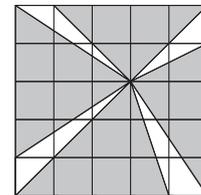
- How many decimeters has the snail Tin hiked?  
**A** 27 **B** 30 **C** 35 **D** 36 **E** 40

- B19.** Turtle Island has an unusual weather system: on Mondays and Wednesdays it's always rainy, on Saturdays it's foggy, and the other days are sunny. A group of tourists would like to go on a 44-day-long holiday to the island. Which day of the week should be the first day of their holiday in order to enjoy the most sunny days?  
**A** Monday **B** Wednesday **C** Thursday **D** Friday **E** Tuesday

- B20.** The sum of two positive integers is equal to 77. If the first number is multiplied by 8 and the second by 6, the two products are equal. The larger of these numbers is  
**A** 23 **B** 33 **C** 43 **D** 44 **E** 54

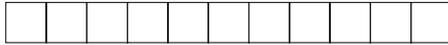
5-POINT QUESTIONS

- B21.** In the diagram drawn on the square grid, find the ratio of the unshaded area to the shaded area.  
**A**  $\frac{1}{4}$  **B**  $\frac{1}{5}$  **C**  $\frac{1}{6}$  **D**  $\frac{2}{5}$  **E**  $\frac{2}{7}$



- B22.** Ella and Emma went mushrooming. They found 70 mushrooms.  $\frac{5}{9}$  of the mushrooms Ella found were boletuses, and  $\frac{2}{17}$  of the mushrooms Emma has found were orange-caps. How many mushrooms did Ella find?  
**A** 27 **B** 36 **C** 45 **D** 54 **E** 10

- B23.** In the picture we have 11 fields.



In the first field there is a 7, and in the ninth field we have a 6. What positive integer has to be written in the second field for the following condition to be valid: the sum of any three adjoining fields is equal to 21?

- A** 7 **B** 8 **C** 6 **D** 10 **E** 21

- B24.** This is a multiplication table. Which two letters represent the same number?

- A**  $L$  and  $M$  **B**  $P$  and  $N$  **C**  $R$  and  $S$   
**D**  $K$  and  $R$  **E**  $M$  and  $T$

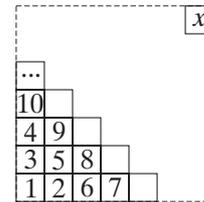
×				7
	$J$	$K$	$L$	56
	$M$	36	8	$N$
	$P$	27	6	$R$
6	18	$S$	$T$	42

- B25.** In a CD store two CD's have the same price. The first CD becomes 5% cheaper, and the other one increases 15% in price. Now the two prices differ by 6 euros. What is the price in euros of the cheaper CD now?

- A** 1.50 **B** 6 **C** 28.50 **D** 30 **E** 34.50

- B26.** You write a number in each square as shown in the square figure. Then, the number  $x$  cannot be:

- A** 128 **B** 256 **C** 81 **D** 121 **E** 400



- B27.** Bill divided  $\underbrace{111\dots1}_{2004}$  by 3. The number of zeros in the quotient he obtained is equal to

- A** 670 **B** 669 **C** 668 **D** 667 **E** 665

- B28.** Imagine that you have 108 red balls and 180 green balls. You want to put all of them in bags, and there must be the same number of balls in each bag, and all the balls in each bag must be the same color. What is the minimum number of bags you need?

- A** 288 **B** 36 **C** 18 **D** 8 **E** 1

- B29.** In the Kangaroo summer camp a math competition was organized with 10 problems. Each correct answer was worth 5 points. For each incorrect answer 3 points were deducted. Everybody answered all the problems. Matt had 34 points, Zsolt had 10 points, and Gábor had 2 points. How many correct answers did they have altogether?

- A** 17 **B** 18 **C** 15 **D** 13 **E** 21

- B30.** A right triangle with legs of length 6 cm and 8 cm is cut out of a sheet of paper and then folded along a straight line. What can the area be, in  $\text{cm}^2$ , of the resulting polygon?

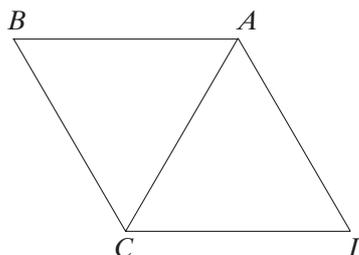
- A** 9 **B** 12 **C** 18 **D** 24 **E** 30

## CADET (grades 7 and 8)

### 3-POINT QUESTIONS

- C1.** What is the value of  $2004 - 200 \cdot 4$ ?  
**A** 7216 **B** 0 **C** 1204 **D** 1200 **E** 2804

- C2.** An equilateral triangle  $ACD$  is rotated counterclockwise around point  $A$ . At what angle has it been rotated when it covers equilateral triangle  $ABC$  for the first time?  
**A**  $60^\circ$  **B**  $120^\circ$  **C**  $180^\circ$  **D**  $240^\circ$  **E**  $300^\circ$



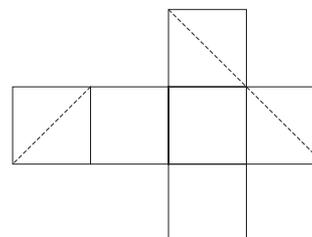
- C3.** We multiplied the number  $x$  by 0.5 and divided the product obtained by 3. By squaring the quotient and adding 1 we obtained 50. What is the number  $x$  equal to?  
**A** 18 **B** 24 **C** 30 **D** 40 **E** 42

- C4.** Caroline wants to write the numbers 1, 2, 3, 4 in the square  $4 \times 4$  in such a way that every row and every column has each of the numbers. You see how she started. How many of the 4 numbers can be written in place of  $x$ ?  
**A** 1 **B** 2 **C** 3 **D** 4 **E** Impossible to determine

1		$x$	
4	1		
	3		
	2		

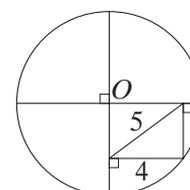
- C5.** The value of the expression  $(1 - 2) - (3 - 4) - (5 - 6) - \dots - (99 - 100)$  is equal to  
**A**  $-50$  **B** 49 **C**  $-48$  **D** 48 **E** 50

- C6.** The section of a cube by a plane generates a plane figure. I have plotted this section in the development of the cube (see the picture). Can you find out what figure it is?  
**A** An equilateral triangle  
**B** A rectangle, but not a square  
**C** A right triangle  
**D** A square  
**E** A hexagon



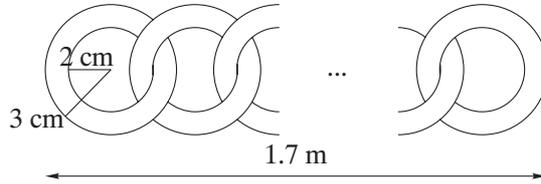
- C7.** We have a rectangle and decide to enlarge it by increasing both length and width by 10%. The percentage of increase in area is  
**A** 10% **B** 20% **C** 21% **D** 100% **E** 121%

- C8.** The point  $O$  is the center of the circle in the picture. What is the diameter of the circle?  
**A** 18 **B** 12 **C** 10 **D** 12.5 **E** 14



- C9.** An ice cream stand has five different flavors. A group of children comes to the stand, and each child buys a double scoop cone with two flavors of ice cream. If none of the children choose the same combination of flavors, and every different combination of flavors is chosen, how many children are there?  
**A** 5 **B** 10 **C** 20 **D** 25 **E** 30

**C10.** We link rings together as shown in the figure below; the length of the chain is 1.7 m.



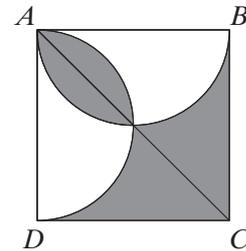
How many rings are there?

- A** 17 **B** 21 **C** 30 **D** 42 **E** 85

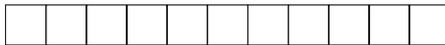
**4-POINT QUESTIONS**

**C11.** In the picture a square  $ABCD$  and two semicircles with diameters  $AB$  and  $AD$  have been drawn. If  $AB = 2$ , what is the area of the shaded region?

- A** 4 **B** 8 **C**  $8\pi$  **D**  $2\pi$  **E** 3



**C12.** In the picture we have 11 fields.



In the first field there is a 7, and in the ninth field we have a 6. What positive integer has to be written in the second field for the following condition to be valid: the sum of any three adjoining fields is equal to 21?

- A** 7 **B** 8 **C** 6 **D** 10 **E** 21

**C13.** In the first year of two consecutive years there were more Thursdays than Tuesdays. Which day of the week was there more of in the second year, considering that neither of these years was a leap year?

- A** Tuesday **B** Wednesday **C** Friday **D** Saturday **E** Sunday

**C14.**  $ABC$  is an isosceles triangle with  $AB = AC = 5$  cm and  $\angle BAC > 60^\circ$ . The length of its perimeter is a whole number of centimeters. How many such triangles are possible?

- A** 1 **B** 2 **C** 3 **D** 4 **E** 5

**C15.** Romeo the ostrich is training for the Head in the Sand Competition. He put his head into the sand at 8:15 on Monday morning and having been underground for 98 hours and 56 minutes reached a new personal record. When did Romeo pull his head out of the sand?

- A** On Thursday at 5:19 **B** On Thursday at 5:41 **C** On Thursday at 11:11  
**D** On Friday at 5:19 **E** On Friday at 11:11

**C16.** Somebody has a large amount of building bricks  $1 \times 2 \times 3$ . What is the smallest number of bricks needed to build a cube?

- A** 12 **B** 18 **C** 24 **D** 36 **E** 60

**C17.** Each of five children thinks of a number, which can be either 1, 2, or 4. Their numbers are multiplied. Which number could be the result?

- A** 100 **B** 120 **C** 256 **D** 768 **E** 2048

**C18.** The average age of grandmother, grandfather, and 7 grandchildren is 28 years. The average age of 7 grandchildren is 15 years. Find the age of grandfather, if it is known that grandfather is 3 years older than grandmother.

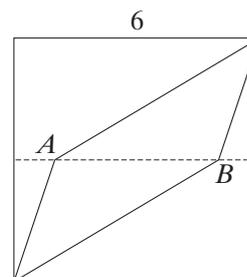
- A** 71 **B** 72 **C** 73 **D** 74 **E** 75

- C19.** There were more than two kangaroos in the enclosure. One kangaroo said, "There are 6 of us here," and jumped out of the enclosure. During each consecutive minute one kangaroo jumped out of the enclosure and said, "Everybody who jumped out before me was lying." It continued until there were no kangaroos in the enclosure. How many kangaroos told the truth?

**A** 0 **B** 1 **C** 2 **D** 3 **E** 4

- C20.** In a square with sides of length 6 the points  $A$  and  $B$  are on a line joining the midpoints of the opposite sides of the square (see the figure). When you draw lines from  $A$  and  $B$  to two opposite vertices, you divide the square in three parts of equal area. What is the length of  $AB$ ?

**A** 3.6 **B** 3.8 **C** 4 **D** 4.2 **E** 4.4



### 5-POINT QUESTIONS

- C21.** A woman goes from a city to the beach at 30 km/h. On the return trip her speed is 10 km/h. What is her average speed for the whole trip?

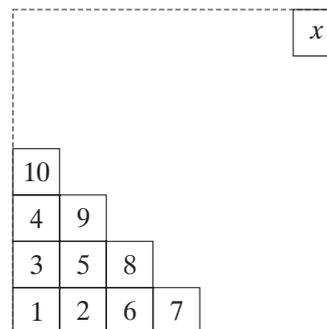
**A** 12 **B** 15 **C** 20 **D** 22 **E** 25

- C22.** John decided to put some of his magazines on his bookshelf. They have either 48 or 52 pages. Which one of these numbers cannot be the total number of pages of the magazines on the bookshelf?

**A** 500 **B** 524 **C** 568 **D** 588 **E** 620

- C23.** You write a number in each square as shown in the square figure. Then, the number  $x$  cannot be:

**A** 128 **B** 256 **C** 81 **D** 121 **E** 400



- C24.** If  $a$  and  $b$  are positive integers, neither of which is divisible by 10, and if  $ab = 10,000$ , then the sum  $a + b$  equals

**A** 1024 **B** 641 **C** 1258 **D** 2401 **E** 1000

- C25.** After one operation, the triplet  $(a, b, c)$  turns into triplet  $(b + c, c + a, a + b)$ . After 2004 successive operations, the triplet  $(1, 3, 5)$  turned into a triplet  $(x, y, z)$ . What is the difference  $x - y$  equal to?

**A**  $-2$  **B** 2 **C** 4008 **D** 2004 **E**  $(-2)^{2004}$

- C26.** This is a multiplication table. Which two letters represent the same number?

**A**  $L$  and  $M$    **B**  $P$  and  $N$    **C**  $R$  and  $S$   
**D**  $K$  and  $R$    **E**  $M$  and  $T$

$\times$				7
	$J$	$K$	$L$	56
	$M$	36	8	$N$
	$P$	27	6	$R$
6	18	$S$	$T$	42

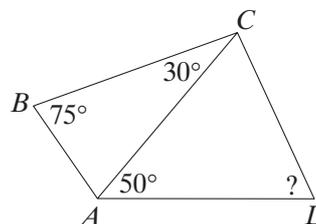
- C27.** Some positive integers are written on the faces of a cube, and at each vertex we write the number equal to the product of the numbers on the three faces adjacent to that vertex. The sum of the numbers at the vertices is 70. Then the sum of the numbers on the faces is:  
**A** 12   **B** 35   **C** 14   **D** 10   **E** Impossible to determine
- C28.** The number 2004 is divisible by 12, and the sum of its digits is equal to 6. Altogether, how many four-digit numbers have these two properties?  
**A** 10   **B** 12   **C** 13   **D** 15   **E** 18
- C29.** A right triangle with legs of length 6 cm and 8 cm is cut out of a sheet of paper and then folded along a straight line. What can the area be, in  $\text{cm}^2$ , of the resulting polygon?  
**A** 9   **B** 12   **C** 18   **D** 24   **E** 30
- C30.** In the Kangaroo summer camp a math competition was organized with 10 problems. Each correct answer was worth 5 points. For each incorrect answer 3 points were deducted. Everybody answered all the problems. Matt had 34 points, Zsolt had 10 points, and Gábor had 2 points. How many correct answers did they have altogether?  
**A** 17   **B** 18   **C** 15   **D** 13   **E** 21

## JUNIOR (grades 9 and 10)

### 3-POINT QUESTIONS

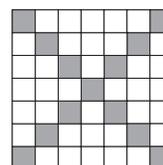
- J1.** The value of the expression  $(1 - 2) - (3 - 4) - (5 - 6) - \dots - (99 - 100)$  is equal to  
**A** -50   **B** 49   **C** -48   **D** 48   **E** 50
- J2.** Edward has 2004 marbles. Half of them are blue, one quarter are red, and one sixth are green. How many marbles are of some other color?  
**A** 167   **B** 334   **C** 501   **D** 1001   **E** 1837
- J3.** A pyramid has 7 faces. How many edges does it have?  
**A** 7   **B** 9   **C** 12   **D** 14   **E** 21
- J4.** The ground plan of a building has a rectangular shape with parameters of  $40 \text{ m} \times 60 \text{ m}$ . In the diagram the ground plan of the building has a perimeter of 100 cm. What is the scale of the diagram?  
**A** 1:100   **B** 1:150   **C** 1:160   **D** 1:170   **E** 1:200
- J5.** Tom and Ron both had some one-euro coins. When Tom got 5 more coins from his grandfather, he had twice as many coins as Ron. And if Tom now gave 12 coins to his grandmother, he would have half as many coins as Ron. How many coins did Tom have at the very beginning?  
**A** 5   **B** 7   **C** 9   **D** 11   **E** 45

- J6.** Some angles in the quadrilateral  $ABCD$  are shown in the figure. If  $BC = AD$ , then what is the angle  $ADC$ ?  
**A**  $30^\circ$  **B**  $50^\circ$  **C**  $55^\circ$  **D**  $65^\circ$  **E**  $70^\circ$



- J7.** There are some boletuses and orange-caps in a basket – 30 mushrooms altogether. If we randomly take out 12 mushrooms, there will be at least one orange-cap among them. If we randomly take out 20 mushrooms, there will be at least one boletus among them. How many boletuses are there in the basket?  
**A** 11 **B** 12 **C** 19 **D** 20 **E** 21

- J8.** In a square  $2003 \times 2003$ , the squares  $1 \times 1$  on the diagonals are colored (like in the picture, where the square is  $7 \times 7$ ). How many white squares are there?  
**A**  $2002^2$  **B**  $2002 \times 2001$  **C**  $2001^2$  **D**  $2003 \times 2002$   
**E**  $2003^2 - 2004$



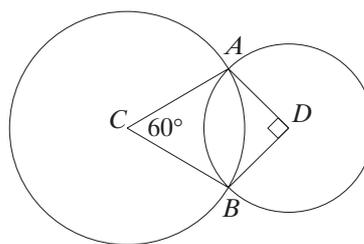
- J9.** The dartboard shown consists of an inner black circle and 2 rings around it. The width of each ring is equal to the radius of the black circle. How many times greater is the area of the grey ring than the area of the inner black circle?  
**A** 2 **B** 3 **C** 4 **D** 5 **E** 6



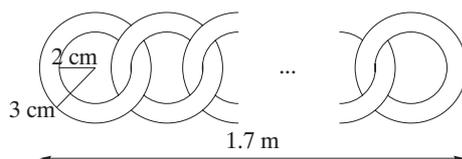
- J10.** After gathering 770 nuts, three girls divided them in proportion to their ages. For every 3 nuts Oxana took, Ira took 4. For every 7 nuts Natalya took, Ira took 6. How many nuts did the youngest girl get?  
**A** 264 **B** 256 **C** 218 **D** 198 **E** 180

#### 4-POINT QUESTIONS

- J11.** Each of five children thinks of a number, which can be either 1, 2, or 4. Their numbers are multiplied. Which number could be the result?  
**A** 100 **B** 120 **C** 256 **D** 768 **E** 2048
- J12.** The circles with centers  $C$  and  $D$  meet at the points  $A$  and  $B$ , as shown. Angle  $ACB = 60^\circ$  and angle  $ADB = 90^\circ$ . How many times longer is the radius of the larger circle than the radius of the smaller circle?  
**A**  $\frac{4}{3}$  **B**  $\sqrt{2}$  **C**  $\frac{3}{2}$  **D**  $\sqrt{3}$  **E** 2



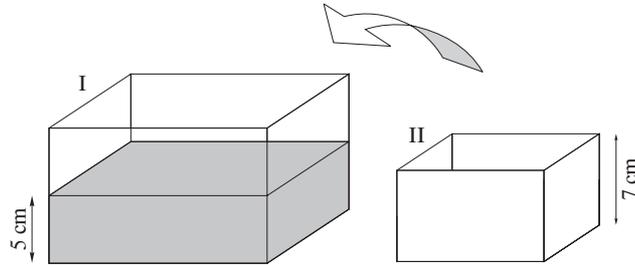
- J13.** We link rings together as shown in the figure below; the length of the chain is 1.7 m.



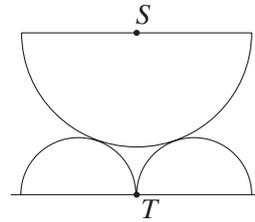
How many rings are there?

- A** 17 **B** 21 **C** 30 **D** 42 **E** 85

- J14.** In tank I, whose base has an area of  $2 \text{ dm}^2$  and whose height is 10 cm, the water is 5 cm high. An empty tank II with a base of area  $1 \text{ dm}^2$  and a height of 7 cm is placed in tank I. The water of tank I rises, of course, and spills over into tank II. What level does the water reach in tank II?  
**A** 1 cm **B** 2 cm **C** 3 cm  
**D** 4 cm **E** 5 cm



- J15.** The hour hand of a clock is 4 cm long, and the minute hand is 8 cm long. What is the ratio of the distances travelled by the tips of the two hands between 2 pm and 5 pm?  
**A** 1:2 **B** 1:4 **C** 1:6 **D** 1:12 **E** 1:24
- J16.** Three semi-circles, the diameters of two of which are equal to 4 and of the third to 8, are arranged as seen in the picture. What is the distance from the center  $S$  of the bigger semi-circle to the tangent point  $T$  of the smaller semi-circles?  
**A** 6 **B**  $\sqrt{32}$  **C** 5.7 **D**  $\sqrt{40}$  **E** 5



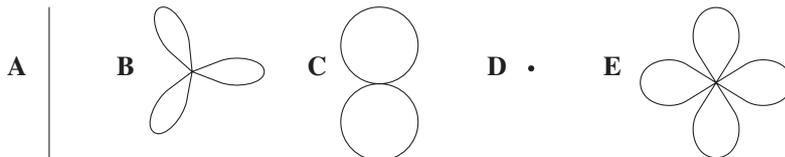
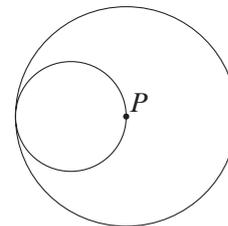
- J17.** A quiz has twenty questions with seven points awarded for each correct answer, two points deducted for each wrong answer, and zero for each question omitted. Andrew scores 87 points. How many questions did he omit?  
**A** 2 **B** 3 **C** 4 **D** 5 **E** 6

- J18.** Caroline wants to write the numbers 1, 2, 3, 4 in the square  $4 \times 4$  in such a way that every row and every column has each of the numbers. You see how she started. In how many different ways can she finish?  
**A** 1 **B** 2 **C** 4 **D** 16 **E** 128

1			
2	1		
	3		
	4		

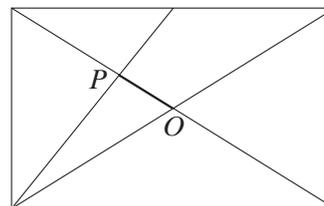
- J19.** How many numbers exist between 100 and 200 which can have only the prime factors 2 and 3?  
**A** 1 **B** 3 **C** 4 **D** 5 **E** 6

- J20.** The diagram shows two tangential circles with radii in the ratio 1:2. The smaller circle rolls around the inside of the large circle. Which of the following is the path traced out by the point  $P$  of the smaller circle?



## 5-POINT QUESTIONS

- J21.** In a rectangle we draw both diagonals and the segment which joins a vertex with the midpoint of one of the sides, as shown in the picture. What is the result of dividing the length of the diagonal by the length of segment  $OP$ ?



**A** 3 **B** 6 **C**  $\frac{13}{3}$  **D** 4

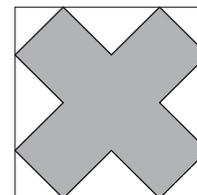
**E** It depends on the dimensions of the rectangle

- J22.** The real numbers  $a$  and  $b$  have different signs. Which of the numbers given below is the largest one?

**A**  $|a^2 - b^2|$  **B**  $(|a| - |b|)^2$  **C**  $(a - b)^2$  **D**  $(a + b)^2$  **E**  $a^2 + b^2$

- J23.** The diagram shows a square and an equilateral right-angled cross-shaped dodecagon. The length of the perimeter of the dodecagon is 36 cm. What, in  $\text{cm}^2$ , is the area of the square?

**A** 48 **B** 72 **C** 108 **D**  $36\sqrt{2}$  **E** 144



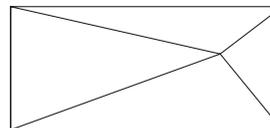
- J24.** How many 3-digit numbers smaller than 200 have the property that the number  $(n + 1)(n + 2)(n + 3)$  is divisible by 7?

**A** 42 **B** 38 **C** 34 **D** 28 **E** 16

- J25.** A rectangle is divided into 4 triangles as shown in the figure. Of the following possibilities for the areas of the triangles at most one can be true. Which one is it?

**A** 4, 5, 8, 9 **B** 3, 5, 6, 7 **C** 5, 6, 7, 12

**D** 10, 11, 12, 19 **E** 5, 6, 8, 10



- J26.** This is a multiplication table. Which two letters represent the same number?

**A**  $L$  and  $M$  **B**  $P$  and  $N$  **C**  $R$  and  $S$

**D**  $K$  and  $R$  **E**  $M$  and  $T$

$\times$				7
	$J$	$K$	$L$	56
	$M$	36	8	$N$
	$P$	27	6	$R$
6	18	$S$	$T$	42

- J27.** After one operation, the triplet  $(a, b, c)$  turns into triplet  $(b + c, c + a, a + b)$ . After 2004 successive operations, the triplet  $(1, 3, 5)$  turned into a triplet  $(x, y, z)$ . What is the difference  $x - y$  equal to?

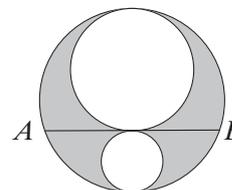
**A**  $-2$  **B** 2 **C** 4008 **D** 2004 **E**  $(-2)^{2004}$

- J28.** How many 8-digit numbers  $\overline{a_1a_2a_3a_4a_5a_6a_7a_8}$  whose digits can only be 0s or 1s ( $a_1 = 1$ ) have the property  $a_1 + a_3 + a_5 + a_7 = a_2 + a_4 + a_6 + a_8$ ?

**A**  $2^7$  **B** 35 **C** 49 **D** 16 **E** 32

- J29.** The area of the shaded shape is equal to  $2\pi$  (see the picture). What is the value of the chord  $AB$ ?

**A** 1 **B** 2 **C** 3 **D** 4 **E** It's impossible to determine.



- J30.** All the integers from 1 to 10,000 were written down on a blackboard. After that the numbers that are not divisible by 5 or 11 were erased. Then the 2004th element of the sequence obtained was:

**A** 1000 **B** 5000 **C** 10,000 **D** 6545 **E** 7348

## STUDENT (grades 11 and 12)

### 3-POINT QUESTIONS

- S1.** If  $m$  pens are bought at  $n$  euros each, and  $n$  pens at  $m$  euros each ( $m \neq n$ ), then the average cost per pen, in euros, is:

**A** 1 **B**  $\frac{m+n}{2}$  **C**  $\frac{2mn}{m+n}$  **D**  $mn$  **E**  $\sqrt{mn}$

- S2.** A pyramid has 17 faces. How many vertices does it have?

**A** 16 **B** 17 **C** 18 **D** 32 **E** 34

- S3.** The smallest real number satisfying the inequality  $x^2 - 2004 \leq 0$  is:

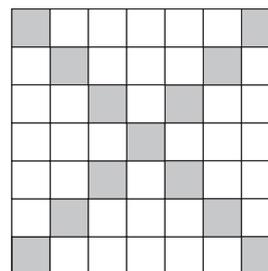
**A**  $-2004$  **B**  $2004$  **C** 0 **D**  $\sqrt{2004}$  **E**  $-\sqrt{2004}$

- S4.** Each Martian has one, two, or three tentacles on its head. Exactly 1% of the Martian population consists of individuals with three tentacles, exactly 97% comprise Martians with two tentacles, and the remaining 2% consists of individuals with one tentacle. What percent of Martians have more tentacles on their head than the average of the whole Martian population?

**A** 1% **B** 3% **C** 97% **D** 98% **E** 99%

- S5.** In a square of side  $s$ , where  $s$  is an odd integer, the squares of side 1 on the diagonals are colored (like in the picture, where the square is of side 7). How many white squares are there?

**A**  $s^2 + 1 - 2s$  **B**  $s^2 + 4 - 4s$  **C**  $2s^2 + 1 - 4s$  **D**  $s^2 - 1 - 2s$   
**E**  $s^2 - 2s$



- S6.** How many two-digit numbers exist whose square and cube end in the same digit?

**A** 1 **B** 9 **C** 10 **D** 21 **E** More than 30

- S7.** Square  $ABCD$  consists of 18 smaller squares, 17 of which have sides equal to 1. The area of the square  $ABCD$  is:

**A** 25 **B** 49 **C** 81 **D** 100 **E** 225

- S8.** How many right triangles can be formed by joining three vertices of a given regular 14-gon?

**A** 72 **B** 82 **C** 84 **D** 88 **E** Other answer

- S9. This is a multiplication table. What two letters represent the same number?

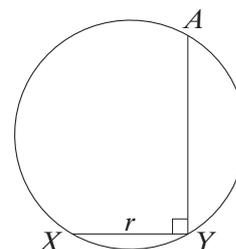
A  $L$  and  $M$    B  $P$  and  $N$    C  $R$  and  $S$    D  $K$  and  $R$    E  $M$  and  $T$

$\times$				7
	$J$	$K$	$L$	56
	$M$	36	8	$N$
	$P$	27	6	$R$
6	18	$S$	$T$	42

- S10. On the circumference of radius  $r$  three points  $X$ ,  $Y$  and  $A$  are marked such that  $XY = r$ ,  $XY \perp AY$  (see the figure).

How many degrees has the angle  $XAY$ ?

A  $22\frac{1}{2}$    B 30   C 45   D 60   E  $67\frac{1}{2}$



#### 4-POINT QUESTIONS

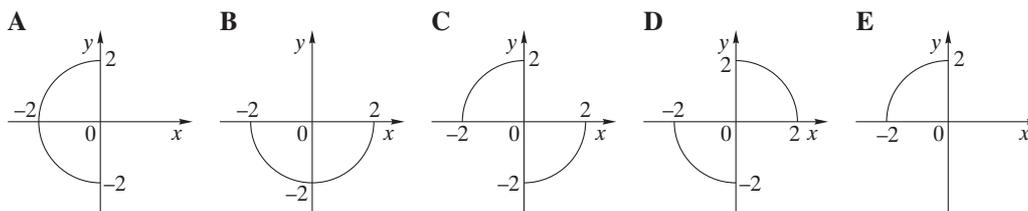
- S11. In the plane  $Oxy$ , how many squares with vertex  $A(-1; -1)$  exist such that at least one of the coordinate axes is an axis of symmetry of the square?

A 2   B 3   C 4   D 5   E 6

- S12. There are 100 cards in a non-transparent envelope, numbered with integers from 1 to 100. There is a different number on each card. What is the smallest number of cards we have to pull out of the envelope at random to be sure that the product of the numbers on the chosen cards is divisible by 4?

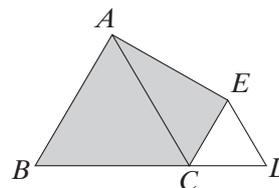
A 4   B 52   C 50   D 48   E 96

- S13. The set of all pairs  $(x, y)$  which satisfy conditions  $xy \leq 0$  and  $x^2 + y^2 = 4$  is on the graph:

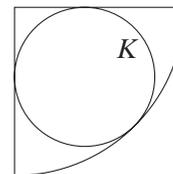


- S14. In the figure the two equilateral triangles  $ABC$  and  $ECD$  have sides of length 2 and 1 respectively. The area of the quadrilateral  $ABCE$  is:

A  $\frac{5\sqrt{3}}{3}$    B  $\frac{4+5\sqrt{3}}{5}$    C 3   D  $\frac{6+\sqrt{3}}{4}$    E  $\frac{3\sqrt{3}}{2}$

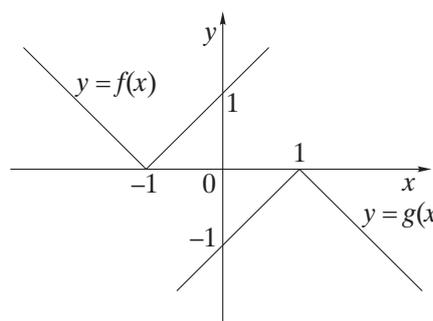
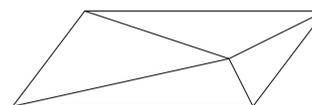


- S15.** How many positive integers can be written as  $a_0 + a_1 \cdot 3 + a_2 \cdot 3^2 + a_3 \cdot 3^3 + a_4 \cdot 3^4$  if  $a_0, a_1, a_2, a_3, a_4$  belong to the set  $\{-1, 0, 1\}$ ?  
**A** 5 **B** 80 **C** 81 **D** 121 **E** 243
- S16.** The number  $(\sqrt{22 + 12\sqrt{2}} - \sqrt{22 - 12\sqrt{2}})^2$  is  
**A** negative **B** equal to zero **C** a fourth power of a non-zero integer  
**D** equal to  $11\sqrt{2}$  **E** a positive integer divisible by 5
- S17.** How many vertices are there in a regular polygon the sum of whose interior angles is one seventh of that of a regular 16-gon?  
**A** 3 **B** 4 **C** 6 **D** 7 **E** 10
- S18.** A circle  $K$  is inscribed in a quarter circle with radius 6 as shown in the figure. What is the radius of circle  $K$ ?  
**A**  $\frac{6-\sqrt{2}}{2}$  **B**  $\frac{3\sqrt{2}}{2}$  **C** 2.5 **D** 3 **E**  $6(\sqrt{2} - 1)$

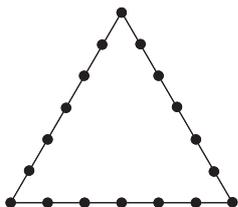


## 5-POINT QUESTIONS

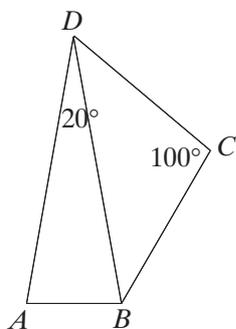
- S21.** An election was held in Herbyville. Every voter who voted for the Broccoli Party had already eaten broccoli. Of the remaining voters who voted for other parties 90% had never eaten broccoli. What percent did the Broccoli Party get in the election if precisely 46% of all voters in the election had eaten broccoli?  
**A** 40% **B** 41% **C** 43% **D** 45% **E** 46%
- S22.** A parallelogram is divided into 4 triangles as shown in the figure. Of the following possibilities for the areas of the triangles at most one can be true. Which one is it?  
**A** 4, 5, 8, 9 **B** 3, 5, 6, 7 **C** 5, 6, 7, 12  
**D** 10, 11, 12, 19 **E** 5, 6, 8, 10
- S23.** The figure shows graphs of functions  $f$  and  $g$  defined on real numbers. Each graph consists of two perpendicular halflines. Which equality is satisfied for every real number  $x$ ?  
**A**  $f(x) = -g(x) + 2$   
**B**  $f(x) = -g(x) - 2$   
**C**  $f(x) = -g(x + 2)$   
**D**  $f(x + 2) = -g(x)$   
**E**  $f(x + 1) = -g(x - 1)$
- S24.** An equilateral triangle  $ABC$  with sides of length 4 is given. The radius of the circular arc, with center at  $A$ , which divides the triangle into two parts of equal area is:  
**A**  $\sqrt{\frac{12\sqrt{3}}{\pi}}$  **B**  $\sqrt{\frac{24\sqrt{3}}{\pi}}$  **C**  $\sqrt{\frac{30\sqrt{3}}{\pi}}$  **D**  $\frac{6\sqrt{3}}{\pi}$  **E**  $\sqrt{\frac{48\sqrt{3}}{\pi}}$



- S25.** A game starts with a sequence of two hundred zeroes. In the first round we add 1 to every number. In the second round we add 1 to the second number and to every second number after it. In the third round we add 1 to the third number and to every third number after it, and so on. What number is in the 120th position after two hundred rounds?  
**A 16 B 12 C 20 D 24 E 32**
- S26.** How many triangles can be drawn with vertices in the 18 points shown in the figure?



- A 816 B 711 C 777 D 717 E 811**
- S27.** If the sum of all the numbers that can be formed by permutation of the three different digits  $0 < a < b < c$  is 1554, what is the value of  $c$ ?  
**A 3 B 4 C 5 D 6 E 7**
- S28.** The number  $m = 999 \dots 9$  consists of 999 nines. What is the sum of the digits of  $m^2$ ?  
**A 8982 B 8991 C 9000 D 9009 E 9018**
- S29.**  $\sin^8 75^\circ - \cos^8 75^\circ$  is equal to:  
**A  $\frac{\sqrt{3}}{2}$  B  $\sqrt{3}$  C  $\frac{7\sqrt{3}}{16}$  D 1 E 0**
- S30.** Let  $ABCD$  be a convex quadrilateral with an area of 1 where  $AB$  and  $BD$  are the bases of two isosceles triangles  $ADB$  and  $BCD$  respectively (as shown).



- The product  $AC \cdot BD$  is equal to:  
**A  $\frac{\sqrt{3}}{3}$  B  $\frac{2\sqrt{3}}{3}$  C  $\sqrt{3}$  D  $\frac{4\sqrt{3}}{3}$  E other answer**

# Questions of Kangaroo 2005

## MINOR (grades 3 and 4)

### 3-POINT QUESTIONS

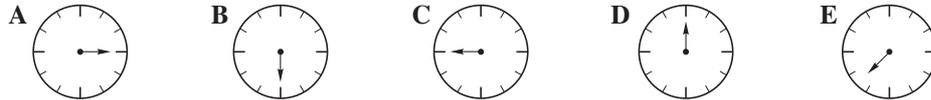
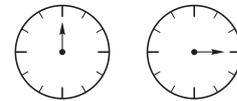
**M1.** A butterfly sat down on a correctly solved exercise. What number is the butterfly covering?

$$2005 - 205 = 1300 +$$



A 250 B 400 C 500 D 910 E 1800

**M2.** At noon the minute hand of a clock is in the position shown on the left and after the quarter of an hour – in the position shown on the right. Which position the minute hand will take after seventeen quarters from the noon?

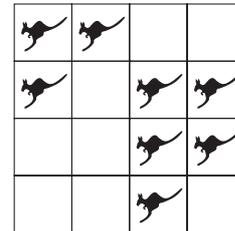


**M3.** Erika bought cookies, each of them costs 3 euros. She gave 10 euros and obtained 1 euro of the change. How many cookies did Erika buy?

A 2 B 3 C 4 D 5 E 6

**M4.** In the diagram every of the eight kangaroos can jump to any empty square. What is the least number of kangaroos that must jump so that each row and each column have exactly two kangaroos?

A 4 B 3 C 2 D 1 E 0

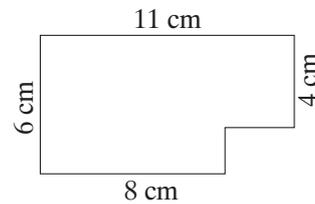


**M5.** Helga lives in her home with father, mother, brother and also one dog, two cats, two parrots and four goldfishes. How many legs do they have altogether?

A 22 B 40 C 28 D 32 E 24

**M6.** John has a chocolate tablet consisting of square pieces of  $1\text{ cm} \times 1\text{ cm}$ . He has eaten already some pieces in a corner (see the picture). How many pieces John still have?

A 66 B 64 C 62 D 60 E 58



**M7.** Daniel wants to fill a tank for his turtle with 4 buckets of water. At each trip he fills one bucket from a faucet but when walking to the tank he spills one half of the water. How many trips from the faucet to the tank does he have to do?

A 4 B 5 C 6 D 7 E 8

**M8.** What is the smallest possible number of children in a family if each child has at least one brother and one sister?

A 2 B 3 C 4 D 5 E 6

## 4-POINT QUESTIONS

**M9.** After the first whistle of the trainer the monkeys in the circus formed 6 rows. In every row there were 4 monkeys. After the second whistle they have rearranged themselves into 8 rows. How many monkeys were in every row after the second whistle?  
**A 1 B 2 C 3 D 4 E 6**

**M10.** Among the five numbers below, the one I chose is even. All its digits are different. The hundreds' digit is double the units' digit, the tens' digit is higher than the thousands' digit. Which one did I choose?  
**A 1246 B 3874 C 4683 D 4874 E 8462**

**M11.** A square piece of paper has been cut in three pieces. Two of them are in the picture on the right. What is the third one?



**M12.** There were 9 pieces of paper. Some of them got cut into three parts. Altogether, there became 15 pieces of paper. How many pieces were cut into parts?  
**A 1 B 2 C 3 D 4 E 5**

**M13.** Jim counts 24 euros in his pockets and John 66 euros. Jack has exactly so much more money as John has more than Jack. How much euros has Jack?  
**A 33 B 35 C 42 D 45 E 48**

**M14.** A frame of a rectangular picture is made from planks of equal width. What is the width of these planks (in centimetres) if the outside perimeter of the frame is 8 cm more than the inside perimeter?

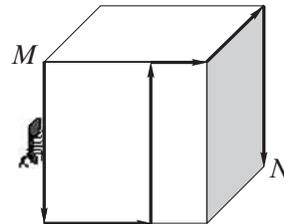
- A 1 B 2 C 4 D 8**  
**E It depends on the dimensions of the picture**



**M15.** In a trunk there are 5 chests, in each chest there are 3 boxes, and in each box there are 10 gold coins. The trunk, the chests, and the boxes are locked. How many locks must be opened in order to get 50 coins?  
**A 5 B 6 C 7 D 8 E 9**

**M16.** The diagram shows a cube with sides of length 12 cm. An ant moves on the cube surface from point  $M$  to point  $N$  following the route shown. Find the length of ant's path.

- A 60 cm B 50 cm C 48 cm D 40 cm**  
**E It is impossible to determine**



## 5-POINT QUESTIONS

**M17.** The lift can not carry more than 150 kg. Four friends weigh: 60 kg, 80 kg, 80 kg and 80 kg. At least how many runs of the lift are necessary to carry the four friends to the highest floor?  
**A 1 B 2 C 3 D 4 E 7**

- M18.** You can make only one rectangle with the perimeter consisting of 6 matches (see the picture). How many different rectangles with the perimeter consisting of 14 matches can you compose?  
**A 2 B 3 C 4 D 6 E 12**

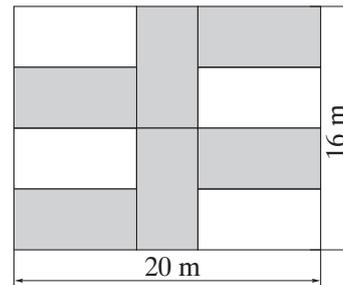


- M19.** Each of seven boy paid exactly the same amount of money for the excursion. The total sum of the money they paid is a three-digital number  $3*0$ . What is the digit in the middle?  
**A 3 B 4 C 5 D 6 E 7**

- M20.** Two traffic signs mark the bridge in my vilage. These marks indicate the maximum width and the maximum possible weight. Which one of the following trucks is allowed to cross that bridge?  
**A** The one 315 cm wide and weighing 4307 kg  
**B** The one 330 cm wide and weighing 4250 kg  
**C** The one 325 cm wide and weighing 4400 kg  
**D** The one 322 cm wide and weighing 4298 kg  
**E** No one of these

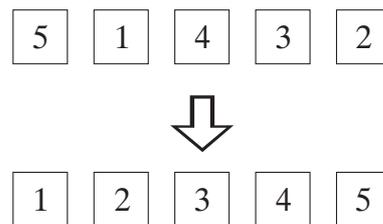


- M21.** The figure shows a rectangular garden with dimensions 16 m and 20 m. The gardener has planted six identical flowerbeds (they are gray in the diagram). What is the perimeter (in metres) of each of the flowerbeds?  
**A 20 B 22 C 24 D 26 E 28**

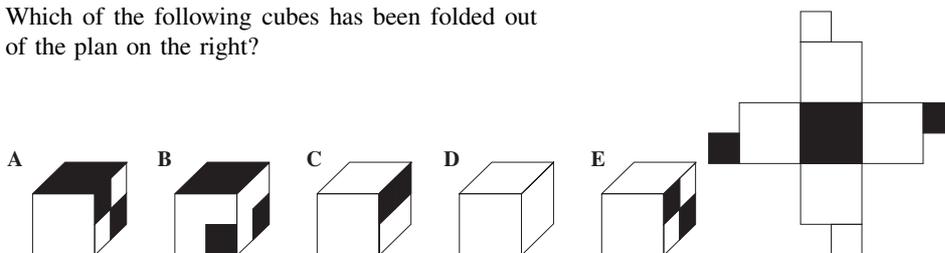


- M22.** Mike has chosen a three-digit number and a two-digit number. Find the sum of these numbers if their difference equals 989.  
**A 1000 B 1001 C 1009 D 1010 E 2005**

- M23.** Five cards are lying on the table in the order 5, 1, 4, 3, 2. You must get the cards in the order 1, 2, 3, 4, 5. Per move, any two cards may be interchanged. How many moves do you need at least?  
**A 2 B 3 C 4 D 5 E 6**



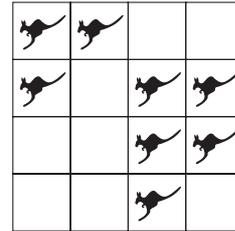
- M24.** Which of the following cubes has been folded out of the plan on the right?



## BENJAMIN (grades 5 and 6)

### 3-POINT QUESTIONS

- B1.** What is  $2005 \times 100 + 2005$ ?  
**A** 2005002005   **B** 20052005   **C** 2007005   **D** 202505   **E** 22055
- B2.** Ann and Betty have 10 sweets, but Betty has 2 more than Ann. How many sweets does Betty have?  
**A** 8   **B** 7   **C** 6   **D** 5   **E** 4
- B3.** In the diagram every one of the eight kangaroos can jump to any empty square. What is the least number of kangaroos that must jump so that each row and each column have exactly two kangaroos?  
**A** 0   **B** 1   **C** 2   **D** 3   **E** 4

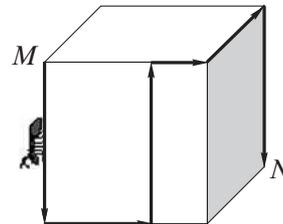


- B4.** Helga lives with her father, mother, brother and also one dog, two cats, two parrots and four goldfishes. How many legs do they have altogether?  
**A** 22   **B** 28   **C** 24   **D** 32   **E** 13
- B5.** A butterfly sat down on my correctly solved exercise:

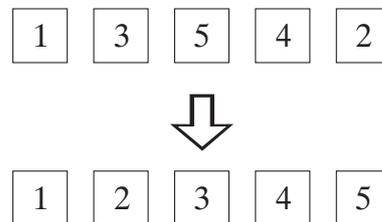
$$2005 - 205 = 25 + \text{🦋}$$

- What number is the butterfly covering?  
**A** 250   **B** 1825   **C** 2185   **D** 1775   **E** 1800

- B6.** The diagram shows a cube with sides of length 12 cm. An ant moves on the cube surface from point  $M$  to point  $N$  following the route shown. Find the length of ant's path.  
**A** 40 cm   **B** 48 cm   **C** 50 cm   **D** 60 cm  
**E** It is impossible to determine

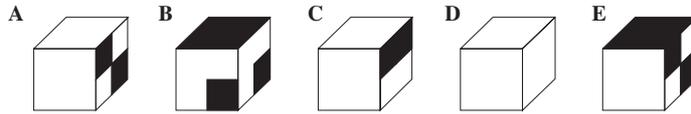
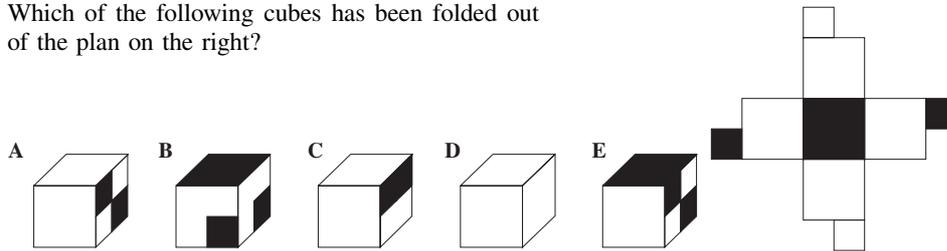


- B7.** Jane cut a sheet of paper into 10 pieces. Then she took one of the pieces and cut it into 10 pieces also. She repeated this twice more. How many pieces of paper did she have in the end?  
**A** 30   **B** 27   **C** 47   **D** 40   **E** 37
- B8.** Five cards are lying on the table in the order 1, 3, 5, 4, 2. You must get the cards in the order 1, 2, 3, 4, 5. Per move, any two cards may be interchanged. How many moves do you need at least?  
**A** 2   **B** 1   **C** 4   **D** 3   **E** 5



- B9.** Vesna chose a whole number and multiplied it by 3. Which of the following numbers could not be her answer?  
**A** 103   **B** 105   **C** 204   **D** 444   **E** 987

**B10.** Which of the following cubes has been folded out of the plan on the right?

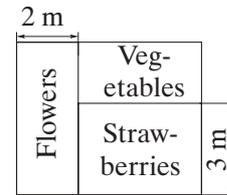


**4-POINT QUESTIONS**

**B11.** How many two-digit numbers have different odd digits?  
**A** 15 **B** 20 **C** 25 **D** 30 **E** 50

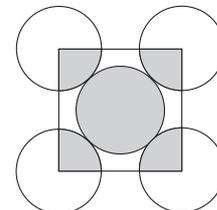
**B12.** Mowgli needs 40 minutes to walk from home to the sea by foot and to return home on an elephant. When he rides both ways on an elephant, the journey takes 32 minutes. How long would the journey last, if he would walk both directions?  
**A** 24 minutes **B** 42 minutes **C** 46 minutes **D** 48 minutes **E** 50 minutes

**B13.** In the diagram you see the rectangular garden of Green’s family. It has an area of  $30\text{m}^2$  and is divided into three rectangular parts. One side of the part where flowers are growing has a length of 2 m. Its area is  $10\text{m}^2$ . The part with strawberries has one side of length 3 m. What is the area of the part where vegetables are growing?  
**A**  $4\text{m}^2$  **B**  $6\text{m}^2$  **C**  $8\text{m}^2$  **D**  $10\text{m}^2$  **E**  $12\text{m}^2$



**B14.** How many hours are there in half the third of the quarter of a day?  
**A** 1 **B** 2 **C** 3 **D**  $\frac{1}{3}$  **E**  $\frac{1}{2}$

**B15.** In the diagram, the five circles have the same radii and touch as shown. The square joins the centres of the four outer circles. The ratio of the area of the shaded part of all five circles to the area of the unshaded parts of the circles is:  
**A** 1:3 **B** 2:3 **C** 2:5 **D** 1:4 **E** 5:4



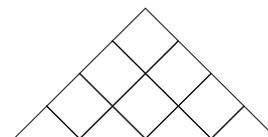
**B16.** If the sum of five consecutive positive integers is 2005, then the largest of these numbers is:  
**A** 401 **B** 403 **C** 404 **D** 405 **E** 2001

**B17.** How many different factors (including 1 and 100) does 100 have?  
**A** 3 **B** 6 **C** 7 **D** 8 **E** 9

**B18.** A frame of a rectangular picture is made from planks of equal width. What is the width of these planks (in centimetres) if the outside perimeter of the frame is 8 cm more than the inside perimeter?  
**A** It depends on the dimensions of the picture  
**B** 8 **C** 4 **D** 2 **E** 1



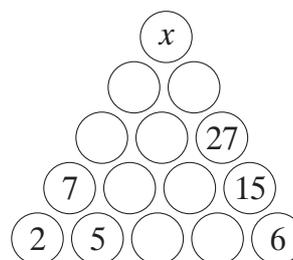
**B19.** There are seven squares in the picture. How many more triangles than squares are there in the picture?  
**A** 1 **B** 2 **C** 3 **D** 4 **E** 0



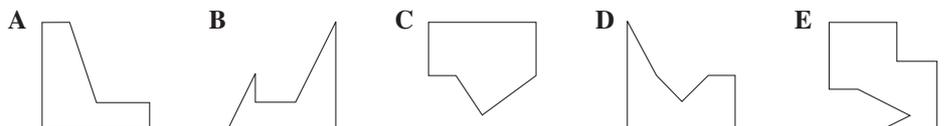
- B20.** In a trunk there are 5 chests, in each chest there are 3 boxes, and in each box there are 10 gold coins. The trunk, the chests, and the boxes are locked. How many locks must be opened in order to get 50 coins?  
**A 6 B 5 C 7 D 9 E 8**

## 5-POINT QUESTIONS

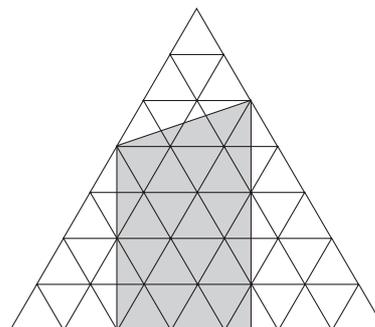
- B21.** You fill the diagram with integers so that every number (except those from the lower row) is equal to the sum of two neighbouring numbers below it. Which number should replace  $x$ ?  
**A 32 B 50 C 55 D 82 E 100**



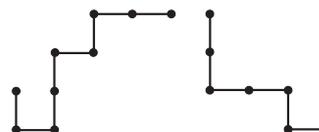
- B22.** A square piece of paper has been cut in three pieces. Two of them are in the picture on the right. What is the third one?



- B23.** In the picture the small equilateral triangles have an area of 1 unit. What is the area of the shaded region?  
**A 20 B 22.5 C 23.5 D 25 E 32**



- B24.** Peter has a three-digit code lock. He has forgotten the code but he knows that all three digits are different, and that the first digit is equal to the square of the quotient of the second and third digit. How many combinations will Peter have to try in order to crack the code?  
**A 8 B 4 C 3 D 2 E 1**
- B25.** What is  $1 + 2 - 3 - 4 + 5 + 6 - 7 - 8 + \dots + 2001 + 2002 - 2003 - 2004 + 2005$ ?  
**A 0 B 2005 C 1 D 2004 E -4**
- B26.** From noon till midnight Clever Cat is sleeping under the oak tree, and from midnight till noon he is awake telling stories. There is a poster on the oak tree saying: "Two hours ago Clever Cat was doing the same as he will be doing after an hour sharp." How many hours a day the poster tells truth?  
**A 6 B 12 C 18 D 3 E 21**
- B27.** Each of these two pieces of wire is made of 8 segments of length 1. One of the pieces is placed one above the other so that they coincide partially. What is the largest possible length of their common part?  
**A 6 B 5 C 4 D 3 E 2**

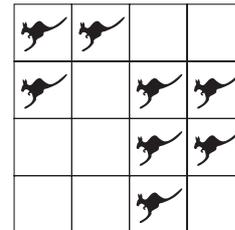


- B28.** To the series of letters AGKNORU (in alphabetical order) is associated a series of different digits, placed in increasing order. What is the biggest number one can associate to the word KANGOUROU?  
**A** 987654321 **B** 987654354 **C** 436479879 **D** 597354354 **E** 536479879
- B29.** The lift can not carry more than 150 kg. Four friends weigh: 50 kg, 75 kg, 80 kg and 85 kg. At least how many runs of the lift are necessary to carry the four friends to the highest floor?  
**A** 1 **B** 2 **C** 7 **D** 4 **E** 3
- B30.** Molly, Dolly, Sally, Elly and Kelly are sitting on a park bench. Molly is not sitting on the far right and Dolly is not sitting on the far left. Sally is not sitting at either end. Kelly is not sitting next to Sally and Sally is not sitting next to Dolly. Elly is sitting to the right of Dolly, but not necessarily next to her. Who is sitting at the far right end?  
**A** Cannot be determined **B** Dolly **C** Sally **D** Elly **E** Kelly

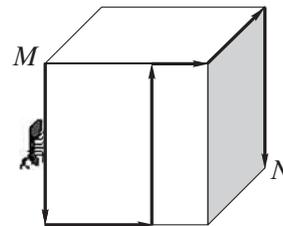
### CADET (grades 7 and 8)

#### 3-POINT QUESTIONS

- C1.** In the diagram every of the eight kangaroos can jump to any empty square. What is the least number of kangaroos that must jump so that each row and each column have exactly two kangaroos?  
**A** 0 **B** 1 **C** 2 **D** 3 **E** 4

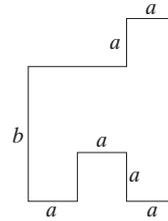


- C2.** How many hours are there in half the third of the quarter of a day?  
**A**  $\frac{1}{3}$  **B**  $\frac{1}{2}$  **C** 1 **D** 2 **E** 3
- C3.** The diagram shows a cube with sides of length 12 cm. An ant moves on the cube surface from point *M* to point *N* following the route shown. Find the length of ant's path.  
**A** It is impossible to determine  
**B** 40 cm **C** 48 cm **D** 50 cm **E** 60 cm



- C4.** Two girls and three boys ate 16 helpings of ice-cream together. Each boy ate twice as much as each girl. How many helpings will be eaten by three girls and two boys with the same passion for ice-cream?  
**A** 12 **B** 13 **C** 14 **D** 16 **E** 17
- C5.** At Sobieski School, 50% of the students have bikes. Of the students who have bikes, 30% have rollerblades. What percent of students of Sobieski School have both a bike and rollerblades?  
**A** 15% **B** 20% **C** 25% **D** 40% **E** 80%
- C6.** In triangle *ABC*, the angle at *A* is three times the size of that at *B* and half the size of the angle at *C*. What is the angle at *A*?  
**A** 30° **B** 36° **C** 54° **D** 60° **E** 72°

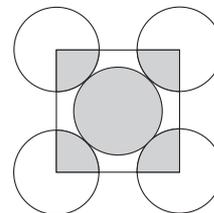
- C7.** The diagram shows the ground plan of a room. The adjacent walls are perpendicular to each other. What is the area of the room?  
**A**  $2ab + a(b-a)$    **B**  $3a(a+b) - a^2$    **C**  $3a^2b$    **D**  $3a(b-a) + a^2$   
**E**  $3ab$



- C8.** Jane cut a sheet of paper to 10 pieces. Then she took one piece and cut it again to 10 pieces. She went on cutting in the same way three more times. How many pieces of paper did she have after the last cutting?  
**A** 46   **B** 50   **C** 36   **D** 40   **E** 56
- C9.** A number of crows is sitting on a number of poles in the back of the garden, one crow on each pole. For one crow there is unfortunately no pole. Sometime later the same crows are sitting in pairs on the poles. Now there is one pole without a crow. How many poles are there in the back of the garden?  
**A** 2   **B** 3   **C** 4   **D** 5   **E** 6
- C10.** To the series of letters AGKNORU (in alphabetical order) is associated a series of different digits, placed in increasing order. What is the biggest number one can associate to the word KANGOUROU?  
**A** 987654321   **B** 987654354   **C** 436479879   **D** 536479879   **E** 597354354

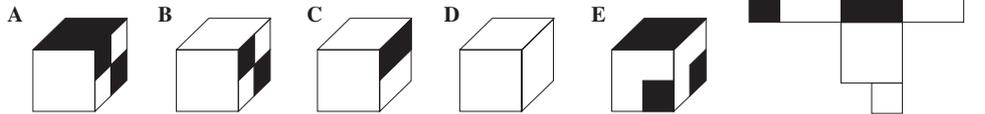
#### 4-POINT QUESTIONS

- C11.** What is  $2005 \cdot 5002$ ?  
**A** 1291   **B** 102910   **C** 10029010   **D** 1000290010   **E** 100002900010
- C12.** A group of classmates is planning a trip. If each of them would make a contribution of 14 euro for the expected travel expenses, they would be 4 euro short. But if each of them would make a contribution of 16 euro, they would have 6 euro more than they need. How much should each of the classmates contribute so that they collect exactly the amount needed for the trip?  
**A** 14,40 euro   **B** 14,60 euro   **C** 14,80 euro   **D** 15,00 euro   **E** 15,20 euro
- C13.** In the diagram, the five circles have the same radii and touch as shown. The square joins the centres of the four outer circles. The ratio of the area of the shaded part of all five circles to the area of the unshaded parts of the circles is:  
**A** 1:3   **B** 1:4   **C** 2:5   **D** 2:3   **E** 5:4



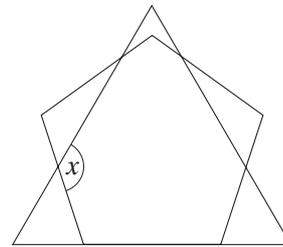
- C14.** The watchman works 4 days a week and has a rest on the fifth day. He had been resting on Sunday and began working on Monday. After how many days will his rest fall on Sunday?  
**A** 30   **B** 36   **C** 12   **D** 34   **E** 7

- C15.** Which of the following cubes has been folded out of the plan on the right?



- C16.** From noon till midnight Clever Cat is sleeping under the oak tree, and from midnight till noon he is telling stories. There is a poster on the oak tree saying: “Two hours ago Clever Cat was doing the same as he will be doing after an hour sharp.” How many hours a day the poster tells truth?  
**A 6 B 12 C 18 D 3 E 21**

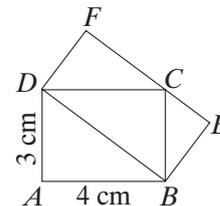
- C17.** The diagram shows an equilateral triangle and a regular pentagon. What is the size of the angle marked  $x$ ?  
**A  $124^\circ$  B  $128^\circ$  C  $132^\circ$  D  $136^\circ$  E  $140^\circ$**



- C18.** Mike has chosen a three-digit number and a two-digit number. Find the sum of these numbers if their difference equals 989.  
**A 1001 B 1010 C 2005 D 1000 E 1009**
- C19.** What is  $1 + 2 - 3 - 4 + 5 + 6 - 7 - 8 + \dots + 2001 + 2002 - 2003 - 2004 + 2005$ ?  
**A 0 B 2005 C 2004 D 1 E -4**
- C20.** For a positive integer  $n$ , by its length we mean the number of factors in the representation of  $n$  as a product of prime numbers. For example, the length of the number  $90 = 2 \cdot 3 \cdot 3 \cdot 5$  is equal to 4. How many odd numbers less than 100 have length 3?  
**A 2 B 3 C 5 D 7 E Another answer**

**5-POINT QUESTIONS**

- C21.** Two rectangles  $ABCD$  and  $DBEF$  are shown in the figure. What is the area (in  $\text{cm}^2$ ) of the rectangle  $DBEF$ ?  
**A 10 B 12 C 13 D 14 E 16**



- C22.** Peter has a three-digit code lock. He has forgotten the code but he knows that all three digits are different, and that the first digit is equal to the square of the quotient of the second and third digit. How many combinations will Peter have to try in order to crack the code?  
**A 1 B 2 C 3 D 4 E 8**
- C23.** How many two-digit numbers are more than trebled when their digits are reversed?  
**A 6 B 10 C 15 D 22 E 33**

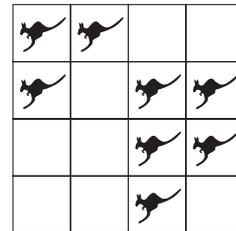


### JUNIOR (grades 9 and 10)

#### 3-POINT QUESTIONS

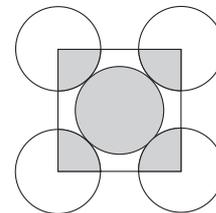
- J1.** Helga lives in her home with father, mother, brother and also one dog, two cats, two parrots and four goldfishes. How many legs do they have altogether?  
**A 22 B 24 C 28 D 32 E 40**
- J2.** Sally had the fiftieth best result, and at the same time the fiftieth poorest result, at the latest Kangaroo contest in her school. How many pupils took part in the competition?  
**A 50 B 75 C 99 D 100 E 101**

- J3.** In the diagram every of the eight kangaroos can jump to an empty square. What is the least number of kangaroos that must jump so that each row and each column have exactly two kangaroos?  
**A 2 B 4 C 5 D 3 E 1**

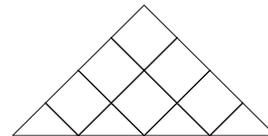


- J4.** 18 pupils are crossing a road in pairs. The pairs are labelled from 1 to 9. A pair with an even label consists of a boy and a girl, and a pair with an odd label consists of two boys. How many boys are crossing the road?  
**A 10 B 12 C 14 D 11 E 18**
- J5.** Johnny inflates 8 balloons every three minutes. How many balloons will be inflated after two hours, if every tenth balloon pops immediately after having been inflated?  
**A 160 B 216 C 240 D 288 E 320**

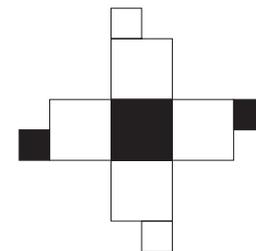
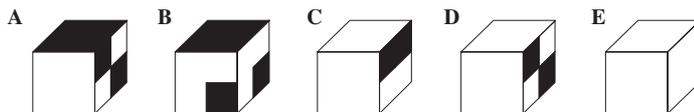
- J6.** In the diagram, the five circles have the same radius and touch as shown. The square joins the centres of the four outer circles. The ratio of the area of the shaded part of all five circles to the area of the unshaded parts of the circles is:  
**A 2:3 B 1:3 C 5:4 D 1:4 E 2:5**



- J7.** Two types of bricks were produced: one of size 10 cm × 12 cm × 14 cm and another of 12 cm × 14 cm × 16 cm. In percentage, how much is the volume of the bigger brick than that of the first brick?  
**A 20% B 30% C 40% D 50% E 60%**
- J8.** There are seven squares in the picture. How many more triangles than squares are there in the picture?  
**A 4 B 3 C 2 D 1 E 0**



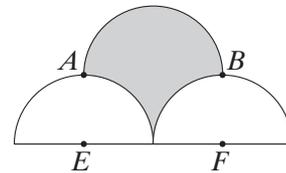
- J9.** Which of the following cubes has been folded out of the plan on the right?



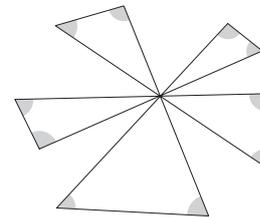
- J10.** A mother kangaroo and her baby Jumpy are jumping around the stadium with a perimeter of 330 m. Both of them make 1 jump every second. The mother's jumps are 5 m long, while Jumpy's jumps are 2 m long. They both start at the same point and move in the same direction. After 25 seconds Jumpy get tired and stops while his mother continues to jump. How long is it until she is next to Jumpy again?  
**A** 15 s **B** 24 s **C** 51 s **D** 66 s **E** 76 s

## 4-POINT QUESTIONS

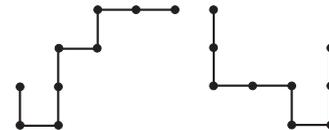
- J11.** What is  $1 + 2 - 3 - 4 + 5 + 6 - 7 - 8 + \dots + 2001 + 2002 - 2003 - 2004 + 2005$ ?  
**A** 0 **B** 1 **C** 2005 **D** 2004 **E** -4
- J12.** For a positive integer  $n$ , by its length we mean the number of factors in the representation of  $n$  as a product of prime numbers. For example, the length of the number  $90 = 2 \cdot 3 \cdot 3 \cdot 5$  is equal to 4. How many odd numbers less than 100 have length 3?  
**A** 7 **B** 5 **C** 3 **D** 2 **E** Another answer
- J13.** We are given three semi-circles as shown.  $ABEF$  is a rectangle and the radius of each of the bottom semi-circles is 2 cm.  $E$  and  $F$  are the centres of the bottom semi-circles. The area of the shaded region (in  $\text{cm}^2$ ) is:  
**A**  $2\pi$  **B** 7 **C**  $2\pi + 1$  **D** 8 **E**  $2\pi + 2$



- J14.** Two bottles of equal volume contain both juice and water. The ratios of the volume of juice to water are, respectively, 2:1 and 4:1. We put all the contents of the two bottles into one big bottle. Then the ratio of juice to water in this bottle will be:  
**A** 11:4 **B** 8:1 **C** 6:4 **D** 5:1 **E** 3:1
- J15.** What is the sum of the 10 angles marked in the picture?  
**A**  $720^\circ$  **B**  $600^\circ$  **C**  $450^\circ$  **D**  $360^\circ$  **E**  $300^\circ$



- J16.** The average of 16 different positive integers is 16. What is the largest possible value that one of these integers could have?  
**A** 16 **B** 24 **C** 32 **D** 136 **E** 256
- J17.** Each of these two pieces of wire is made of 8 segments of length 1. One of the pieces is placed one above the other so that they coincide partially. What is the largest possible length of their common part?  
**A** 2 **B** 3 **C** 4 **D** 5 **E** 6
- J18.** In a bag we have 17 balls numbered from 1 to 17. If we select some balls at random, what is the smallest number of balls needed to guarantee that the selection contains at least one pair of balls that add to 18?  
**A** 7 **B** 8 **C** 10 **D** 11 **E** 17



- J19.** A rectangle with length 24 m and width 1 m is cut into smaller rectangles, each with width 1 m. There are four pieces with length 4 m, two pieces with length 3 m and one piece with length 2 m. These smaller rectangles are put together to form another rectangle. What is the smallest possible perimeter of the new rectangle?  
**A** 14 m **B** 20 m **C** 22 m **D** 25 m **E** 28 m

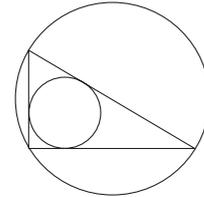


- J20.** A car drove with constant speed of 90 km/h. When the car clock showed 21:00, the daily mileage recorder showed 116.0, meaning that up to that moment 116.0 km had been driven. Later that evening the mileage recorder showed the same row of four ciphers as the clock. At what time did that occur?  
**A** 21:30 **B** 21:50 **C** 22:00 **D** 22:10 **E** 22:30

5-POINT QUESTIONS

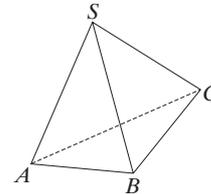
- J21.** Let  $a$  and  $b$  be two shorter sides of the right-angled triangle. Then the sum of the diameter of the incircle and that of the circumcircle of this triangle is equal to:

- A**  $a + b$  **B**  $2(a + b)$  **C**  $0,5(a + b)$  **D**  $\sqrt{ab}$   
**E**  $\sqrt{a^2 + b^2}$



- J22.** In the pyramid  $SABC$  all plane angles with vertex  $S$  are equal to  $90^\circ$ . The areas of the lateral faces  $SAB$ ,  $SAC$  and  $SBC$  are 3, 4 and 6, respectively. Find the volume of  $SABC$ .

- A** 12 **B** 8 **C** 6 **D** 5 **E** 4

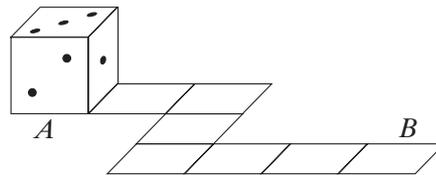


- J23.** Every other day Charles always speaks the truth, otherwise he lies. Today he stated exactly four of the following sentences. Which one could he not have stated today?

- A** I have a prime number of friends  
**B** 288 is divisible by 12  
**C** I have as many male friends as female  
**D** I always speak the truth  
**E** Three of my friends are older than me

- J24.** The sum the dots on opposite faces of a die always equals 7. A die rolls as shown below. At the starting point ( $A$ ) the top face is 3. Which will be the face at the end point ( $B$ )?

- A** 2 **B** 3 **C** 4 **D** 5 **E** 6

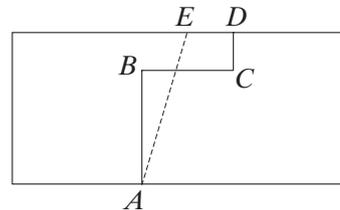


- J25.** How many positive integers  $n$  satisfy the inequality  $2000 < \sqrt{n(n+1)} < 2005$ ?

- A** 1 **B** 2 **C** 3 **D** 4 **E** 5

- J26.** Two pieces of land are separated by the borderline  $ABCD$ , as shown in the figure. The line segments  $AB$ ,  $BC$  and  $CD$  are parallel to the sides of the rectangle and have lengths 30m, 24m and 10m, respectively. We want to straighten the borderline by replacing it with a line  $AE$ , such that the areas of the two pieces of land do not change. How far from  $D$  must be  $E$ ?

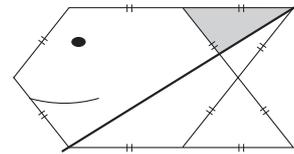
- A** 8m **B** 10m **C** 12m **D** 14m **E** 16m



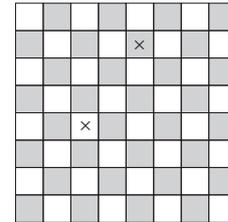
- J27.** How many 4-digit divisors does the number  $102^2$  have?

- A** 2 **B** 3 **C** 4 **D** 5 **E** 6

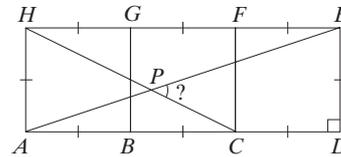
- J28.** Ten matches are used to make this fish-shaped figure. The piece of string is placed on the shape as shown. The area of the whole shape is 24. What is the area of the shaded triangle?  
**A**  $\sqrt{2}$  **B**  $\sqrt{3}$  **C** 2 **D**  $\sqrt{5}$  **E**  $\sqrt{6}$



- J29.** How many ways are there to choose a white square and a black square from an  $8 \times 8$  chess-board so that these squares lie neither in the same row nor in the same column?  
**A** 56 **B** 5040 **C** 720 **D** 672 **E** 768



- J30.** Three squares are placed together as shown. The lines  $AE$  and  $CH$  intersect at point  $P$ . What is the angle  $\angle CPE$ ?  
**A**  $30^\circ$  **B**  $45^\circ$  **C**  $60^\circ$  **D  $50^\circ$  **E**  $40^\circ$**



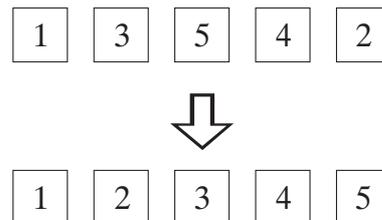
### STUDENT (grades 11 and 12)

#### 3-POINT QUESTIONS

- S1.** For which of the following values of  $x$  is the value of the expression  $\frac{x^2}{x^3}$  the smallest?  
**A** 1 **B**  $-1$  **C**  $-2$  **D**  $-3$  **E** 100

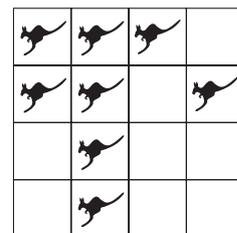
- S2.** How many numbers from 2 to 100 are equal to the cube of an integer?  
**A** 1 **B** 2 **C** 3 **D** 4 **E** 5

- S3.** Five cards are lying on the table in the order 1, 3, 5, 4, 2. You must get the cards in the order 1, 2, 3, 4, 5. Per move, any two cards may be interchanged. How many moves do you need at least?  
**A** 5 **B** 4 **C** 3 **D** 2 **E** 1

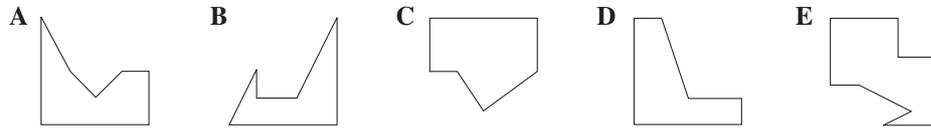


- S4.** If  $888 \cdot 111 = 2 \cdot (2 \cdot n)^2$ , and  $n$  is a positive integer,  $n$  equals:  
**A** 8 **B** 11 **C** 22 **D** 111 **E** 444

- S5.** In the diagram every of the eight kangaroos can jump to any empty square. What is the least number of kangaroos that must jump so that each row and each column have exactly two kangaroos?  
**A** 1 **B** 5 **C** 3 **D** 4 **E** 2

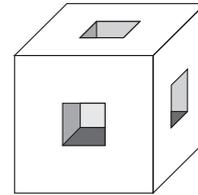


- S6.** A square piece of paper has been cut in three pieces. Two of them are in the picture on the right. What is the third one?



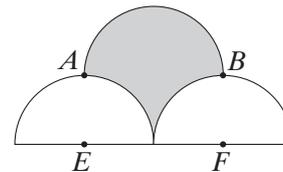
- S7.** The sum of four consecutive positive integers cannot be equal to:  
**A** 2002 **B** 22 **C** 202 **D** 222 **E** 220

- S8.** A  $3 \times 3 \times 3$  cube weighs 810 grams. If we drill three holes through it as shown, each of which is a  $1 \times 1 \times 3$  rectangular parallelepiped, the weight of the remaining solid is:  
**A** 540 g **B** 570 g **C** 600 g **D** 630 g **E** 660 g



- S9.** If  $f$  is a function such that  $f(x + 1) = 2f(x) - 2002$  holds for all integer values of  $x$  and  $f(2005) = 2008$ , then  $f(2004)$  equals:  
**A** 2004 **B** 2005 **C** 2008 **D** 2010 **E** 2016

- S10.** We are given three semi-circles as shown.  $ABEF$  is a rectangle and the radius of each of the semi-circles is 2 cm.  $E$  and  $F$  are the centers of the bottom semi-circles. The area of the shaded region (in  $\text{cm}^2$ ) is:  
**A** 8 **B** 7 **C**  $2\pi$  **D**  $2\pi + 1$  **E**  $2\pi + 2$

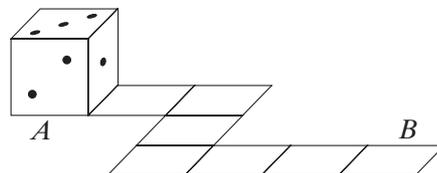


4-POINT QUESTIONS

- S11.** A mother kangaroo and her baby Jumpy are jumping around the stadium with a perimeter of 330 m. Both of them make 1 jump every second. The mother's jumps are 5 m long, while Jumpy's jumps are 2 m long. They both start at the same point and move in the same direction. After 25 seconds Jumpy get tired and stops while his mother continues to jump. How long is it until she is next to Jumpy again?  
**A** 15 s **B** 24 s **C** 40 s **D** 51 s **E** 66 s

- S12.** Henny paints each face of several wooden cubes white or black, using both colours on each cube. How many different colourings are possible?  
**A** 8 **B** 16 **C** 32 **D** 52 **E** 64

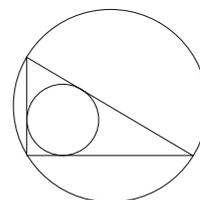
- S13.** The sum the dots on opposite faces of a die always equals 7. A die rolls as shown below. At the starting point (A) the top face is 3. Which will be the face at the end point (B)?  
**A** 6 **B** 5 **C** 4 **D** 3 **E** 2



- S14.** A box contains 60 tickets: some red, some blue and some white. If all red tickets were replaced by blue tickets, then there would be twice as many blue tickets as white tickets; but if all the white tickets were replaced with blue ones, then there would be three times as many blue tickets as red tickets. The number of blue tickets in the box is:  
**A** 10 **B** 15 **C** 20 **D** 25 **E** 30

- S15.** Let  $a$  and  $b$  be two shorter sides of the right-angled triangle. Then the sum of the diameter of the incircle and that of the circumcircle of this triangle is equal to:

**A**  $2(a + b)$    **B**  $a + b$    **C**  $0,5(a + b)$    **D**  $\sqrt{ab}$    **E**  $\sqrt{a^2 + b^2}$



- S16.** Let  $M$  be the set of all real numbers  $x$  for which the inequality  $2^{4x} < 4^{2x}$  holds. Then  $M$  is:

**A**  $(-\infty; 1)$    **B**  $(0; 1)$    **C**  $(-\infty; 1) \cup (1; \infty)$    **D**  $(0; \infty)$    **E**  $\mathbb{R}$

- S17.**  $1 + 2 - 3 - 4 + 5 + 6 - 7 - 8 + \dots + 2001 + 2002 - 2003 - 2004 + 2005 =$

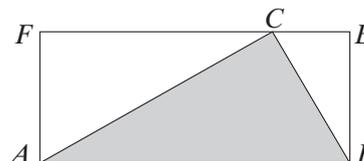
**A** 2004   **B** 2005   **C**  $-4$    **D** 0   **E** 1

- S18.** Two bottles of equal volume contain both juice and water. The ratios of the volume of juice to water are, respectively, 2:1 and 4:1. We put all the contents of the two bottles into one big bottle. Then the ratio of juice to water in this bottle will be:

**A** 3:1   **B** 6:1   **C** 11:4   **D** 5:1   **E** 8:1

- S19.** The diagram shows a rectangle  $ABEF$  and a triangle  $ABC$ . We know that the angle  $ACF$  equals angle  $CBE$ . If  $FC = 6$  and  $CE = 2$  then the area of  $ABC$  is:

**A** 12   **B** 16   **C**  $8\sqrt{2}$    **D**  $8\sqrt{3}$    **E** Another value



- S20.** Every other day Charles always says the truth, otherwise he lies. Today he stated exactly four of the following sentences. Which one couldn't he have stated today?

**A** I have a prime number of friends  
**B** I have as many male friends as female  
**C** 288 is divisible by 12  
**D** I always say the truth  
**E** Three of my friends are older than me

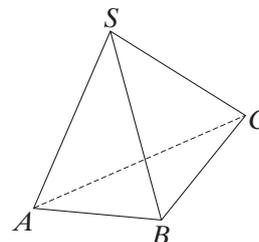
#### 5-POINT QUESTIONS

- S21.** Which of the following numbers can be expressed as the product of four different integers, each of them greater than 1?

**A** 625   **B** 124   **C** 108   **D** 2187   **E** 2025

- S22.** In the pyramid  $SABC$  all plane angles with vertex  $S$  are equal to  $90^\circ$ . The areas of the lateral faces  $SAB$ ,  $SAC$  and  $SBC$  are 3, 4 and 6, respectively. Find the volume of  $SABC$ .

**A** 4   **B** 5   **C** 6   **D** 8   **E** 12



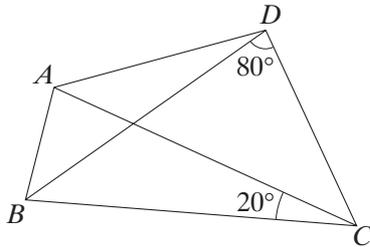
- S23.** If the sum of the digits of  $m$  is 30, then the sum of the digits of  $m + 3$  cannot be:

**A** 6   **B** 15   **C** 21   **D** 24   **E** 33

- S24.** In a bag we have 17 balls numbered by  $5 + k \cdot 125$ ,  $k = 0, \dots, 16$ , i.e. by 5, 130, 255, 380, 505,  $\dots$  1755, 1880, 2005. If we select several balls at random, what is the smallest number of balls needed to guarantee that the selection contains at least one pair of balls that add up to 2010?

**A** 7   **B** 8   **C** 10   **D** 11   **E** 17

- S25.** If  $\sqrt{2005} + \sqrt{1995} = a$ , which of the following expressions has the value  $\sqrt{2005} - \sqrt{1995}$ ?  
**A**  $10 - a$    **B**  $\frac{10}{a}$    **C**  $\frac{a}{10}$    **D**  $\frac{1}{a}$    **E**  $10 + a$
- S26.** The positive integer  $m$  has exactly two divisors. The positive integer  $n$  has exactly five divisors. How many divisors does the number  $m \cdot n$  have? (The unity is a divisor. The integer itself is a divisor.)  
**A** 5   **B** 6   **C** 7   **D** 10  
**E** It is not possible to determine without additional information.
- S27.** A positive integer has  $k$  odd divisors and  $n$  even divisors. Which of the following can be the value of the quotient  $\frac{n}{k}$ ? (The unity is a divisor. The integer itself is a divisor.)  
**A**  $\frac{1}{3}$    **B**  $\frac{3}{5}$    **C**  $\frac{2}{3}$    **D** 2   **E** 4
- S28.** Start with a number, double it and then subtract 1. After applying this procedure 98 more times (starting each time from the previous result) you get  $2^{100} + 1$ . Which was the number you started with?  
**A** 1   **B** 2   **C** 4   **D** 6   **E** None of these
- S29.** In the quadrilateral  $ABCD$  the diagonal  $BD$  is the bisector of  $\angle ABC$  and  $AC = BC$ .



- Given  $\angle BDC = 80^\circ$  and  $\angle ACB = 20^\circ$ ,  $\angle BAD$  is equal to:  
**A**  $90^\circ$    **B**  $100^\circ$    **C**  $110^\circ$    **D**  $120^\circ$    **E**  $135^\circ$
- S30.** Henry must travel from  $A$  to  $B$  and he plans to go at a certain speed. He would like to arrive earlier than planned and notes that travelling at a speed 5 km/h faster than planned he will arrive 5 hours earlier and travelling at a speed 10 km/h faster than planned he will arrive 8 hours earlier. What is his planned speed?  
**A** 10 km/h   **B** 15 km/h   **C** 20 km/h   **D** 25 km/h   **E** Impossible to determine



# KANGAROO-2005: Correct Answers



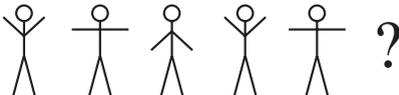
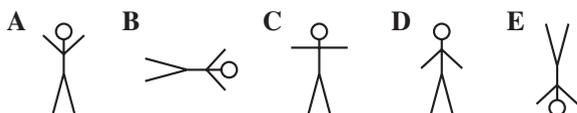
N	Ecolier	Benjamin	Cadet	Junior	Student
1	A	D	A	C	C
2	A	C	C	C	C
3	B	A	C	B	B
4	B	C	A	C	D
5	A	C	C	D	B
6	A	C	D	D	A
7	A	C	C	E	E
8	B	A	B	C	C
9	A	B	A	E	B
10	A	C	A	C	A
11	A	D	A	D	D
12	A	B	C	C	A
13	B	D	C	E	E
14	B	D	D	C	D
15	A	A	C	D	A
16	B	D	D	B	A
17	B	D	C	D	D
18	B	C	D	C	C
19	B	B	C	E	D
20	B	C	B	D	B
21			B	E	E
22			B	D	A
23			A	E	C
24			D	E	C
25			C	A	B
26				D	E
27				B	A
28				E	E
29				C	D
30				E	B

# Questions of Kangaroo 2006

## MINOR (grades 3 and 4)

### 3-POINT QUESTIONS

**M1.** Betty keeps drawing three different figures in the same order. Which figure should be the next?

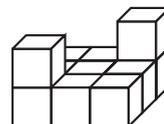
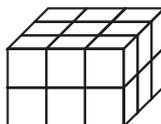



**M2.** What is the value of  $2 \cdot 0 \cdot 0 \cdot 6 + 2006$ ?

- A** 0   **B** 2006   **C** 2014   **D** 2018   **E** 4012

**M3.** How many cubes have been taken from the block?

- A** 4   **B** 5   **C** 6   **D** 7   **E** 9



**M4.** Kate’s birthday was yesterday. Tomorrow is Thursday. What day was Kate’s birthday?

- A** Tuesday   **B** Wednesday   **C** Thursday   **D** Saturday   **E** Monday

**M5.** Ivo was playing “Darts”. He had 10 arrows. For each throw at the centre he gained two additional arrows. Ivo made 20 throws. How many times did he hit the centre?

- A** 6   **B** 8   **C** 10   **D** 5   **E** 4

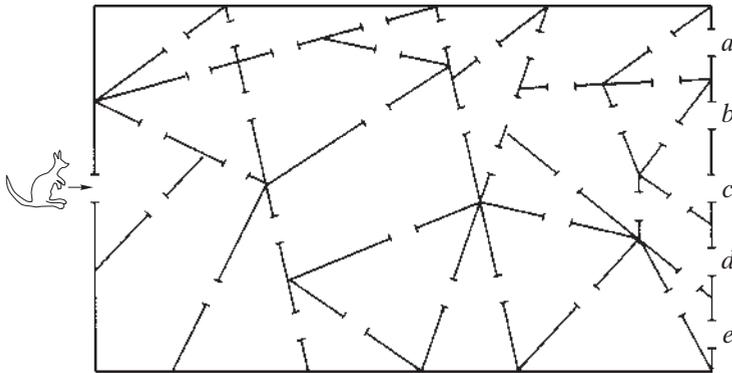
**M6.** Four people can sit at a square table. For the school party the students put together 7 square tables in order to make one long rectangular table. How many people could sit at this long table?

- A** 14   **B** 16   **C** 21   **D** 24   **E** 28

**M7.** In his purse Stan has a note of 5 euros, a coin of 1 euro and one coin of 2 euros. Which of the following amounts Stan can not pay without change?

- A** 3 euros   **B** 4 euros   **C** 6 euros   **D** 7 euros   **E** 8 euros

**M8.** A kangaroo enters a building. He only passes through triangular rooms. Where does he leave the building?



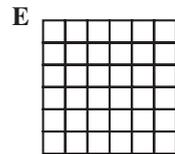
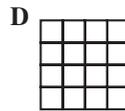
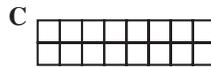
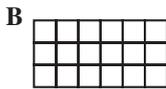
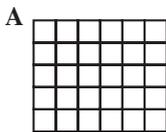
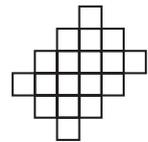
A a B b C c D d E e

4-POINT QUESTIONS

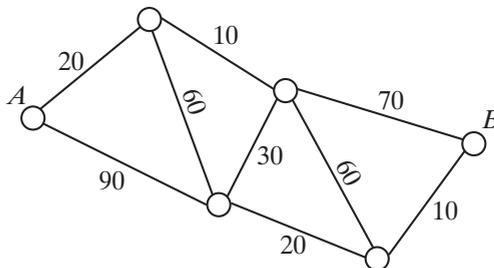
**M9.** On the left side of Main Street one will find the house numbers 1, 3, 5,..., 19. On the right side the house numbers are 2, 4, 6,..., 14. How many houses are there on Main Street?

A 8 B 16 C 17 D 18 E 33

**M10.** From which rectangular can you cut the figure shown on the right side out?

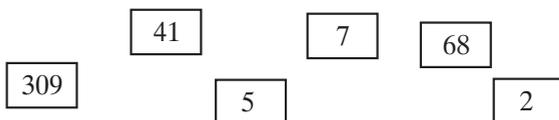


**M11.** Numbers in the picture are ticket prices between neighbouring towns. Peter wants to go from A to B as cheaply as possible. What is the lowest price he has to pay?



A 90 B 100 C 110 D 180 E 200

**M12.** Six numbers are written on the following cards, as shown.



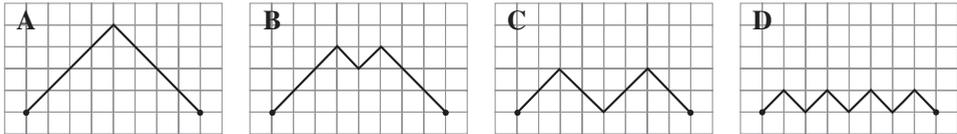
What is the smallest number you can form with the given cards?

A 1234567890 B 1023456789 C 3097568241 D 2309415687  
E 2309415678

**M13.** Six weights – 1g, 2g, 3g, 4g, 5g and 6g – were sorted into three boxes, two weights in every box. The weights in the first box weigh 9 grams together and those in the second box weigh 8 grams. What weights are in the third box?

- A 5g and 2g      B 6g and 1g      C 3g and 1g      D 4g and 2g      E 4g and 3g

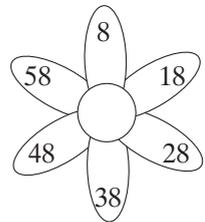
**M14.** Between two points four routes are drawn. Which route is the shortest?



- E All routes are equal

**M15.** In the picture you can see a number flower. Mary pulled out all the leaves with numbers which give remainder 2 when divided by 6. What is the sum of the numbers on the leaves that Mary pulled out?

- A 46    B 66    C 84    D 86    E 114

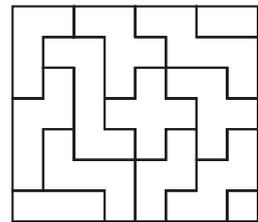
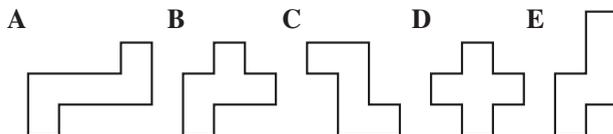


**M16.** Four crows sit on the fence. Their names are Dana, Hana, Lena and Zdena. Dana sits exactly in the middle between Hana and Lena. The distance between Hana and Dana is the same as the distance between Lena and Zdena. Dana sits 4 metres from Zdena. How far does Hana sit from Zdena?

- A 5 m    B 6 m    C 7 m    D 8 m    E 9 m

5-POINT QUESTIONS

**M17.** You can move or rotate each shape as you like, but you are not allowed to flip them over. What shape is not used in the puzzle?



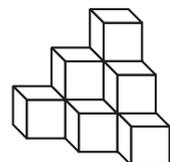
**M18.** John is building houses of cards. On the picture there are houses of one, two, and three layers that John built. How many cards does he need to build a 4-layer house?

- A 23    B 24    C 25    D 26    E 27



**M19.** The structure shown in the picture is glued together from 10 cubes. Roman painted the entire structure, including the bottom. How many faces of the cubes are painted?

- A 18    B 24    C 30    D 36    E 42



**M20.** Irena, Ann, Kate, Olga and Elena live in the same house: two of the girls live on the first floor, three of them on the second floor. Olga lives on a different floor from Kate and Elena. Ann lives on a different floor from Irena and Kate. Who is living on the first floor?

- A** Kate and Elena    **B** Irena and Elena    **C** Irena and Olga  
**D** Irena and Kate    **E** Ann and Olga

**M21.** In the expression  $2006 * 2005 * 2004 * 2003 * 2002$  instead of each asterisk  $+$  or  $-$  can be written. Which result is impossible?

- A** 2004    **B** 2005    **C** 2006    **D** 2008    **E** 2010

**M22.** During some month, 5 Mondays occurred. Then this month could not have

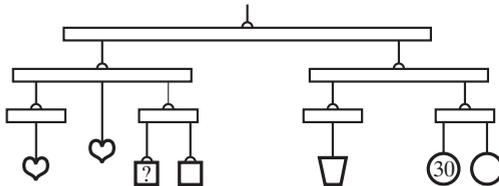
- A** 5 Saturdays    **B** 5 Sundays    **C** 5 Tuesdays    **D** 5 Wednesdays  
**E** 5 Thursdays

**M23.** In each of the nine cells of the square we will write down one of the digits 1, 2 or 3. We will do this in such a way that in each horizontal row and vertical column each of the digits 1, 2 and 3 will be written. In the upper left cell we will start with 1. How many different squares can we then make?

- A** 2    **B** 3    **C** 4    **D** 5    **E** 8

1		

**M24.** A child's toy hangs from the ceiling and it is in balance at all places. The same shapes have the same weight. The weight of a circle is 30 grams. What is the weight of a square?



- A** 10    **B** 20    **C** 30    **D** 40    **E** 50

## BENJAMIN (grades 5 and 6)

### 3-POINT QUESTIONS

**B1.**  $3 \cdot 2006 = 2005 + 2007 + x$ . Find  $x$ .

- A** 2005    **B** 2006    **C** 2007    **D** 2008    **E** 2009

**B2.** Six numbers are written on the following cards, as shown:



What is the largest number you can form with the given cards?

- A** 9876543210    **B** 4130975682    **C** 3097568241    **D** 7903684152    **E** 7685413092

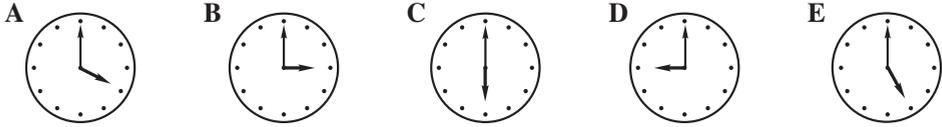
**B3.** Four people can sit at a square table. For the school party the students put together 10 square tables in order to make one long table. How many people could sit at this long table?

- A** 40    **B** 32    **C** 30    **D** 22    **E** 20

**B4.** A ball and a dumb-bell cost 90Lt, and 3 balls and 2 dumb-bells cost 240Lt. How much does one ball cost?

- A** 130Lt    **B** 60Lt    **C** 50Lt    **D** 40Lt    **E** 30Lt

**B5.** Choose the picture where the angle between the hands of a watch is  $150^\circ$ .

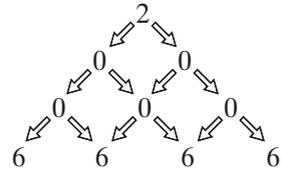


**B6.** On the left side of Main Street one will find all odd house numbers from 1 to 39. On the right side the house numbers are all the even numbers from 2 to 34. How many houses are there on Main Street?

- A 37 B 38 C 28 D 36 E 73

**B7.** With how many ways one can get a number 2006 while following the arrows on the figure?

- A 12 B 11 C 10 D 8 E 6

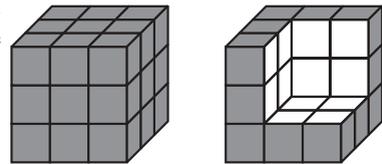


**B8.** One half of one hundredth is

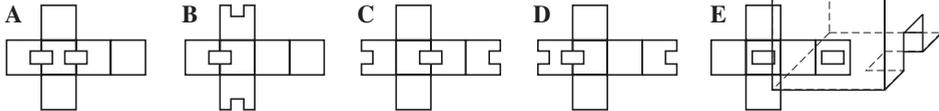
- A 0.005 B 0.002 C 0.05 D 0.02 E 0.5

**B9.** We need 9 kg of ink (in kilograms) to paint the whole cube. How much ink do you need to paint the white surface?

- A 2 B 3 C 4.5 D 6 E 7



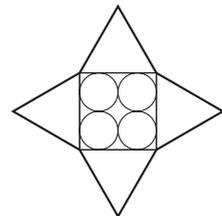
**B10.** Which of the following nets has a cube in the right picture?



**4-POINT QUESTIONS**

**B11.** What is the perimeter of the star (in centimetres) if you know that the star on the picture is formed by four equal circles with radius 5 cm, one square and four equilateral triangles?

- A 40 B 80 C 120 D 160 E 240

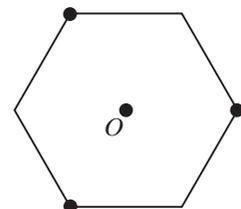


**B12.** What is the difference between the sum of the first 1000 strictly positive even numbers and the sum of the first 1000 positive odd numbers?

- A 1 B 1002 C 500 D 1000 E 2000

**B13.** A paper in the shape of a regular hexagon, as the one shown, is folded in such a way that the three marked corners touch each other at the centre of the hexagon. What is the obtained figure?

- A Six corner star B Dodecagon C Hexagon D Square E Triangle



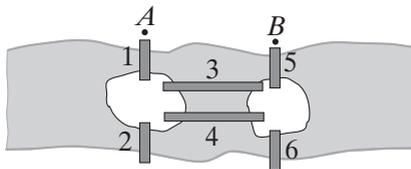


5-POINT QUESTIONS

**B21.** A rod of length 15 dm was divided into the greatest possible number of pieces of different integer lengths in dm. The number of cuts is:

- A 3 B 4 C 5 D 6 E 15

**B22.** A river goes through a city and there are two islands. There are also six bridges how it is shown in the attached image. How many paths there are going out of a shore of the river (point A) and come back (to point B) after having spent one and only one time for each bridge?



- A 0 B 2 C 4 D 6 E More than 6

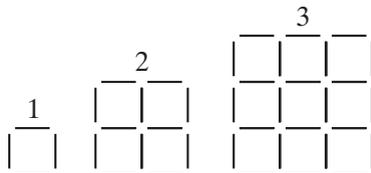
**B23.** Which set of three numbers represents three dots with the same space in between, if you plot them on a number line?

- A  $\frac{1}{3}; \frac{1}{4}; \frac{1}{5}$  B 12; 21; 32 C 0.3; 0.7; 1.3 D  $\frac{1}{10}; \frac{9}{80}; \frac{1}{8}$  E 24; 48; 64

**B24.** Ann calculated the sum of the greatest and the least two-digit multiples of three. Bob calculated the sum of the greatest and the least two-digit numbers that are not multiples of three. The number of Ann is greater than the number of Bob by how much?

- A 2 B 3 C 4 D 5 E 6

**B25.** Belinda is building squares with matches adding small squares that it already has built according to the schema of the figure. How many matches does she have to add to the 30th square to build the 31st?

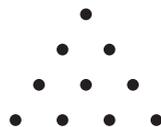


- A 148 B 61 C 254 D 120 E 124

**B26.** The natural numbers from 1 to 2006 are written down on the blackboard. Peter underlined all numbers divisible by 2, then all numbers divisible by 3, and then all numbers divisible by 4. How many numbers are underlined precisely twice?

- A 1003 B 668 C 501 D 334 E 167

**B27.** What is the smallest number of dots that need to be removed from the pattern shown, so that no three of the remaining dots are at the vertices of an equilateral triangle?

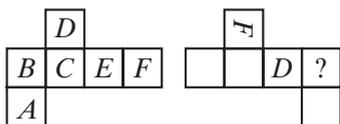


- A 2 B 3 C 4 D 5 E 6

**B28.** Three friends, Alex, Ben and Charlie, were together 15 times in the swimming pool. Alex bought the tickets for all of them 8 times, and Ben — 7 times. Charlie pays his share by using 30 coins, all of the same value. The right way to distribute the coins is

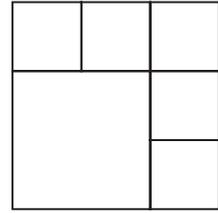
- A 22 to Alex and 8 to Ben B 20 to Alex and 10 to Ben  
C 15 to Alex and 15 to Ben D 16 to Alex and 14 to Ben  
E 18 to Alex and 12 to Ben

**B29.** On the faces of a cube are written letters. First figure represents one possibility of its net. What letter should be written instead of the question mark in the other version of its net?



- A A B B C C D E E Impossible to determine

- B30.** In how many ways can all the numbers 1, 2, 3, 4, 5, 6 be written on the squares of the picture (one on each square) so that there are no adjacent squares in which the difference of the numbers written is 3? (Squares that share only a corner are not considered adjacent.)



- A  $3 \cdot 2^5$    B  $3^6$    C  $6^3$    D  $2 \cdot 3^5$    E  $3 \cdot 5^2$

### CADET (grades 7 and 8)

#### 3-POINT QUESTIONS

- C1.** The contest Kangaroo in Europe has taken place every year since 1991. So, the contest Kangaroo in 2006 is the

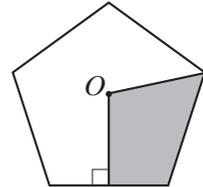
- A 15<sup>th</sup>   B 16<sup>th</sup>   C 17<sup>th</sup>   D 13<sup>th</sup>   E 14<sup>th</sup>

- C2.**  $20 \cdot (0 + 6) - (20 \cdot 0) + 6 =$

- A 0   B 106   C 114   D 126   E 12

- C3.** The point  $O$  is the centre of a regular pentagon. How much of the pentagon is shaded?

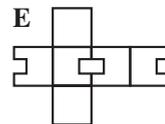
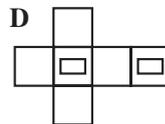
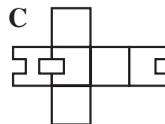
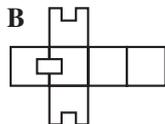
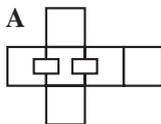
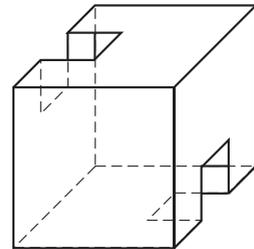
- A 10%   B 20%   C 25%   D 30%   E 40%



- C4.** Granny told her grandchildren: “If I bake 2 pies for each of you, I’ll have enough pastry left for 3 more pies. But I won’t be able to bake 3 pies for each of you, as I’ll have no pastry left for the last 2 pies.” How many grandchildren does Granny have?

- A 2   B 3   C 4   D 5   E 6

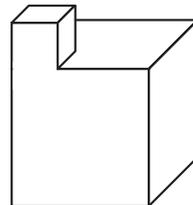
- C5.** Which of the following nets has a cube in the right picture?



- C6.** An interview of 2006 schoolchildren revealed that 1500 of them participated in the *Kangaroo* contest, 1200 – in the *Beaver* contest. How many from the interviewed children participated in both competitions, if 6 of them did not participate in either of the competitions?

- A 300   B 500   C 600   D 700   E 1000

- C7.** The solid in the picture is created from two cubes. The small cube with edges 1 cm long is placed on the top of a bigger cube with edges 3 cm long. What is the surface area of this solid?



**A**  $56 \text{ cm}^2$    **B**  $58 \text{ cm}^2$    **C**  $59 \text{ cm}^2$    **D**  $60 \text{ cm}^2$    **E**  $64 \text{ cm}^2$

- C8.** A bottle that can hold  $\frac{1}{3}$  litre is  $\frac{3}{4}$  full. How much will it contain after  $\frac{1}{5}$  ℓ has been poured out of it?

**A**  $\frac{1}{20}$  ℓ   **B**  $\frac{3}{40}$  ℓ   **C**  $0.13$  ℓ   **D**  $\frac{1}{8}$  ℓ   **E** It will be empty

- C9.** Two sides of a triangle are each 7 cm long. The length of the third side is an integer number of centimeters. At most how many centimeters does the perimeter of the triangle measure?

**A** 14 cm   **B** 15 cm   **C** 21 cm   **D** 27 cm   **E** 28 cm

- C10.** A rod of length 21 dm was divided into the greatest possible number of pieces of different integer lengths in dm. The number of cuts is:

**A** 3   **B** 4   **C** 5   **D** 6   **E** 20

#### 4-POINT QUESTIONS

- C11.** If it's blue, it's round.

If it's square, it's red.

It's either blue or yellow.

If it's yellow, it's square.

It's either square or round.

That means:

**A** It's red   **B** It's red and round   **C** It's a blue and square

**D** It's blue and round   **E** It's yellow and round

- C12.** Three Tuesdays of a month fall on even dates. What day of a week was the 21<sup>st</sup> day of this month?

**A** Wednesday   **B** Thursday   **C** Friday   **D** Saturday   **E** Sunday

- C13.** Alex, Hans and Stan saved money to buy a tent for a camping trip. Stan saved 60 % of the price. Alex saved 40 % of what was left of the price. This way Hans' share of the price was 30 euros. What was the price of the tent in euros?

**A** 50   **B** 60   **C** 125   **D** 150   **E** 200

- C14.** Several aliens are travelling through the space in their rocket STAR 1. They are of three colours: green, orange or blue. Green aliens have two tentacles, orange aliens have three tentacles and blue aliens have five tentacles. In the spaceship there are as many green aliens as orange ones and 10 more blue ones than green ones. Altogether they have 250 tentacles. How many blue aliens are travelling in the rocket?

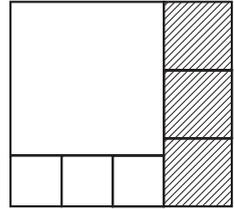
**A** 15   **B** 20   **C** 25   **D** 30   **E** 40

- C15.** If kangaroo Jumpy pushes himself with his left leg, he will jump on 2 m, if he pushes with the right leg, he will jump on 4 m, and if he pushes with both legs, he will jump on 7 m. What the least number of jumps should Jumpy make to cover a distance of exactly 1000 m?

**A** 140   **B** 144   **C** 175   **D** 176   **E** 150

- C16.** A rectangle on the right is divided into 7 squares. The sides of the grey squares are all 8. What is the side of the great white square?

A 16   B 18   C 20   D 24   E 30



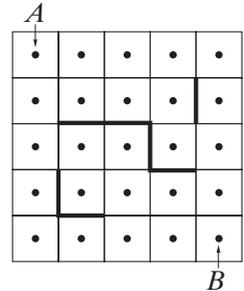
- C17.** Which number when squared is increased by 500%?  
**C18.** How many isosceles triangles with area 1 have a side of length 2?

A 5   B 6   C 7   D 8   E 10

A 0   B 1   C 2   D 3   E 4

- C19.** Max and Moritz have drawn a square  $5 \times 5$  and marked the centres of the small squares. Afterwards, they draw obstacles and then find out in how many ways it is possible to go from  $A$  to  $B$  using the shortest way avoiding the obstacles and going from centre to centre only vertically and horizontally. How many shortest paths are there from  $A$  to  $B$  under these conditions?

A 6   B 8   C 9   D 11   E 12



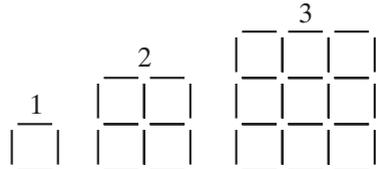
- C20.** The last digit of a three-digit number is 2. If we move the last digit to the front, the number is reduced by 36. What is the sum of digits of the original number?

A 4   B 10   C 7   D 9   E 5

5-POINT QUESTIONS

- C21.** Belinda is making patterns with toothpicks according to the schema of the figure. How many toothpicks does Belinda add to the 30th pattern to make the 31st?

A 124   B 148   C 61   D 254   E 120



- C22.** A train is composed of five wagons, I, II, III, IV and V, pulled by a locomotive. In how many ways can the train be composed so that the wagon I is nearer the locomotive than the wagon II?

A 120   B 60   C 48   D 30   E 10

- C23.** What is the first digit of the smallest positive integer that has the sum of its digits equal to 2006?

A 1   B 3   C 5   D 6   E 8

- C24.** Mother asks her son little John to make pairs from his socks after washing, but he didn't do that. He put his socks – 5 pairs of black, 10 pairs of brown and 15 pairs of grey socks – mixed in a box. John want to go to a 7-day trip. What is the smallest number of socks has he to take out to guarantee that he will have at least 7 pairs of socks, all of the same colour?

A 21   B 41   C 40   D 37   E 31

- C25.** The three positive numbers  $x, y, z$  satisfy the conditions  $x \geq y \geq z, x + y + z = 20.1$ . Which of the answers is true?

A Always  $x \cdot y < 99$    B Always  $x \cdot y > 1$    C Always  $x \cdot y \neq 75$    D Always  $x \cdot y \neq 25$   
 E None of the above

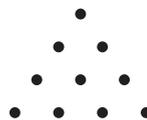
- C26.** Peter rides a bicycle from point  $P$  to point  $Q$  with a constant speed. If he increases his speed by 3 m/s, he will arrive to  $Q$  3 times faster. How many times faster will Peter arrive to  $Q$ , if he increases his speed by 6 m/s?  
**A** 4   **B** 5   **C** 6   **D** 4.5   **E** 8

- C27.** If the product of two integers equals

$$2^5 \cdot 3 \cdot 5^2 \cdot 7^3,$$

then their sum

- A** can be divisible by 8   **B** can be divisible by 3   **C** can be divisible by 5  
**D** can be divisible by 49   **E** cannot be divisible by 8, 3, 5, 49
- C28.** What is the smallest number of dots that need be removed from the pattern shown, so that no three of the remaining dots are at the vertices of an equilateral triangle?  
**A** 2   **B** 3   **C** 4   **D** 5   **E** 6



- C29.** The first row shows 11 cards, each with two letters. The second row shows rearrangement of the cards.

M	I	S	S	I	S	S	I	P	P	I
K	I	L	I	M	A	N	J	A	R	O
P	S	I	S	I	M	I	S	S	P	I

Which of the following could appear on the bottom line of the second row?

- A** ANJAMKILIOR   **B** RLIIMKOJNAA   **C** JANAMKILIRO  
**D** RAONJMILIKA   **E** ANMAIKOLIRJ
- C30.** Find the value  $x - y$ , if  $x = 1^2 + 2^2 + 3^2 + \dots + 2005^2$  and  $y = 1 \cdot 3 + 2 \cdot 4 + 3 \cdot 5 + \dots + 2004 \cdot 2006$ .  
**A** 2000   **B** 2004   **C** 2005   **D** 2006   **E** 0

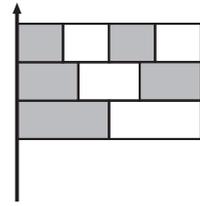
## JUNIOR (grades 9 and 10)

### 3-POINT QUESTIONS

- J1.** What is halfway between 2006 and 6002?  
**A** 3998   **B** 4000   **C** 4002   **D** 4004   **E** 4006
- J2.** How many four-digit numbers whose four digits are distinct are divisible by 2006?  
**A** 1   **B** 2   **C** 3   **D** 4   **E** 5
- J3.** What is the least 10-digit number that can be obtained by putting together the following six numbers one after another: 309, 41, 5, 7, 68, and 2?  
**A** 1 234 567 890   **B** 2 309 241 568   **C** 3 097 568 241   **D** 2 309 415 687   **E** 2 309 416 857
- J4.** How many times between 00:00 and 23:59 does an electronic watch show all the four digits 2, 0, 0 and 6 in any order?  
**A** 2   **B** 4   **C** 5   **D** 6   **E** 12

- J5.** A flag consists of three stripes of equal width, which are divided into two, three and four equal parts, respectively. What fraction of the area of the flag is coloured grey?

A  $\frac{1}{2}$    B  $\frac{2}{3}$    C  $\frac{3}{5}$    D  $\frac{4}{7}$    E  $\frac{5}{9}$



- J6.** My Grandma's watch gains one minute every hour. My Grandpa's watch loses one minute every hour. When I left their house I synchronised their watches and told them I would return when the difference between the times on their watches is exactly one hour. How long will it be before I return?

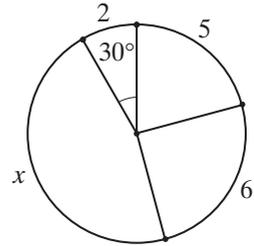
A 12h   B 14h 30min   C 30h   D 60h   E 90h

- J7.** Peter says that 25% of his books are novels, and  $\frac{1}{9}$  of them are poetry. Given that he has between 50 and 100 books, how many books does he have?

A 50   B 56   C 64   D 72   E 93

- J8.** A circle is divided into four arcs of length 2, 5, 6,  $x$ . Find the value of  $x$ , if the arc of length 2 subtends an angle of  $30^\circ$  at the centre.

A 7   B 8   C 9   D 10   E 11



- J9.** One packet of Chocofruit candies costs 10 crowns. There is a coupon inside every packet. For three coupons you get another packet of Chocofruit candies. How many packets of Chocofruit candies can you get for 150 crowns?
- J10.** The numbers  $a, b, c, d$  and  $e$  are positive, such that  $ab = 2, bc = 3, cd = 4, de = 5$ . What is the value of  $\frac{e}{a}$ ?

A  $\frac{15}{8}$    B  $\frac{5}{6}$    C  $\frac{3}{2}$    D  $\frac{4}{5}$    E Impossible to determine

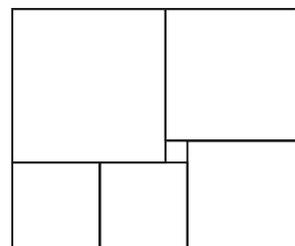
#### 4-POINT QUESTIONS

- J11.** A tactless person asked Lady Agnes how old she is. Lady Agnes replied: "If I live to be one hundred, then my age is two thirds of my remaining time." How old is Lady Agnes?

A 20   B 40   C 50   D 60   E 80

- J12.** The rectangle in the picture is divided into six squares. The length of the sides of the smallest square is 1. What is the length of the sides of the largest square?

A 4   B 5   C 6   D 7   E 8



- J13.** Each letter represents a different digit, and each digit a different letter. What digit could G represent?

A 1 B 2 C 3 D 4 E 5

$$\begin{array}{r} \text{K A N} \\ + \text{K A G} \\ \hline \text{K N G} \\ \hline \text{2 0 0 6} \end{array}$$

- J14.** While Nick is solving one of the *Kangaroo* problems he makes the following correct conclusions:

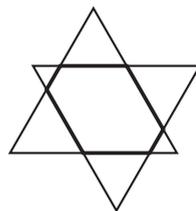
- 1) If answer A is true, then answer B is also true.
- 2) If answer C is not true, then answer B is also not true.
- 3) If answer B is not true, then neither D nor E is true.

Which of the answers to the problem is true? (Recall that for any *Kangaroo* problem exactly one answer is true.)

A A B B C C D D E E

- J15.** Two identical equilateral triangles with perimeters 18 are overlapped with their respective sides parallel. What is the perimeter of the resulting hexagon?

A 11 B 12 C 13 D 14 E 15



- J16.** What is the maximum number of digits that a number could have if every pair of consecutive digits is a perfect square?

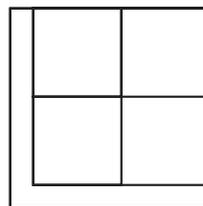
A 5 B 4 C 3 D 6 E 10

- J17.** A box contains 36 balls: 15 balls are coloured red-blue (half red, half blue), 12 balls are coloured blue-green and 9 balls are coloured green-red. What is the smallest number of balls that must be selected to guarantee that you have at least seven balls that share a colour?

A 7 B 8 C 9 D 10 E 11

- J18.** A square of area  $125 \text{ cm}^2$  was divided into five parts of equal area – four squares and one L-shaped figure as shown in the picture. Find the length of the shortest side of the L-shaped figure.

A 1 B  $1.2$  C  $2(\sqrt{5} - 2)$  D  $3(\sqrt{5} - 1)$  E  $5(\sqrt{5} - 2)$



- J19.** The three positive numbers  $x$ ,  $y$ ,  $z$  satisfy the conditions  $x \geq y \geq z$ ,  $x + y + z = 20$ . Which of the answers is true?

A Always  $x \cdot y < 99$  B Always  $x \cdot y > 1$  C Always  $x \cdot y \neq 25$  D Always  $x \cdot y \neq 75$   
E None of the above

- J20.** What is the smallest number of dots that need be removed from the pattern shown, so that no three of the remaining dots are at the vertices of an equilateral triangle?

A 2 B 3 C 4 D 5 E 6



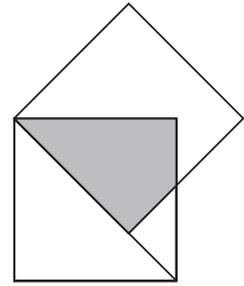
### 5-POINT QUESTIONS

- J21.** A train consists of five wagons: I, II, III, IV and V. How many ways can the wagons be arranged so that wagon I is nearer to the locomotive than wagon II is?

A 120 B 60 C 48 D 30 E 10

- J22.** Two squares have side 1. What is the area of the black quadrangle?

A  $\sqrt{2} - 1$    B  $\frac{\sqrt{2}}{2}$    C  $\frac{\sqrt{2}+1}{2}$    D  $\sqrt{2} + 1$    E  $\sqrt{3} - \sqrt{2}$

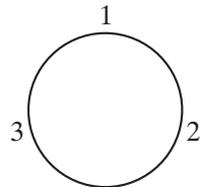


- J23.** The Dobson family consists of the father, the mother, and some children. The mean age of the Dobson family is 18 years. Without the 38-year-old father the mean age of the family decreases to only 14 years. How many children are there in the Dobson family?

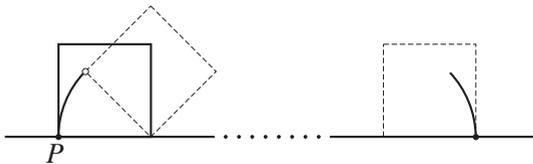
A 2   B 3   C 4   D 5   E 6

- J24.** The numbers 1, 2, 3 are written on the circumference of a circle. Then the sum of each pair of neighbouring numbers is written between them, so 6 numbers are obtained (1, 3, 2, 5, 3 and 4). This operation is repeated 4 more times, resulting in 96 numbers on the circle. What is the sum of these numbers?

A 162   B 1458   C 486   D 144   E 210



- J25.** A square with sides of length 10 is rolled without slipping along a line.



The rolling stops when  $P$  first returns to the line. What is the length of the curve that  $P$  has travelled?

A  $10\pi$    B  $5\pi + 5\pi\sqrt{2}$    C  $10\pi + 5\pi\sqrt{2}$    D  $5\pi + 10\pi\sqrt{2}$    E  $10\pi + 10\pi\sqrt{2}$

- J26.** Each face of a cube is coloured with a different colour from a selection of six colours. How many different cubes can be made in this way?

A 24   B 30   C 36   D 42   E 48

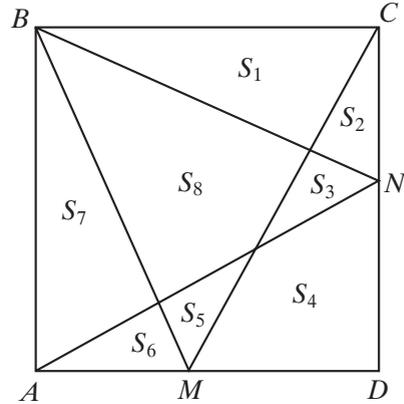
- J27.** Both the number 257 and number 338 each have 3 digits, which create a larger number when put in reverse order. How many 3-digit numbers have this property?

A 124   B 252   C 280   D 288   E 360

- J28.**  $y$  is defined to be the sum of the digits of  $x$ , and  $z$  is the sum of the digits of  $y$ . How many natural numbers  $x$  satisfy  $x + y + z = 60$ ?

A 0   B 1   C 2   D 3   E More than 3

- J29.** Points  $M$  and  $N$  are arbitrarily chosen on the sides  $AD$  and  $DC$ , respectively, of a square  $ABCD$ . Then the square is divided into eight parts of areas  $S_1, S_2, \dots, S_8$  as shown in the diagram. Which of the following expressions is always equal to  $S_8$ ?
- A**  $S_2 + S_4 + S_6$
  - B**  $S_1 + S_3 + S_5 + S_7$
  - C**  $S_1 + S_4 + S_7$
  - D**  $S_2 + S_5 + S_7$
  - E**  $S_3 + S_4 + S_5$

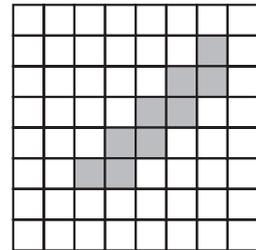


- J30.** Suppose the final result of a football match is 5:4 to the home team. If the home team scored first and kept the lead until the end, in how many different orders could the goals have been scored?
- A** 17   **B** 13   **C** 20   **D** 14   **E** 9

## STUDENT (grades 11 and 12)

### 3-POINT QUESTIONS

- S1.** Which of the following numbers is greatest?  
**A**  $2006 \cdot 2006$    **B**  $2005 \cdot 2007$    **C**  $2004 \cdot 2008$    **D**  $2003 \cdot 2009$    **E**  $2002 \cdot 2010$
- S2.** How many zeroes does the product of the first 2006 prime numbers end with?  
**A** 0   **B** 1   **C** 2   **D** 9   **E** 26
- S3.** We consider the perimeter and the area of the region corresponding to the grey squares. How many more squares can we colour grey for the grey area to increase without increasing its perimeter?  
**A** 0   **B** 7   **C** 18   **D** 12   **E** 16



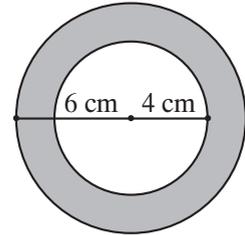
- S4.** There are four cards on the table as in the picture. Every card has a letter on one side and a number on the other side. Peter said: "For every card on the table it is true that if there is a vowel on one side, there is an even number on the other side." What is the smallest number of cards Alice must turn in order to check whether Peter said the truth?
- E

K

6
- 4

7
- A** 1   **B** 2   **C** 3   **D** 4   **E** 5
- S5.** Two trains with the same length are travelling in opposite directions. The first is travelling at 100 km/h and the second at 120 km/h. A passenger on the second train observes that it takes the first train exactly 6 sec to pass completely in front of him. How long does it take for a passenger on the first train to see the second train pass completely?  
**A** 5 s   **B** 6 s   **C** Between 6 s and 7 s   **D** 7 s   **E** Impossible to determine

- S6. Susan has two pendants made of the same material. They are equally thick and weigh the same. One of them has the shape of an annulus created from two concentric circles with the radii 6 cm and 4 cm (see the diagram). The second has the shape of a solid circle. What is the radius of the second pendant?



A 4 cm B  $2\sqrt{6}$  cm C 5 cm D  $2\sqrt{5}$  cm E  $\sqrt{10}$  cm

- S7. The difference between any two consecutive numbers on the list  $a, b, c, d, e$  is the same. If  $b = 5.5$  and  $e = 10$ , what is the value of  $a$ ?

A 0.5 B 3 C 4 D 4.5 E 5

- S8. If  $4^x = 9$  and  $9^y = 256$ , then  $xy$  equals

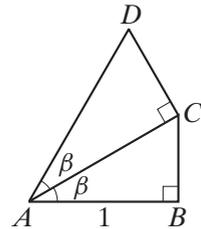
A 2006 B 48 C 36 D 10 E 4

- S9. Consider all 9-digit integers made by using all the digits 1, 2, ..., 9. Write each such number on a separate sheet and put all the resulting sheets in a box. What is the minimum number of sheets that you must extract from the box if you want to be certain that there are at least two numbers with the same digit in the first place among the chosen numbers?

A 9! B 8! C 72 D 10 E 9

- S10. In the diagram,  $AB$  has length 1;  $\angle ABC = \angle ACD = 90^\circ$ ;  $\angle CAB = \angle DAC = \theta$ . What is the length of  $AD$ ?

A  $\cos \beta + \text{tg } \beta$  B  $\frac{1}{\cos(2\beta)}$  C  $\cos^2 \beta$   
 D  $\cos(2\beta)$  E  $\frac{1}{\cos^2 \beta}$



#### 4-POINT QUESTIONS

- S11. Which of the following gives the formula of a function whose graph has the  $y$ -axis as an axis of symmetry?

A  $y = x^2 + x$  B  $y = x^2 \sin x$  C  $y = x \cos x$  D  $y = x \sin x$  E  $y = x^3$

- S12. On a fair roulette wheel there are 37 numbers: 0 and the positive integers from 1 to 36. What is the probability that the ball lands on a prime number?

A  $\frac{5}{18}$  B  $\frac{11}{37}$  C  $\frac{11}{36}$  D  $\frac{12}{37}$  E  $\frac{1}{3}$

- S13. The remainder of the division of the number 1001 by some one-digit number is equal to 5. What is the remainder of the division of the number 2006 by the same one-digit number?

A 2 B 3 C 4 D 5 E 6

- S14. The radius of the traffic sign is 20 cm. Each of the dark pieces is a quarter of a circle. The area of all 4 quarters equals that of the light part of the sign. What is the radius of this circle in centimetres?

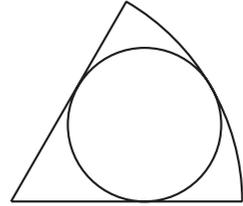
A  $10\sqrt{2}$  B  $4\sqrt{5}$  C  $\frac{20}{3}$  D 12.5 E 10



- S15. You are given three prime numbers  $a, b, c$  with  $a > b > c$ . If  $a + b + c = 78$  and  $a - b - c = 40$  then  $abc =$

A 438 B 590 C 1062 D 1239 E 2006

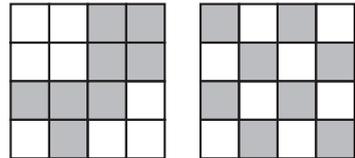
- S16.** The ratio of the radii of the sector and the incircle in the picture is 3 : 1. Then the ratio of their areas is:  
**A** 3 : 2   **B** 4 : 3   **C**  $\sqrt{3}$  : 1   **D** 2 : 1   **E** 9 : 1



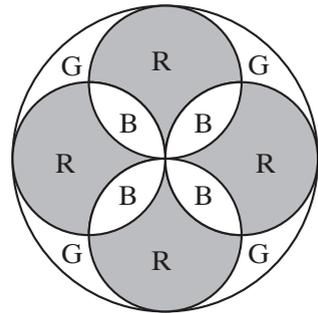
- S17.** Sixteen teams play in a volleyball league. Each team plays one game against each other team. For each game the winning team gets 1 point, and the losing team 0 points. There are no draws. After all games have been played the team scores form an arithmetic sequence. How many points has the team in last place received?  
**A** 3   **B** 2   **C** 1   **D** The situation described is not possible  
**E** The answer is some other number

- S18.** Last year there were 30 more boys than girls in the school choir. This year the number of choir-members has increased by 10%: the number of girls has increased by 20% and the number of boys by 5%. How many members has the choir this year?  
**A** 88   **B** 99   **C** 110   **D** 121   **E** 132

- S19.** The cells of a 4×4 table are coloured black and white as shown in the left figure. One move allows us to exchange any two cells positioned in the same row or in the same column. What is the least number of moves necessary to obtain in the right figure?  
**A** This is not possible   **B** 2   **C** 3   **D** 4   **E** 5



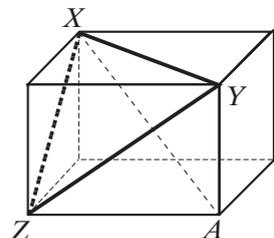
- S20.** In a church there is a rose window as in the figure, where the letters R, G and B represent glass of red colour, green colour and blue colour, respectively. Knowing that 400 cm<sup>2</sup> of green glass have been used, how many cm<sup>2</sup> of blue glass are necessary?  
**A** 120π   **B** 90√2π   **C** 382   **D** 396   **E** 400



5-POINT QUESTIONS

- S21.** Given that numbers  $a$  and  $b$  are both greater than 1, which of the following fractions has the greatest value?  
**A**  $\frac{a}{b-1}$    **B**  $\frac{a}{b+1}$    **C**  $\frac{2a}{2b+1}$    **D**  $\frac{2a}{2b-1}$    **E**  $\frac{3a}{3b+1}$

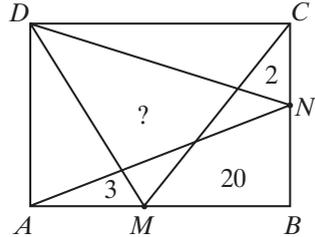
- S22.** The lengths of the sides of triangle  $XYZ$  are  $XZ = \sqrt{55}$ ,  $XY = 8$ ,  $YZ = 9$ . Find the length of the diagonal  $XA$  of the rectangular parallelepiped in the figure.  
**A**  $\sqrt{90}$    **B** 10   **C**  $\sqrt{120}$    **D** 11   **E**  $10\sqrt{2}$



- S23.** For how many values of the real number  $b$  does the equation  $x^2 - bx + 80 = 0$  have two different positive even integer solutions?  
**A** 0 **B** 1 **C** 2 **D** 3 **E** Infinitely many

- S24.** How many nonempty subsets of  $\{1, 2, 3, \dots, 12\}$  exist in which the sum of the largest element and the smallest element is 13?  
**A** 1024 **B** 1175 **C** 1365 **D** 1785 **E** 4095

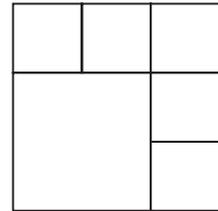
- S25.** Points  $M$  and  $N$  are given on the sides  $AB$  and  $BC$  of a rectangle  $ABCD$ . Then the rectangle is divided into several parts as shown in the picture. The areas of 3 parts are also given in the picture. Find the area of the quadrilateral marked with “?”.  
**A** 20 **B** 21 **C** 25 **D** 26  
**E** Not enough information is given



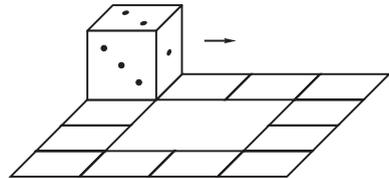
- S26.** John takes 10 cards, on 5 of them he writes letter A and on the other five – letter B. Then he turns them upside-down and aligns them on the table in random order. In view of the fact that there is an equal amount of letter A and B, an experienced participant of *Kangaroo* Ann claims that she can write either letter A or B on the face side of each card so that on both sides of at least 4 cards the same letter will be written. In how many ways can she do that?  
**A**  $5^5$  **B** 255 **C** 2 **D** 10 **E** 22

- S27.** Paul removed one number from ten consecutive natural numbers. The sum of the remaining ones is 2006. The removed number is  
**A** 218 **B** 219 **C** 220 **D** 225 **E** 227

- S28.** In how many ways can all the numbers 1, 2, 3, 4, 5, 6 be written in the squares of the figure (one in each square) so that there are no adjacent squares in which the difference of the numbers written is equal to 3? (Squares that share only a corner are not considered adjacent.)  
**A**  $3 \cdot 2^5$  **B**  $3^6$  **C**  $6^3$  **D**  $2 \cdot 3^5$  **E**  $3 \cdot 5^2$

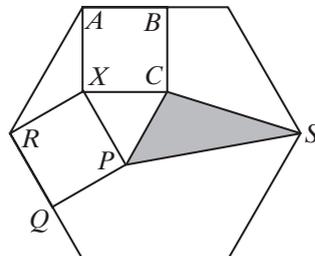


- S29.** A die is in the position shown in the picture. It can be rolled along the path of 12 squares as shown. How many times must the die go around the path in order for it to return to its initial position with all faces in the initial positions?  
**A** 1 **B** 2 **C** 3 **D** 4  
**E** It is impossible to do so



- S30.** If each side of the regular hexagon has length  $\sqrt{3}$  and  $XABC$  and  $XPQR$  are squares, what is the area of the shaded region?

- A**  $\frac{5 - \sqrt{3}}{4}$  **B**  $\frac{\sqrt{3} + 1}{2}$  **C**  $\frac{\sqrt{3}}{4}$   
**D**  $\frac{2 - \sqrt{3}}{4}$  **E**  $\frac{2 + \sqrt{3}}{4}$





# KANGAROO-2006: Correct Answers



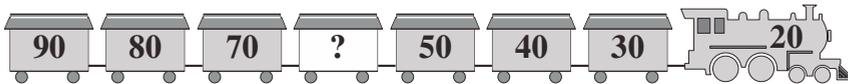
N	Ecolier	Benjamin	Cadet	Junior	Student
1	B	B	B	D	A
2	A	D	C	C	B
3	B	B	C	D	E
4	A	D	C	E	C
5	A	C	D	E	B
6	B	C	D	C	D
7	B	A	B	D	C
8	A	D	A	E	B
9	B	D	D	A	D
10	B	C	D	D	E
11	B	D	C	B	D
12	A	B	D	B	B
13	B	B	B	D	A
14	A	D	C	A	A
15	A	C	C	C	E
16	B	B	B	A	A
17	B	C	D	E	D
18	B	D	D	E	B
19	A	D	A	A	D
20	B	C	C	B	B
21			C	E	A
22			B	B	B
23			D	B	D
24			C	A	C
25			D	C	C
26				C	E
27				C	B
28				C	A
29				C	C
30				B	A

# Questions of Kangaroo 2007

## NIPPER (grades 1 and 2)

### 3-POINT QUESTIONS

N1. Which number should be written in place of the question mark?



A 10 B 20 C 40 D 60 E 80

N2. Which bike is most expensive?

950 Lt



A

590 Lt



B

905 Lt



C

899 Lt



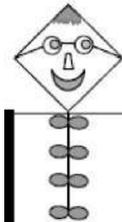
D

509 Lt

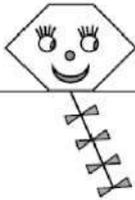


E

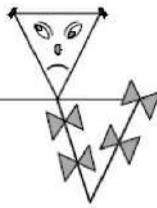
N3. Which kite has the longest string?



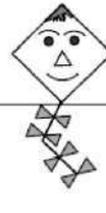
A



B



C



D



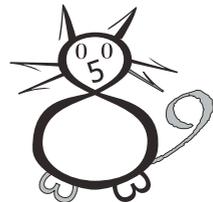
E

N4. Yesterday we celebrated John's birthday. Tomorrow will be Thursday. Which day of the week was John's birthday?

A Monday B Tuesday C Wednesday D Thursday E Friday

N5. How many different digits can you find in this picture?

A 5 B 6 C 7 D 9 E 13

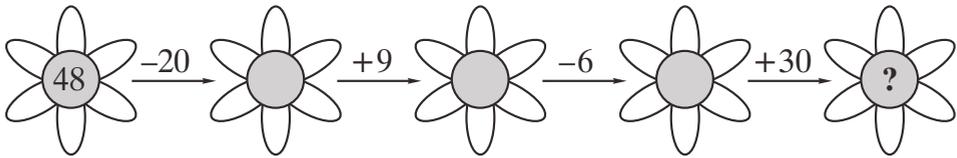


N6. There were 14 passengers in the bus. At the first busstop 8 passengers got off and 5 passengers got on. In the next busstop 1 passenger got off and 8 got on. How many passengers are now going by the bus?

A 10 B 18 C 24 D 0 E 4

4-POINT QUESTIONS

N7. Which number do you have to write in the last daisy?

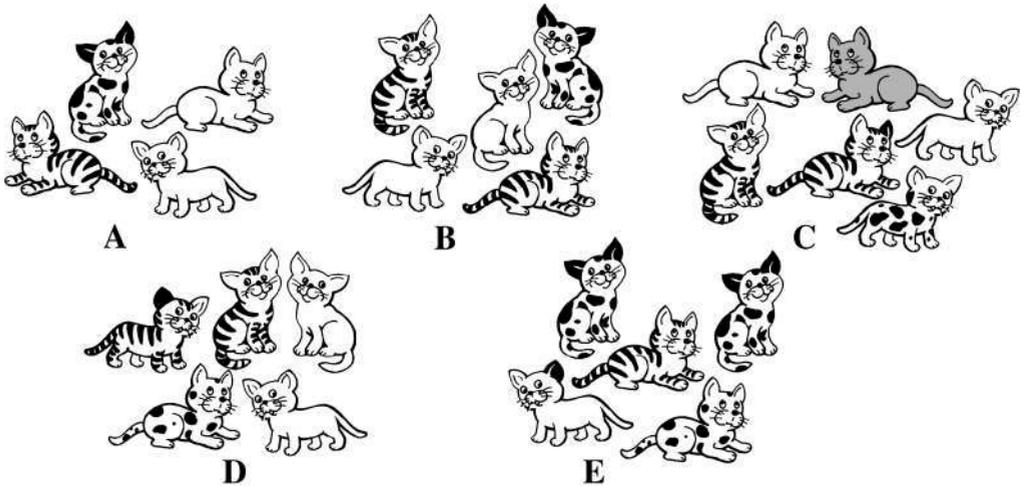


- A 35 B 47 C 54 D 61 E 113

N8. Caroline lives with her mother, father and brother Andrew. They have got Brutus the dog, two cats, two parrots and four fishes in the aquarium. How many legs have all the inhabitants of this house in total?

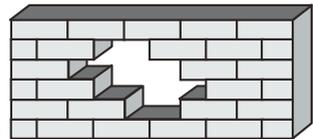
- A 22 B 28 C 32 D 24 E 12

N9. Misty the cat has five kittens: two of them are striped, one spotty, the rest of them are absolutely white. In which picture can we see the kittens of Misty, knowing that the ears of one of them are of different colour?



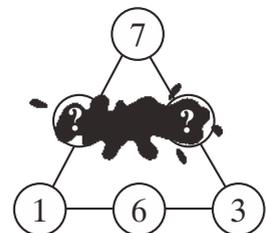
N10. How many bricks are missing in the wall?

- A 5 B 6 C 7 D 8 E 9



N11. The sums of the all the three numbers on each side of the triangle are equal. Two numbers happened to be stained with ink. How much is the sum of these two numbers?

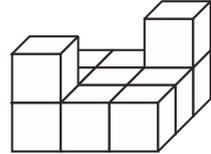
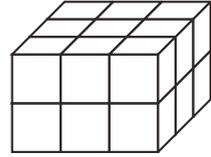
- A 2 B 0 C 3 D 4 E 10





- N16.** Mike has built a construction, shown in the upper picture, from equal cubes. Lily has taken several cubes out of it, thus Mike's construction became such as we see in the lower picture. How many cubes has Lily taken?

A 4 B 5 C 6 D 7 E 8



- N17.** Monkey Micky eats 4 kg of bananas per day and monkey Minnie 3 kg. In how many days monkey Minnie will eat as much bananas as Micky in 3 days?

A 3 B 4 C 5 D 6 E 7

- N18.** Eva is painting the cells in a certain order: a first cell red, a second one yellow, a third one blue, a fourth one green, a fifth one violet, and then she repeats the colours in the same order. Which colour will a thirty third cell be painted?

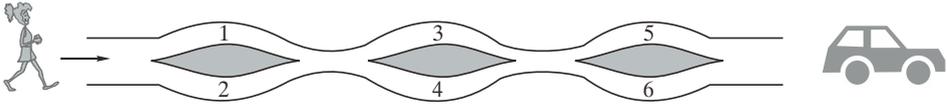
r	y	b	g	v	r	y	b	g									
---	---	---	---	---	---	---	---	---	--	--	--	--	--	--	--	--	--

A Red B Yellow C Blue D Green E Violet

## MINOR (grades 3 and 4)

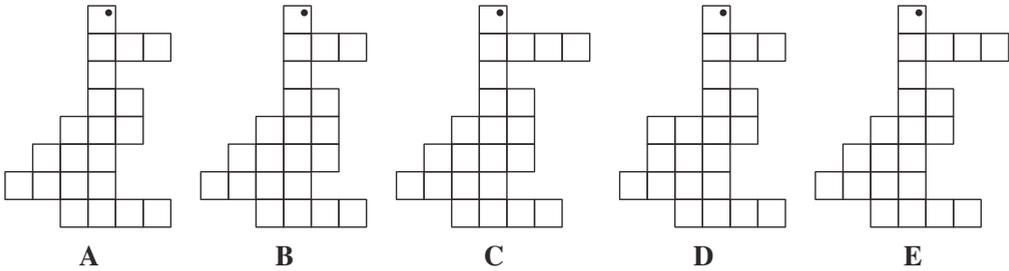
### 3-POINT QUESTIONS

**M1.** Zita walks from left to right and puts the numbers into her basket. Which of the following numbers can be in her basket?



- A** 1, 2 and 4   **B** 2, 3 and 4   **C** 2, 3 and 5   **D** 1, 5 and 6   **E** 1, 2 and 5

**M2.** In which figure can you find the largest number of small squares?



**M3.** How many common letters do the words KANGAROO and PROBLEM have?

- A** 5   **B** 1   **C** 7   **D** 2   **E** 3

**M4.** What is the first number larger than 2007 such that the sum of the digits be the same as that of 2007?

- A** 2016   **B** 2115   **C** 2008   **D** 1008   **E** 2070

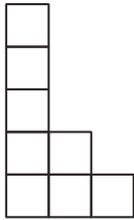
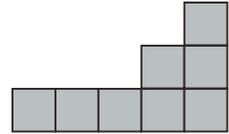
**M5.** There are 9 lampposts on one side of the path in the park. The distance between each pair of neighbouring lampposts is 8 metres. George was jumping all the way from the first lamppost to the last one. How many metres has he jumped?

- A** 48   **B** 56   **C** 64   **D** 72   **E** 80

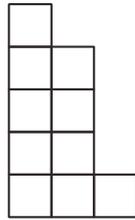
**M6.** The combination for opening a safe is a three-digit number made up of different digits. How many different combinations can you make using digits 1, 3 and 5 only?

- A** 2   **B** 3   **C** 4   **D** 5   **E** 6

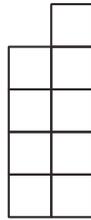
- M7.** What is the piece that fits completely to the given one to form a rectangle?



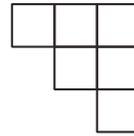
A



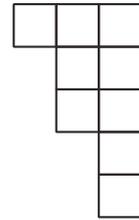
B



C

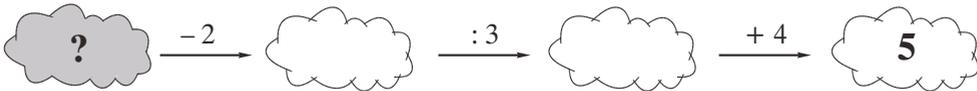


D



E

- M8.** Which number has to be put into the dark cloud to have all the given calculations right?



A 1 B 3 C 5 D 7 E 9

#### 4-POINT QUESTIONS

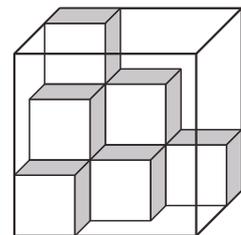
- M9.**  $4 \times 4 + 4 + 4 + 4 + 4 + 4 + 4 \times 4 = ?$   
A 32 B 44 C 48 D 56 E 144

- M10.** In the square below the numbers 1, 2 and 3 must be written in the cells. In each row and in each column each of the numbers 1, 2 and 3 must appear. Harry started to fill in the square. Which number can be written in the cell with the question mark?

1	?	
2	1	

- A Only 1 B Only 2 C Only 3 D 2 or 3 E 1, 2 or 3
- M11.** Hermenegilda has 5 euro. She intends to buy 5 exercise books, 80 eurocents each, and some pencils, 30 eurocents each. How many pencils can she afford to buy at most?  
A 5 B 4 C 3 D 2 E 1

- M12.** Daniela has got cubes with their edges 1 dm long. She has put some of them into the aquarium of the shape of a cube with the edges 3 dm long as you see in the picture. How much more cubes can she put into the aquarium?  
A 9 B 13 C 17 D 21 E 27



- M13.** Basil, who is older than Pete by 1 year and 1 day, was born on January 1, 2002. What is the date of Pete's birth?  
A January 2, 2003 B January 2, 2001 C December 31, 2000  
D December 31, 2002 E December 31, 2003

**M14.** John has 400 spaghetti strands, each 15 cm long, on his lunch plate. If he joined them end to end (using sauce as glue) to form one long strand, how long it would be:

- A 6 km B 60 m C 600 cm D 6000 mm E 60 000 cm

**M15.** Peter wrote a one-digit number, then an additional digit on its right. He added 19 to the obtained number and got 72. What number did Peter write at first?

- A 2 B 5 C 6 D 7 E 9

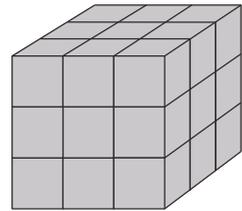
**M16.** A digital clock shows the time 20:07. What minimal time should pass in order that the same four digits (in any order) would appear on the clock?

- A 4 h 20 min B 6 h 00 min C 10 h 55 min D 11 h 13 min E 24 h 00 min

5-POINT QUESTIONS

**M17.** A cube with the edge 3 cm long is painted grey and cut into smaller cubes each with an edge of 1 cm long. How many smaller cubes will have exactly 2 faces painted?

- A 4 B 6 C 8 D 10 E 12



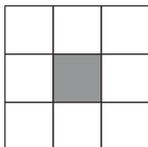
**M18.** A *palindrome* is a number which remains the same when its digits are written in a reverse order. For example, 1331 is a palindrome. A car’s odometer reads 15951. What is the least number of kilometers required for the next palindrome to appear?

- A 100 B 110 C 710 D 900 E 1010

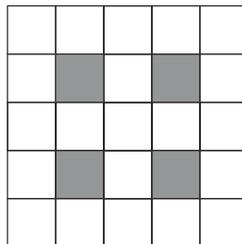
**M19.** Romain, Fabien, Lise, Jennifer, Adrien are in a single queue. Romain is after Lise. Fabien is before Romain and just after Jennifer. Jennifer is before Lise, but she is not the first. Which is Adrien in the queue?

- A 1st B 2nd C 3rd D 4th E 5th

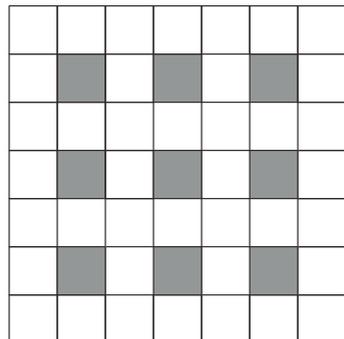
**M20.** We count the number of white cells. How many white cells has the next square?



8 white cells



21 white cells

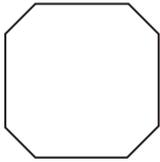
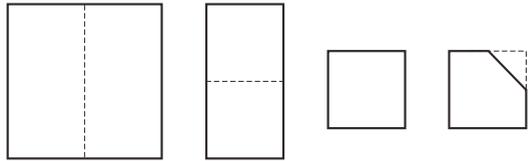
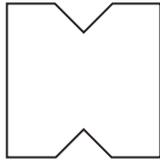
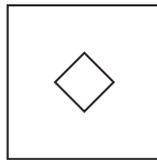
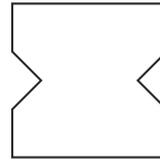
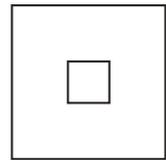


40 white cells

- A 50 B 60 C 65 D 70 E 75

- M21.** What is the perimeter of a figure made by cutting out four squares, one at each corner, with a perimeter of 8 cm from the rectangle 15 cm by 9 cm?  
**A** 48 **B** 40 **C** 32 **D** 24 **E** 16
- M22.** The seats on a children's merry-go-round are numbered 1, 2, 3, ... On this merry-go-round, Peter was sitting on the seat number 11, exactly opposite Maria, who was sitting on the seat number 4. How many seats are there on this merry-go-round?  
**A** 13 **B** 14 **C** 16 **D** 17 **E** 22
- M23.** How many digits do you need to write down all the numbers from 1 to 100?  
**A** 100 **B** 150 **C** 190 **D** 192 **E** 200

- M24.** A square piece of paper is folded twice so that the result is a square again. In this square one of the corners is cut off. Then the paper is folded out. Which sample below cannot be obtained in this way?

**A****B****C****D****E**

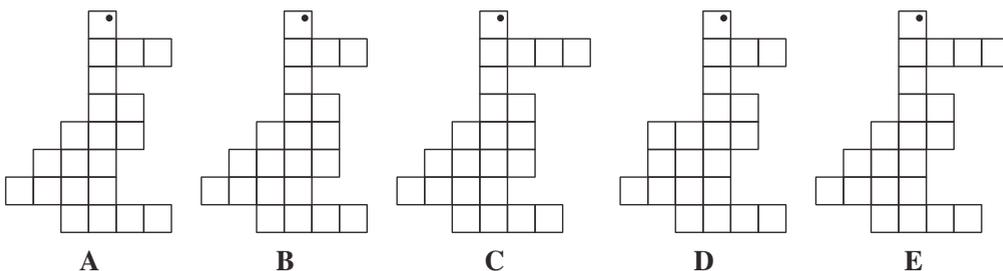
## BENJAMIN (grades 5 and 6)

### 3-POINT QUESTIONS

**B1.** How many common letters do the words KANGAROO and PROBLEM have?

- A 5   B 1   C 7   D 2   E 3

**B2.** In which figure can you find the largest number of small squares?



**B3.** In the square below the numbers 1, 2 and 3 must be written in the cells. In each row and in each column each of the numbers 1, 2 and 3 must appear. Harry started to fill in the square. In how many ways can he complete this task?

- A 1   B 2   C 3   D 4   E 5

1		
2	1	

**B4.** It takes kangaroo 6 seconds for every 4 jumps. How long does it take it to do 10 jumps?

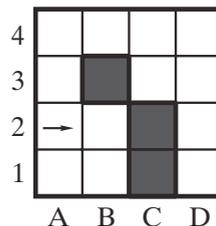
- A 10   B 12   C 15   D 18   E 20

**B5.** How much is  $2007 : (2 + 0 + 0 + 7) - 2 \times 0 \times 0 \times 7$ ?

- A 1   B 9   C 214   D 223   E 2007

**B6.** The robot starts walking over white cells of the table from the cell A2 in the direction of the arrow, as shown in the picture. It goes always forward. If it meets an obstacle (a black cell or the border of the table), it turns right. The robot stops in case, it cannot go forward after turning right (i.e., it stops in the cell where the obstacles appear in front of him and on the right). In which cell will it stop?

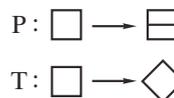
- A B2   B B1   C A1   D D1   E It never stops



**B7.** Basil, who is older than Pete by 1 year minus 1 day, was born on January 1, 2002. What is the date of Pete's birth?

- A January 2, 2003   B January 2, 2001   C December 31, 2000  
 D December 31, 2002   E December 31, 2003

**B8.** The carpenter's machine can perform two operations: P and T. The operation P is "printing" and T is "turning" (see the figure). What is the right sequence of operations to obtain  $\square$  starting from  $\square$ ?



- A TTP   B PTT   C TPT   D TPP   E TPTT

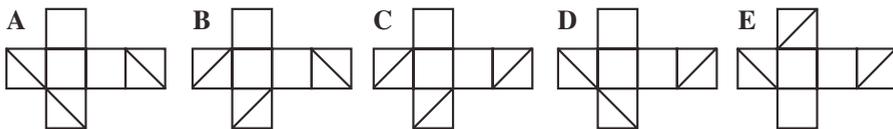
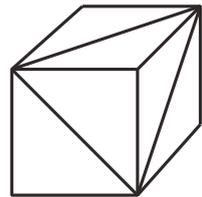
**B9.** If you cut a 1 meter cube into decimeter cubes and put them one on the other, what height will this structure have?

- A 100 m   B 1 km   C 10 km   D 1000 km   E 10 m

- B10.** Vanda cut a square-shaped paper with the 20 cm perimeter into two rectangles. The perimeter of one rectangle was 16 cm. What was the perimeter of the second rectangle?  
 A 8 cm B 9 cm C 12 cm D 14 cm E 16 cm

#### 4-POINT QUESTIONS

- B11.** In a square grid Hanna coloured the small squares that lie on the diagonals. How many small squares has the grid if Hanna has coloured 9 of them all in all?  
 A 9 B 16 C 25 D 64 E 81
- B12.** Anna, Betty, Cecil and Diana each goes in for a different kind of sport: karate, soccer, volleyball and judo. Ana does not like sports played with a ball, the judo player Betty often attends a soccer match to watch her friend play. Which of the following statements is true?  
 A Anna plays volleyball B Betty plays soccer C Cecil plays volleyball  
 D Diana goes in for karate E Anna goes in for judo
- B13.** Diagonals are drawn in three adjacent faces of a cube as shown in the picture. Which of the following nets is that of the given cube?



- B14.** There were 60 birds on three trees. At some moment 6 birds flew away from the first tree, 8 birds flew away from the second one, and 4 birds flew away from the third one. Then there remained the equal number of birds on each of the three trees. How many birds were there on the second tree at the beginning?  
 A 26 B 24 C 22 D 21 E 20
- B15.** Kelly had a paper ribbon of 27 cm long. She divided it into four rectangles of different size and drew two segments both of which connected the centres of the two adjacent rectangles



(see the picture). Find the sum of lengths of the two segments.

- A 12 cm B 13,5 cm C 14 cm D 14,5 cm E The number depends on the division
- B16.** Two squares  $9\text{ cm} \times 9\text{ cm}$  overlap so as to form a rectangle  $9\text{ cm} \times 13\text{ cm}$  as shown. Find the area of the region in which the two squares overlap.  
 A  $36\text{ cm}^2$  B  $45\text{ cm}^2$  C  $54\text{ cm}^2$  D  $63\text{ cm}^2$  E  $72\text{ cm}^2$

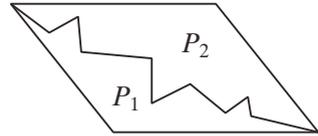


**B17.** Harry sent a pigeon at 7.30 a.m. to deliver a message to Ron. The pigeon delivered the envelope to Ron at 9.10 a.m. It flew 10 minutes every 4 km. What was the distance between Ron and Harry?

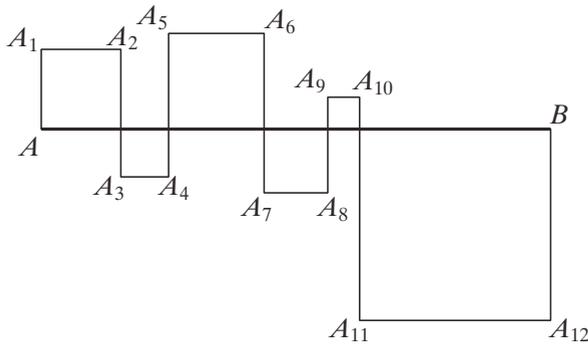
- A** 14 km **B** 20 km **C** 40 km **D** 56 km **E** 64 km

**B18.** A parallelogram is divided in two parts  $P_1$  and  $P_2$ , as shown in the picture. Which sentence is always true?

- A**  $P_2$  has a longer perimeter than  $P_1$   
**B**  $P_2$  has a smaller perimeter than  $P_1$   
**C**  $P_2$  has a smaller area than  $P_1$   
**D**  $P_1$  and  $P_2$  have the same perimeter  
**E**  $P_1$  and  $P_2$  have the same area



**B19.** The squares are formed by intersecting the segment  $AB$  of 24 cm by the broken line  $AA_1A_2 \dots A_{12}B$  (see the figure). Find the length of  $AA_1A_2 \dots A_{12}B$ .



- A** 48 cm  
**B** 72 cm  
**C** 96 cm  
**D** 56 cm  
**E** 106 cm

**B20.** The 2007-th letter in the sequence KANGAROOKANGAROOKANG... is

- A** K **B** A **C** N **D** R **E** O

### 5-POINT QUESTIONS

**B21.** Agnes is 10 years old. Her mother Lisa is 4 times as old. How old will Lisa be when Agnes is twice as old as she is now?

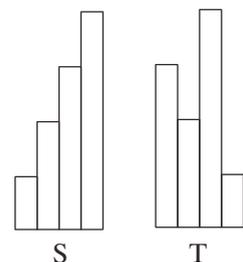
- A** 40 years **B** 50 years **C** 60 years **D** 70 years **E** 80 years

**B22.** On the right side of a given 2-digit number we write the same number and obtain a 4-digit number. How many times the 4-digit number is greater than the 2-digit number?

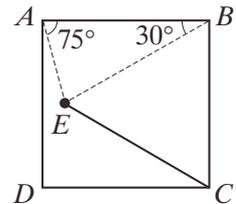
- A** 11 **B** 101 **C** 100 **D** 1001 **E** 10

**B23.** Figure S is made from four paper ribbons 10 cm wide. Each of the ribbons is 25 cm longer than the previous one (see the picture). By how many centimetres will the perimeter of figure T (made from the same ribbons) exceed that of figure S?

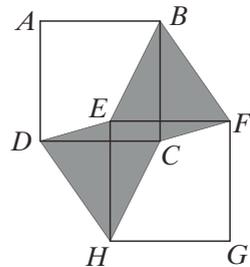
- A** 20 **B** 25 **C** 40 **D** 50  
**E** S and T have the same perimeter



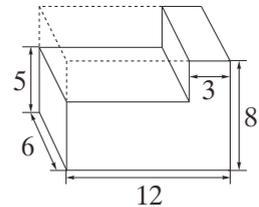
- B24.** Bill thinks of an integer. Nick multiplies it either by 5 or by 6. John adds to Nick's result either 5 or 6. Andrew subtracts from John's result either 5 or 6. The obtained result was 73. What number did Bill think of?  
**A** 10 **B** 11 **C** 12 **D** 14 **E** 15
- B25.** Five integers are written around a circle so that no two or three adjacent numbers give a sum divisible by 3. How many of those 5 numbers are divisible by 3?  
**A** 0 **B** 1 **C** 2 **D** 3 **E** Impossible to determine
- B26.** The side of the square  $ABCD$  is 10 cm. The inner point  $E$  of the square is such that  $\angle EAB = 75^\circ$ ,  $\angle ABE = 30^\circ$ . The length of the segment  $EC$  is:  
**A** 8 cm **B** 9 cm **C** 9,5 cm **D** 10 cm **E** 11 cm



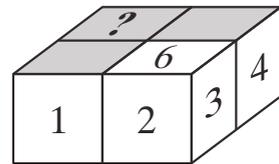
- B27.** In the picture,  $ABCD$  and  $EFGH$ , with  $AB$  parallel to  $EF$ , are two equal squares. The shaded area is equal to 1. What is the area of the square  $ABCD$ ?  
**A** 1 **B** 2 **C**  $\frac{1}{2}$  **D**  $\frac{3}{2}$   
**E** It depends on the position of the squares



- B28.** A rectangular section was cut out of a rectangular block as shown in the diagram. Find the decrease percentage of the surface area.  
**A** Less than 12,5%  
**B** 12,5%  
**C** More than 12,5%, but less than 25%  
**D** 25%  
**E** More than 25%



- B29.** The die is a cube, the faces of which are numbered by 1, 2, ..., 6, the sum of the numbers in any two opposite faces being 7. Using 4 such identical dice, Nick composed a parallelepiped  $2 \times 2 \times 1$  as shown in the figure, the numbers on any two touching faces of the dice being equal. The numbers on some faces are shown in the figure. Which number is written in the face denoted by the question mark?  
**A** 5 **B** 6 **C** 4 **D** 3 **E** 1



- B30.** The multiplication

$$\begin{array}{|c|c|c|} \hline \square & Y & \square \\ \hline \end{array} \times \begin{array}{|c|c|} \hline \square & \square \\ \hline \end{array} = \begin{array}{|c|c|c|c|} \hline 7 & 6 & 3 & 2 \\ \hline \end{array}$$

uses each of the digits from 1 to 9 exactly once. What is digit  $Y$ ?

- A** 1 **B** 4 **C** 5 **D** 8 **E** 9

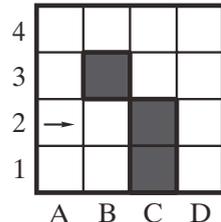
## CADET (grades 7 and 8)

### 3-POINT QUESTIONS

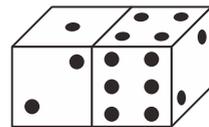
C1.  $\frac{2007}{2 + 0 + 0 + 7} =$   
**A** 1003 **B** 75 **C** 223 **D** 213 **E** 123

- C2. Rose bushes were planted in a line on each side of the path. The distance between two bushes in the line was 2 m. How many bushes could be planted if the path is 20 m long?  
**A** 22, 21 or 20 **B** 21, 20 or 19 **C** 22 or 20 **D** 22, 20 or 18 **E** 21 or 19

- C3. The robot starts walking over white cells of the table from the cell A2 in the direction of the arrow, as shown in the picture. It goes always forward. If it meets an obstacle (a black cell or the border of the table), it turns right. The robot stops in case, it cannot go forward after turning right (i.e., it stops in the cell where the obstacles appear in front of him and on the right). In which cell will it stop?  
**A** B2 **B** B1 **C** A1 **D** D1 **E** It never stops

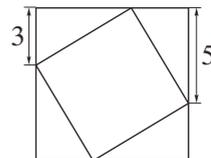


- C4. What is the sum of the points on the invisible faces of the dice?  
**A** 15 **B** 12 **C** 17 **D** 27 **E** Another answer

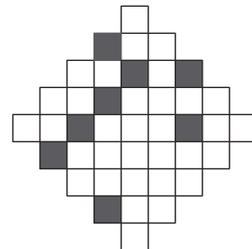


- C5. Points  $A = (6, 7)$ ,  $B = (7, 6)$ ,  $C = (-6, -7)$ ,  $D = (6, -7)$  and  $E = (7, -6)$  are marked on a coordinate grid. The line segment which is horizontal is  
**A** AD **B** BE **C** BC **D** CD **E** AB

- C6. A small square is inscribed in a big one as shown in the figure. Find the area of the small square.  
**A** 16 **B** 23 **C** 34 **D** 36 **E** 49

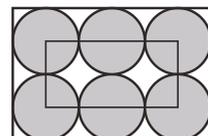


- C7. How many little squares at least do we have to shade in the picture on the right in order that it have an axis of symmetry?  
**A** 4 **B** 6 **C** 5 **D** 2 **E** 3



- C8. A *palindromic number* is one that reads the same backwards as forwards, e.g., 13931 is a palindromic number. What is the difference of the largest 6-digit palindromic number and the smallest 5-digit palindromic number?  
**A** 989989 **B** 989998 **C** 998998 **D** 999898 **E** 999988

- C9. There are six identical circles in the picture. The circles touch the sides of a large rectangle and one another as well. The vertices of the small rectangle lie in the centres of the four circles, as illustrated. The perimeter of the small rectangle is 60 cm. What is the perimeter of the large rectangle?  
**A** 160 cm **B** 140 cm **C** 120 cm **D** 100 cm **E** 80 cm

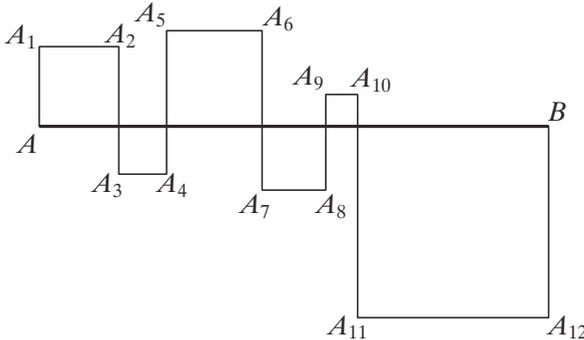


**C10.** An integer  $x$  is strictly negative. Which is the largest number below?

- A**  $x + 1$    **B**  $2x$    **C**  $-2x$    **D**  $6x + 2$    **E**  $x - 2$

#### 4-POINT QUESTIONS

**C11.** The squares are formed by intersecting the segment  $AB$  of 24 cm by the broken line  $AA_1A_2 \dots A_{12}B$  (see the figure). Find the length of  $AA_1A_2 \dots A_{12}B$ .



- A** 48 cm  
**B** 72 cm  
**C** 96 cm  
**D** 56 cm  
**E** 106 cm

**C12.** Six points were marked in the parallel lines  $a$  and  $b$ : 4 in line  $a$  and 2 in line  $b$ . What is the total number of triangles whose vertices are the points marked?

- A** 6   **B** 8   **C** 12   **D** 16   **E** 18

**C13.** A survey has shown that  $\frac{2}{3}$  of all customers buy product  $X$  and  $\frac{1}{3}$  buy product  $Y$ . After a publicity campaign on product  $Y$  a new survey has shown that  $\frac{1}{4}$  of the customers who preferred product  $X$  are now buying product  $Y$ . So now the part of the customers buying product  $Y$  is

- A**  $\frac{7}{12}$    **B**  $\frac{3}{4}$    **C**  $\frac{5}{12}$    **D**  $\frac{1}{2}$    **E**  $\frac{2}{3}$

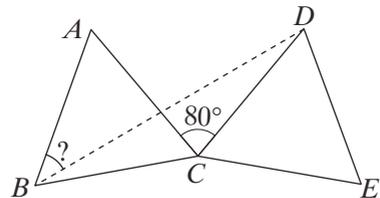
**C14.** In order to obtain number  $8^8$ , we must raise  $4^4$  to the power

- A** 2   **B** 3   **C** 4   **D** 8   **E** 16

**C15.**  $ABC$  and  $CDE$  are equal equilateral triangles.

If  $\angle ACD = 80^\circ$ , what is  $\angle ABD$ ?

- A**  $25^\circ$    **B**  $30^\circ$    **C**  $35^\circ$    **D**  $40^\circ$    **E**  $45^\circ$

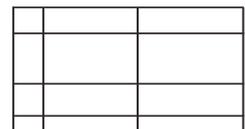


**C16.** Look at the numbers 1, 2, 3, 4, ..., 10000. What percent of these numbers is a square?

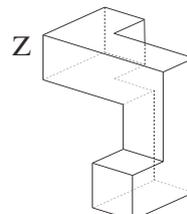
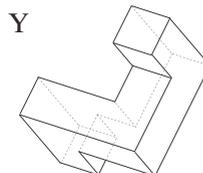
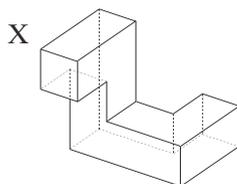
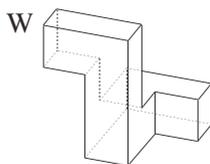
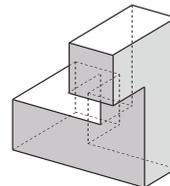
- A** 1%   **B** 1,5%   **C** 2%   **D** 2,5%   **E** 5%

**C17.** By drawing 9 segments (5 horizontal and 4 vertical) one can make a table of 12 cells. How many cells can you get maximally if you draw 15 segments?

- A** 22   **B** 30   **C** 36   **D** 40   **E** 42



**C18.** Which of the following objects can be obtained by rotating in space the grey object?



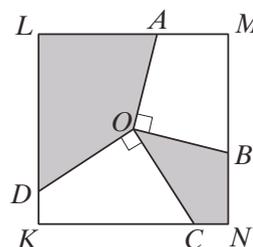
**A** W and Y   **B** X and Z   **C** Only Y   **D** None of these   **E** W, X or Y

**C19.** You choose three numbers from the grid shown so that you have one number from each row and one number from each column. Then add the three numbers together. What is the largest total you can obtain?

1	2	3
4	5	6
7	8	9

**A** 12   **B** 15   **C** 18   **D** 21   **E** 24

**C20.** Segments  $OA$ ,  $OB$ ,  $OC$  and  $OD$  are drawn from the centre  $O$  of the square  $KLMN$  to its sides so that  $OA \perp OB$  and  $OC \perp OD$  (as shown in the figure). If the side of the square equals 2, the area of the shaded region equals



**A** 1   **B** 2   **C** 2,5   **D** 2,25

**E** Depends on the choice of points  $B$  and  $C$

**5-POINT QUESTIONS**

**C21.** A defective calculator does not display digit 1. For example, if we type number 3131, then only 33 is displayed, without space. Mike typed a 6-digit number in that calculator, but only 2007 appeared on the display. How many numbers could Mike have typed?

**A** 12   **B** 13   **C** 14   **D** 15   **E** 16

**C22.** A walker takes a two-hour hike: first, walking on the flat, then climbing up and back (going down and on the flat again). His speed is 4 km/h on the flat part, 3 km/h when going up and 6 km/h when going down. What is the distance covered?

**A** We can't know   **B** 6 km   **C** 7,5 km   **D** 8 km   **E** 10 km

**C23.** Al and Bill together weigh less than Charlie and Dan; Charlie and Ed together weigh less than Frank and Bill. Which one of the following sentences is certainly true?

- A** Al and Ed together weigh less than Frank and Dan
- B** Dan and Ed together weigh more than Charlie and Frank
- C** Dan and Frank together weigh more than Al and Charlie
- D** Al and Bill together weigh less than Charlie and Frank
- E** Al, Bill and Charlie together weigh as much as Dan, Ed and Frank

**C24.** The first digit of a 4-digit number is equal to the number of noughts in this number, the second digit is equal to the number of digits 1, the third digit is equal to the number of digits 2, the fourth one – to the number of digits 3. How many such numbers there exist?

**A** 0   **B** 2   **C** 3   **D** 4   **E** 5

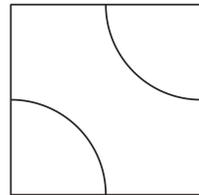
- C25.** A positive integer  $n$  has 2 divisors, while  $n + 1$  has 3 divisors. How many divisors does  $n + 2$  have?  
**A** 2 **B** 3 **C** 4 **D** 5 **E** Depends on  $n$

- C26.** The table  $3 \times 3$  contains positive integers (see the picture). Nick and Pete crossed out four numbers each so that the sum of the numbers crossed out by Nick is three times as large as the sum of the numbers, crossed out by Pete. The number which remained in the table after crossing is:  
**A** 4 **B** 7 **C** 14 **D** 23 **E** 24

4	12	8
13	24	14
7	5	23

- C27.** Five integers are written around a circle so that no two or three adjacent numbers give a sum divisible by 3. How many of those 5 numbers are divisible by 3?  
**A** 0 **B** 1 **C** 2 **D** 3 **E** Impossible to determine

- C28.** In the picture there is a square tile with two fourths of a circle. The radius of every fourth is half the side of the tile and its length equals 5 dm. We form a large square from 16 such tiles and try to get the longest unbroken curve consisting of the fourths. How long can this continuous curve be at most?  
**A** 75 dm **B** 100 dm **C** 105 dm **D** 110 dm **E** 80 dm



- C29.** A three-digit integer has been divided by 9. As a result, the sum of the digits decreased by 9. How many three-digit numbers possess the same property?  
**A** 1 **B** 2 **C** 4 **D** 5 **E** 11
- C30.** Given a number, a defective calculator can only work as follows: multiply it by 2 or by 3 and to raise it to the power 2 or 3. Starting from number 15, what can be obtained by applying this calculator 5 times consecutively?  
**A**  $2^8 \cdot 3^5 \cdot 5^6$  **B**  $2^8 \cdot 3^4 \cdot 5^2$  **C**  $2^3 \cdot 3^3 \cdot 5^3$  **D**  $2^6 \cdot 3^6 \cdot 5^4$  **E**  $2 \cdot 3^2 \cdot 5^6$

## JUNIOR (grades 9 and 10)

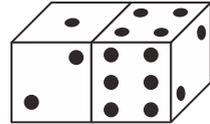
### 3-POINT QUESTIONS

**J1.** Anh, Ben and Chen have 30 balls together. If Ben gives 5 to Chen, Chen gives 4 to Anh and Anh gives 2 to Ben, then the boys will have the same number of balls. How many balls did Anh have at first?

- A 8   B 9   C 11   D 13   E 15

**J2.** What is the sum of the points on the invisible faces of the dice?

- A 15   B 12   C 17   D 27   E Another answer



**J3.** When announcing the results of a tombola, the moderator said: “The winning tickets are those containing at least 5-digit numbers such that three of their digits at most are larger than 2”. Subsequently, the speaker drew tickets with numbers 1022, 22222, 102334, 213343, 3042531. How many of them were the winning ones?

- A 1   B 2   C 3   D 4   E 5

**J4.** In the triangle  $ABC$ ,  $D$  is the midpoint of  $AB$ ,  $E$  is the midpoint of  $DB$ ,  $F$  is the midpoint of  $BC$ . If the area of  $\triangle ABC$  is 96, then the area of  $\triangle AEF$  is

- A 16   B 24   C 32   D 36   E 48

**J5.** Frida has divided her 2007 marbles into three bags A, B and C in such a way that each bag contains exactly the same number of marbles. If Frida moves  $\frac{2}{3}$  of the marbles from bag A to bag C, then the ratio between the number of marbles in bag A and C will be

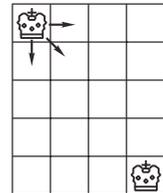
- A 1:2   B 1:3   C 2:3   D 1:5   E 3:2

**J6.** An international organization has 32 members. How many members will it have after three years, if the number of members increases each year by 50% compared to the previous one?

- A 182   B 128   C 108   D 96   E 80

**J7.** How many routes are possible for the king to travel from the top left square to the bottom right square of the grid with the minimum number of moves. (The king can move to any adjacent square, including that adjacent diagonally.)

- A 1   B 4   C 7   D 20   E 35



**J8.** The cells of the table are being coloured red (R) and green (G). In each row and in each column there must be two red and two green cells. What will the lowest row look like after colouring the table?

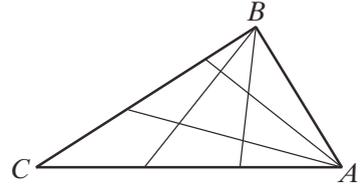
- A GRGR   B RGRG   C GRRG   D RGGR   E GGRR

R		R	
		R	
			G

**J9.** Different letters represent different digits. Find the least possible value of the expression  $2007 - KAN - GA - ROO$ .

- A 100   B 110   C 112   D 119   E 129

- J10.** The diagram on the right shows a triangle  $ABC$  where two lines are drawn to the opposite sides from each of the two vertices  $A$  and  $B$ . This divides the triangle into nine non-overlapping sections. If eight lines are drawn to the opposite sides, four from  $A$  and four from  $B$ , what is the number of non-overlapping sections the triangle is divided into?  
**A** 16 **B** 25 **C** 36 **D** 42 **E** 49



#### 4-POINT QUESTIONS

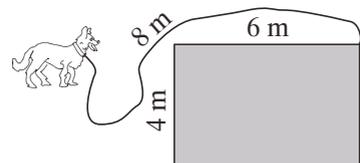
- J11.** The island is inhabited by liars and nobles (the liars always tell lies and the nobles always tell the truth). One day 12 islanders, both liars and nobles, gathered together and issued a few statements. Two people said: “Exactly two people among us twelve are liars”. The other four people said: “Exactly four people among us twelve are liars”. The rest six people said: “Exactly six people among us twelve are liars”. How many liars were there?  
**A** 2 **B** 4 **C** 6 **D** 8 **E** 10

- J12.** In order to obtain number  $8^8$ , we must raise  $4^4$  to the power  
**A** 2 **B** 3 **C** 4 **D** 8 **E** 16

- J13.** Five integers are written around a circle so that no two or three adjacent numbers give a sum divisible by 3. How many of those 5 numbers are divisible by 3?  
**A** 0 **B** 1 **C** 2 **D** 3 **E** Impossible to determine

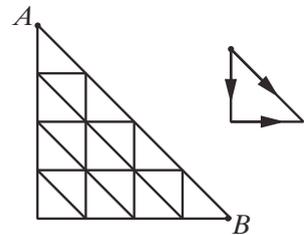
- J14.** The students were solving an interesting problem at the “Kangaroo”. As a result the number of the boys who had solved the problem turned out to be the same as the number of the girls who hadn’t solved the problem. Who are in the majority: those who had solved the problem or the girls?  
**A** Girls **B** Those who have solved the problem  
**C** Equal  
**D** Impossible to find  
**E** The situation is not possible

- J15.** An 8 m long rope is fastened to the corner of the house. A dog is fastened to the rope. Find the perimeter of the area, where the dog can be found.  
**A**  $15\pi + 16$  **B**  $15\pi + 20$  **C**  $15\pi$  **D**  $15\pi + 18$   
**E**  $30\pi + 16$



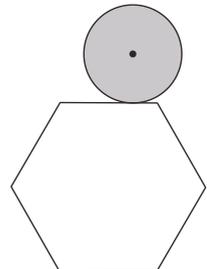
- J16.** It is 21.00 o'clock. I am driving at a speed of 100 km/h. At this speed I have got enough petrol for the distance of 80 km. The nearest petrol pump is 100 km away. The amount of petrol my car uses per km is inversely proportional to the speed of the car. I want to reach the petrol pump as soon as possible. At what time can I arrive at the petrol pump?  
**A** 22.12   **B** 22.15   **C** 22.20   **D** 22.25   **E** 22.30
- J17.** A trapezium is formed by removing a corner of an equilateral triangle. Then two copies of this trapezium are placed side by side to form a parallelogram. The perimeter of the parallelogram is 10 cm longer than that of the original triangle. What was the perimeter of the original triangle?  
**A** 10 cm   **B** 30 cm   **C** 40 cm   **D** 60 cm   **E** More information needed
- J18.** The sequence of letters KANGAROOKANGAROO...KANGAROO contains 20 words KANGAROO. First, all the letters in the odd places of the sequence were erased. Then, in the sequence obtained, all the letters in the odd places were erased once more, and so on. At the very end, only one letter remained. This letter is  
**A** K   **B** A   **C** N   **D** G   **E** O
- J19.** Two schools should play table tennis one against the other. Five students should represent each of these schools. Only doubles should play. Each pair from one school should play against each pair from the other school just once. How many times should each student play?  
**A** 10   **B** 20   **C** 30   **D** 40   **E** 50

- J20.** How many different ways can you follow from point  $A$  to point  $B$  if you can go only down, right or down diagonally by the sides of small triangles?  
**A** 16   **B** 27   **C** 64   **D** 90   **E** 111



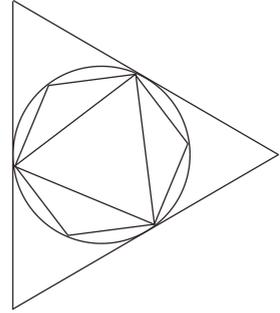
### 5-POINT QUESTIONS

- J21.** In a village there are no two people with the same number of hairs. Nobody has exactly 2007 hairs. Joe has the most number of hairs in the village. The number of villagers is larger than the number of Joe's hairs. What can the maximum number of villagers be?  
**A** 0   **B** 2006   **C** 2007   **D** 2008   **E** 2009
- J22.** A coin with diameter 1 cm rolls around the contour outside of a regular hexagon with sides 1 cm long, as shown. How long is the path traced by the centre of the coin (in cm)?  
**A**  $6 + \frac{\pi}{2}$    **B**  $6 + \pi$    **C**  $12 + \pi$    **D**  $6 + 2\pi$    **E**  $12 + 2\pi$



- J23.** An equilateral triangle and a regular hexagon are inscribed in a circle, the latter being inscribed in an equilateral triangle (see the picture).  $S$  is the area of the big triangle,  $s$  the area of the little one and  $Q$  is the area of the hexagon. What is true?

**A**  $Q = \sqrt{S \cdot s}$     **B**  $Q = \frac{S+s}{2}$     **C**  $S = s + Q$   
**D**  $Q = \sqrt{S^2 + s^2}$     **E**  $S = Q + 3s$



- J24.** Let  $A$  be the least positive integer with the following property:  $10 \cdot A$  is a perfect square and  $6 \cdot A$  is a perfect cube. How many positive divisors has number  $A$ ?

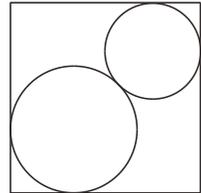
**A** 30    **B** 40    **C** 54    **D** 72    **E** 96

- J25.** In a safe-deposit there are some necklaces. All the necklaces have the same number of diamonds (at least two diamonds in each necklace). If the number of diamonds in the safe-deposit were be known, then the number of the necklaces would also be known without doubt. The number of diamonds is more than 200, but less than 300. How many necklaces are there in the safe-deposit?

**A** 16    **B** 17    **C** 19    **D** 25    **E** Another answer

- J26.** Two circles have their centres on the same diagonal of a square. They touch each other and the sides of the square as shown. The side of the square is 1 cm long. What is the sum of the lengths of the radii of the circles in centimetres?

**A**  $\frac{1}{2}$     **B**  $\frac{1}{\sqrt{2}}$     **C**  $\sqrt{2} - 1$     **D**  $2 - \sqrt{2}$   
**E** It depends on sizes of the circles



- J27.** There are three cards in a box for each of the following colours: red, green, yellow and blue. For each colour, the three cards are numbered 1, 2 and 3. You take randomly three cards out of the box. Which of the following events is the most probable one?

- A** The three cards are of the same colour  
**B** The three cards, independent of their colours, have numbers 1, 2 and 3  
**C** The three cards are of three different colours  
**D** The three cards have the same number  
**E** None, the four previous events have the same probability

- J28.** In a party four friends are going to give gifts to one another so that everybody gives one and receives one gift (of course, no one should receive his own gift). In how many ways is this possible?

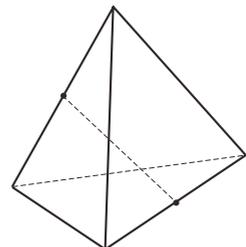
**A** 24    **B** 16    **C** 12    **D** 10    **E** 9

- J29.** For each real number  $x$ , let  $f(x)$  be the least one of the numbers  $4x + 1$ ,  $x + 2$ ,  $-2x + 4$ . What is the biggest value of the function  $f(x)$ ?

**A**  $\frac{1}{2}$     **B**  $\frac{2}{3}$     **C**  $\frac{7}{3}$     **D**  $\frac{8}{3}$     **E** 3

- J30.** The distance of two not-crossing edges of a regular tetrahedron (triangular pyramid with all the six edges equal) is 6 cm. What is the volume of the tetrahedron (in  $\text{cm}^3$ )?

**A** 18    **B** 36    **C** 48    **D** 72    **E** 144

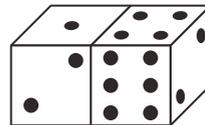


## STUDENT (grades 11 and 12)

### 3-POINT QUESTIONS

**S1.** What is the sum of the points on the invisible faces of the dice?

- A 15   B 12   C 17   D 27   E Another answer

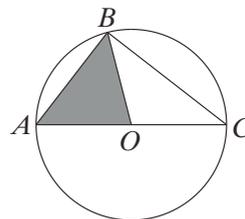


**S2.** In order to obtain number  $8^8$ , we must raise  $4^4$  to the power

- A 2   B 3   C 4   D 8   E 16

**S3.** The shaded area is equal to  $\sqrt{3}$ . What is the area of the triangle  $ABC$ ?

- A  $2\sqrt{3}$    B 2   C 5   D 6   E  $4\sqrt{3}$

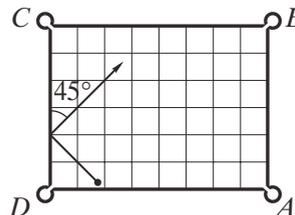


**S4.** The value of  $\frac{\sin 1^\circ + \cos 1^\circ}{\sin 89^\circ + \cos 89^\circ}$  equals

- A  $\frac{1}{89}$    B  $\text{tg } 1^\circ$    C  $\frac{1}{2}$    D  $\text{ctg } 1^\circ$    E 1

**S5.** The billiard ball meets the board under  $45^\circ$  as shown. Which pocket will it fall into?

- A A   B B   C C   D D   E Neither of the pockets



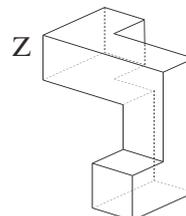
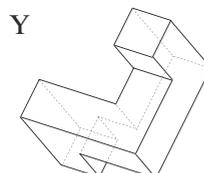
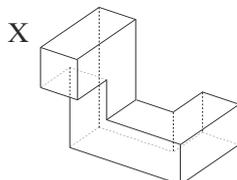
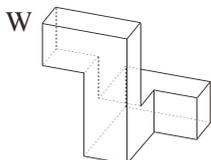
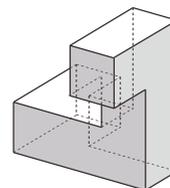
**S6.** Five integers are written around a circle so that no two or three adjacent numbers give a sum divisible by 3. How many of those 5 numbers are divisible by 3?

- A 0   B 1   C 2   D 3   E Impossible to determine

**S7.** At an examination Peter answered 80% of the questions correctly. He did not know the answer to the remaining 5 of them. How many questions were there in the test?

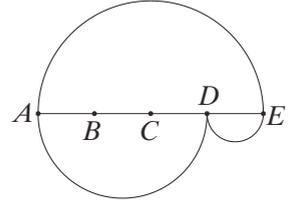
- A 20   B 25   C 30   D 35   E 40

**S8.** Which of the following objects can be obtained by rotating in space the grey object?



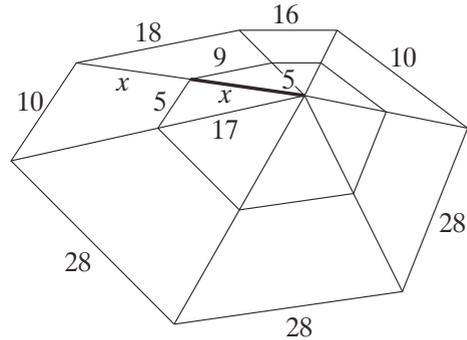
- A W and Y   B X and Z   C only Y   D None of these   E W, X or Y

- S9.** The segment  $AE$  is divided into four equal parts and semicircles are drawn taking  $AE$ ,  $AD$  and  $DE$  as diameters, creating two paths from  $A$  to  $E$  as shown. Determine the ratio of the length of the upper path to the length of the lower path.



**A** 1:2 **B** 2:3 **C** 2:1 **D** 3:2 **E** 1:1

- S10.** A mathematically skilled spider spins a cobweb and some of the strings have lengths as shown in the picture. If  $x$  is an integer, determine the value of  $x$ .



**A** 11 **B** 13 **C** 15 **D** 17 **E** 19

#### 4-POINT QUESTIONS

- S11.** Given a square  $ABCD$  with side 1, one has to draw all possible squares that have at least two common vertices with  $ABCD$ . The area of the region of all points covered by at least one of these squares is

**A** 5 **B** 6 **C** 7 **D** 8 **E** 9

- S12.** Angle  $\beta$  is 25% smaller than angle  $\gamma$  and 50% greater than angle  $\alpha$ . Then angle  $\gamma$  is

**A** 25% greater than  $\alpha$  **B** 50% greater than  $\alpha$  **C** 75% greater than  $\alpha$   
**D** 100% greater than  $\alpha$  **E** 125% greater than  $\alpha$

- S13.** Given  $2^{x+1} + 2^x = 3^{y+2} - 3^y$ , where  $x$  and  $y$  are integers, the value of  $x$  is

**A** 0 **B** 3 **C** -1 **D** 1 **E** 2

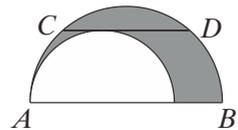
- S14.** What is the value of

$$\cos 1^\circ + \cos 2^\circ + \cos 3^\circ + \dots + \cos 358^\circ + \cos 359^\circ?$$

**A** 1 **B**  $\pi$  **C** 0 **D** 180 **E** -1

- S15.** Two semicircles are drawn as shown in the figure. The chord  $CD$ , of length 4, is parallel to the diameter  $AB$  of the greater semicircle and touches the smaller semicircle. Then the area of the shaded region equals

**A**  $\pi$  **B**  $1.5\pi$  **C**  $2\pi$  **D**  $3\pi$  **E** Not enough data



- S16.** The sum of five consecutive integers is equal to the sum of the next three consecutive integers. The greatest number of these eight numbers is:

**A** 4 **B** 8 **C** 9 **D** 11 **E** 12

- S17.** Thomas was born on his mother's 20th birthday, and so they share birthdays. How many times will Thomas' age be a divisor of his mother's age if they both live long lives?

**A** 4 **B** 5 **C** 6 **D** 7 **E** 8

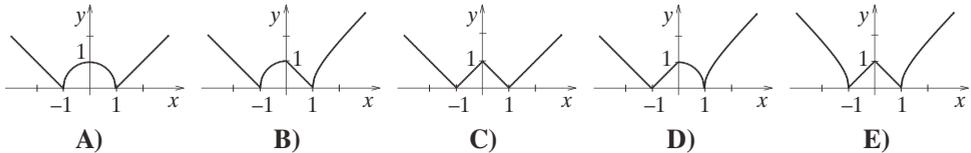
**S18.** It is 21.00 o'clock. I am driving at a speed of 100 km/h. At this speed I have got enough petrol for the distance of 80 km. The nearest petrol pump is 100 km away. The amount of petrol my car uses per km is inversely proportional to the velocity of the car. I want to reach the petrol pump as soon as possible. At what time can I arrive at the petrol pump?

A 22.12 B 22.15 C 22.20 D 22.25 E 22.30

**S19.** Consider a sphere of radius 3 with the centre at the origin of a Cartesian coordinate system. How many points have integer coordinates got on the surface of this sphere?

A 30 B 24 C 12 D 6 E 3

**S20.** Which is the graph of the function  $y = \sqrt{|(1+x)(1-|x|)|}$ ?



### 5-POINT QUESTIONS

**S21.** Which of the following numbers cannot be written as  $x + \sqrt{x}$ , if  $x$  is an integer?

A 870 B 110 C 90 D 60 E 30

**S22.** If  $f(x) = \frac{2x}{3x+4}$  and  $f(g(x)) = x$ , then

A  $g(x) = \frac{3x+4}{2x}$  B  $g(x) = \frac{3x}{2x+4}$  C  $g(x) = \frac{2x+4}{4x}$  D  $g(x) = \frac{4x}{2-3x}$  E  $g(x) = \frac{2-3x}{4x}$

**S23.** Ann, Belinda and Charles are throwing a die. Ann wins if she throws 1, 2 or 3; Belinda wins if she throws 4 or 5; Charles wins if he throws 6. The die rotates from Ann to Belinda, then to Charles, to Ann, etc., until one player wins. Calculate the probability that Charles wins.

A  $\frac{1}{6}$  B  $\frac{1}{8}$  C  $\frac{1}{11}$  D  $\frac{1}{13}$  E 0

**S24.** How many degrees do the acute angles of a rhombus have, if its side is the geometrical mean of the diagonals?

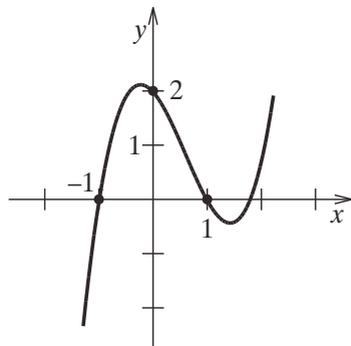
A  $15^\circ$  B  $30^\circ$  C  $45^\circ$  D  $60^\circ$  E  $75^\circ$

**S25.** We see in the diagram at the right a piece of the graphic of the function

$$f(x) = ax^3 + bx^2 + cx + d.$$

What is the value of  $b$ ?

A -4 B -2 C 0 D 2 E 4



**S26.** Determine the number of integers  $a$  such that the quadratic equation

$$x^2 + ax + 2007 = 0$$

has two integer roots.

A 3 B 4 C 6 D 8 E 2007

**S27.** The sum

$$\frac{1}{2\sqrt{1} + 1\sqrt{2}} + \frac{1}{3\sqrt{2} + 2\sqrt{3}} + \cdots + \frac{1}{100\sqrt{99} + 99\sqrt{100}}$$

is equal to:

**A**  $\frac{999}{1000}$  **B**  $\frac{99}{100}$  **C**  $\frac{9}{10}$  **D** 9 **E** 1

**S28.** In a party five friends are going to give gifts to one another so that everybody gives one and receives one gift (of course, no one should receive his own gift). In how many ways is this possible?

**A** 5 **B** 10 **C** 44 **D** 50 **E** 120

**S29.** The digits of the sequence 123451234512345... fill the cells on a sheet of paper in a spiral-like manner beginning with the marked cell (see the figure). Which digit is written in the cell being 100 cells above the marked one?

**A** 1 **B** 2 **C** 3 **D** 4 **E** 5

		1	2	3		
		5	2	3	4	5
		4	1	1	2	1
		3	5	4	3	2
		2	1	5	4	3

**S30.** The increasing sequence 1, 3, 4, 9, 10, 12, 13, ... is composed of all the powers of 3 and all the numbers that can be written as the sum of different powers of 3. What is the 100th element of the sequence?

**A** 150 **B** 981 **C** 1234 **D** 2401 **E**  $3^{100}$

## Atsakymai • Ответы • Odpowiedzi • Answers

Klausimo Nr. Nr. pytania No. of question	Grupė Grupa Group					
	N (P)	M	B	K (C)	J	S
1	D	C	B	C	A	D
2	A	C	C	A	D	B
3	C	B	A	D	B	A
4	B	A	C	D	D	E
5	B	C	D	D	D	C
6	B	E	D	C	C	C
7	D	B	D	E	B	B
8	D	C	B	B	A	A
9	D	C	A	D	B	E
10	B	C	D	C	B	B
11	A	C	C	B	C	C
12	D	C	C	D	B	D
13	B	A	D	D	C	B
14	D	B	C	B	C	E
15	C	B	B	D	A	C
16	D	A	B	A	B	D
17	B	E	C	E	B	C
18	C	B	D	A	E	B
19		A	B	B	D	A
20		C	E	B	D	D
21		A	B	D	C	D
22		B	B	D	B	D
23		D	D	A	A	D
24		E	C	B	D	B
25			C	A	B	B
26			D	C	D	C
27			A	C	C	C
28			B	D	E	C
29			A	D	D	A
30			C	D	D	B
	<b>H</b>	<b>M</b>	<b>B</b>	<b>K</b>	<b>J</b>	<b>S</b>
№ вопроса	Группа					



# KANGAROO-2007: Correct Answers



N	Ecolier	Benjamin	Cadet	Junior	Student
1	B	C	B	E	A
2	B	B	A	C	A
3	B	A	D	B	A
4	A	C	D	D	E
5	A	D	C	B	C
6	A	B	C	C	C
7	A	A	A	B	B
8	B	D	B	D	A
9	A	C	C	B	E
10	A	D	A	B	B
11	A	B	B	C	C
12	B	B	C	B	D
13	A	C	C	B	B
14	B	D	A	C	E
15	B	A	D	A	C
16	B	A	D	B	D
17	A	D	D	E	C
18	A	B	A	D	E
19	A	C	B	D	A
20	B	A	B	A	D
21			D	D	D
22			B	D	D
23			A	A	D
24			B	D	B
25			C	B	B
26				D	C
27				C	C
28				C	C
29				D	A
30				B	B

# Questions of Kangaroo 2008

## NIPPER (grades 1 and 2)

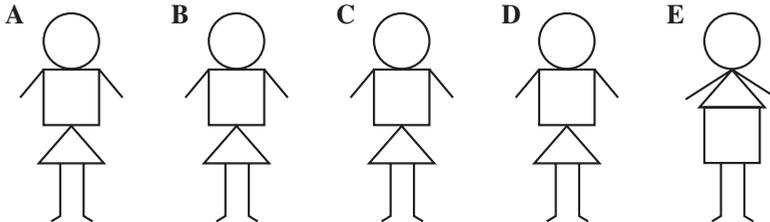
### 3-POINT QUESTIONS

**N1.** Now it is 2008. What is the total sum of these digits?

- A** 0   **B** 6   **C** 10   **D** 16   **E** 20

2008		
Birželis	Liepa	Rugpjūtis
P 6 12 18 24 30	P 6 11 17 23 29	P 6 12 18 24 30
A 1 7 13 19 25 31	A 5 11 18 24 30	A 1 7 13 19 25 31
T 2 8 14 20 26	T 7 13 19 25	T 2 8 14 20 26
K 3 9 15 21 27	K 2 8 14 20 26	K 3 9 15 21 27
P 4 10 16 22 28	P 3 9 15 21 27	P 4 10 16 22 28
S 5 11 17 23 29	S 4 10 16 22 28	S 5 11 17 23 29

**N2.** Which of these figures differs from the rest four?



**N3.** Mary has written all the numbers from 1 to 30. How many times has she written digit 2?

- A** 10   **B** 12   **C** 13   **D** 19   **E** 27

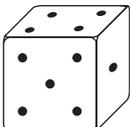


**N4.** Emily celebrated her birthday on Thursday, and her sister Liepa 8 days earlier. Which weekday was that?

- A** Wednesday   **B** Thursday   **C** Friday  
**D** Tuesday   **E** Sunday

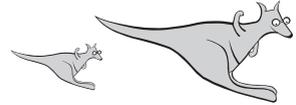


**N5.** How many points are there in the three unseen sides of dice?



- A** 9   **B** 10   **C** 11   **D** 12   **E** 13

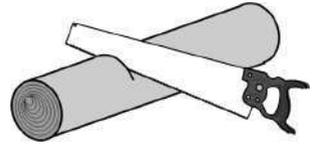
**N6.** A jump of a little kangaroo is three times shorter than its mother's. How many jumps should the little kangaroo make to cover the distance equal to 7 jumps of its mother?



- A** 10 **B** 26 **C** 21 **D** 30 **E** 4

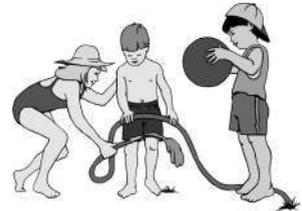
**4-POINT QUESTIONS**

**N7.** A fifteen-meter log has to be sawn into three-meter pieces. How many cuts are needed for that?



- A** 4 **B** 5 **C** 7 **D** 6 **E** 14

**N8.** Mary has got 3 brothers and 2 sisters. How many brothers and sisters has her brother Mike got?



- A** 3 brothers and 2 sisters **B** 2 brothers and 3 sisters  
**C** 2 brothers and 2 sisters **D** 3 brothers and 3 sisters  
**E** Another answer

**N9.** Eve has taken 2 bananas to school. At first she changed each of them into 4 apples, later on she exchanged each apple into 3 mandarins. How many mandarins has Eve got?



- A**  $2 + 4 + 3$  **B**  $2 \cdot 4 + 3$  **C**  $2 + 4 \cdot 3$   
**D**  $2 \cdot 4 \cdot 3$  **E**  $2 + 4 - 3$

**N10.** How many plums (see the picture) weigh as much as an apple?

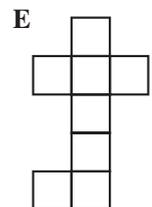
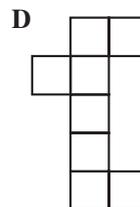
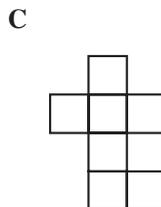
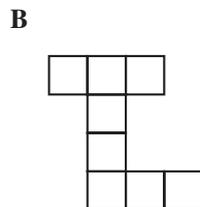
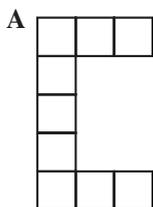
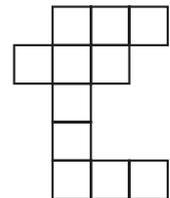


- A** 3 **B** 1 **C** 4 **D** 2 **E** 5

**N11.** Tom's papa is 4 years elder than his mammy. Now his papa is 37 years old. How old his mammy was ten years ago?

- A** 31 **B** 23 **C** 21 **D** 20 **E** 27

**N12.** Which of the figures shown bellow cannot be cut out of the figure illustrated nearby?



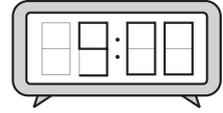
## 5-POINT QUESTIONS

**N13.** Anthony paid 6 litas for 15 buns. How many litas did John pay for 5 buns more?

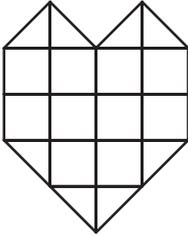
A 7 B 8 C 9 D 10 E 20

**N14.** What time is it now, if after 6 hours and 30 minutes the clock will show 4:00?

A 10:00 B 10:30 C 2:30 D 22:10 E 21:30



**N15.** Tom bought a chocolate heart (see the picture) to Mary on her birthday.



How many grams did the chocolate weigh, if each square weighs 10 grams?

A 180 B 170 C 150 D 140 E 160

**N16.** How many different letters are there in the word

M A T H E M A T I C S ?

A 12 B 11 C 7 D 10 E 8

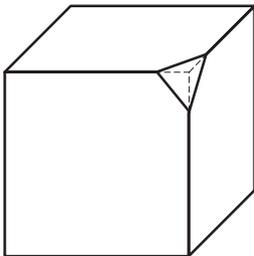
**N17.** A trip of the pupils to the zoo took 135 minutes.



How many hours and minutes does it make?

A 3 h 5 min B 2 h 15 min C 1 h 35 min D 2 h 35 min E 3 h 35 min

**N18.** A wooden block has 8 vertices. One vertex is cut off now (see the picture).



How many vertices has the block now?

A 8 B 9 C 7 D 10 E 11

## MINOR (grades 3 and 4)

### 3-POINT QUESTIONS

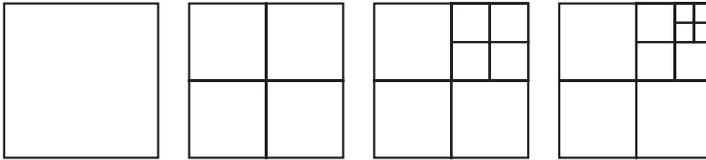
**M1.** We have 3 meals a day. How many meals do we have in a week?

- A 7   B 18   C 21   D 28   E 37

**M2.** An adult ticket to the zoo costs 4 euros, the ticket for a child is 1 euro cheaper. How many euros must a father pay to enter the zoo with his two children?

- A 5   B 6   C 7   D 10   E 12

**M3.** We make a sequence of figures by dividing a square. The first four figures have 1, 4, 7 and 10 parts, respectively.



How many parts will the fifth figure have?

- A 11   B 12   C 13   D 14   E 15

**M4.** Miriam has bought 5 bunches of flowers: yellow tulips, white roses, yellow roses, red carnations, yellow carnations. She gave her mother, grandmother, aunt and two sisters each a bunch. Which of them was for her mother, if you know that the flowers for sisters and aunt were of the same colour, and grandmother did not receive roses?

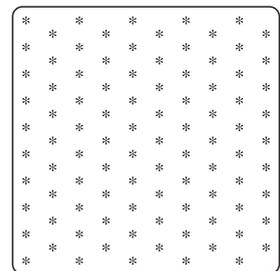
- A Yellow tulips   B White roses   C Red carnations  
D Yellow roses   E Yellow carnations

**M5.** Theresa has 37 CDs. Her friend Claudia said: “If you give me 10 of your CDs, we will both have the same number of CDs.” How many CDs does Claudia have?

- A 10   B 17   C 22   D 27   E 32

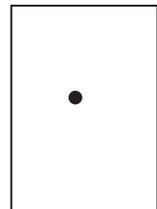
**M6.** How many stars are inside the figure?

- A 100   B 90   C 95   D 85   E 105



**M7.** Rebecca has drawn a point on a sheet of paper. She now draws four straight lines that pass through this point. Into how many sections do these lines divide the paper?

- A 4   B 6   C 5   D 8   E 12



**M8.** In six and a half hours it will be four hours after midnight. What time is it now?

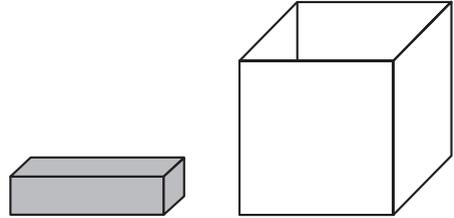
- A 21:30   B 04:00   C 20:00   D 02:30   E 10:30



- M16.** There are three songs on a CD. The first song is 6 minutes and 25 seconds long, the second song is 12 minutes and 25 seconds long, and the third song is 10 minutes and 13 seconds long. How long are all the three songs together?  
**A** 28 minutes 30 seconds    **B** 29 minutes 3 seconds    **C** 30 minutes 10 seconds  
**D** 31 minutes 13 seconds    **E** 31 minutes 23 seconds

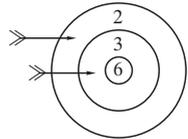
**5-POINT QUESTIONS**

- M17.** We have a large number of blocks of  $1\text{ cm} \times 2\text{ cm} \times 4\text{ cm}$ . We will try to put as many of these blocks as possible into a box of  $4\text{ cm} \times 4\text{ cm} \times 4\text{ cm}$  so that we were able to close the box with a lid. How many blocks fit in?  
**A** 6    **B** 7    **C** 8    **D** 9    **E** 10

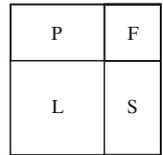


- M18.** A kangaroo noticed that each winter he put on 5 kilos and each summer he lost only 4 kilos. His weight is steady in spring and autumn. In the spring of 2008, he weighs 100 kg. How much did he weigh in the autumn of 2004?  
**A** 92 kg    **B** 93 kg    **C** 94 kg    **D** 96 kg    **E** 98 kg

- M19.** Jane shoots two arrows at the target. In the drawing we see that her score is 5. If both arrows hit the target, how many different scores can she obtain?  
**A** 4    **B** 6    **C** 8    **D** 9    **E** 10



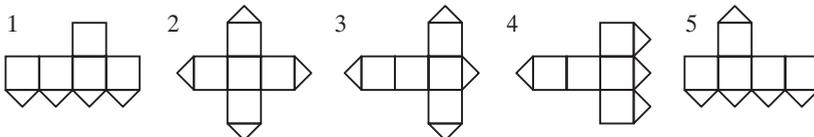
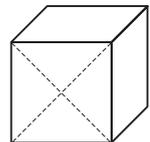
- M20.** A garden of a square shape is divided into a pool (P), a flowerbed (F), a lawn (L) and a sandpit (S) (see the picture). The lawn and the flowerbed are of a square shape. The perimeter of the lawn is 20 m, the perimeter of the flowerbed is 12 m. What is the perimeter of the pool?  
**A** 10 m    **B** 12 m    **C** 14 m    **D** 16 m    **E** 18 m



- M21.** Bill has as many brothers as sisters. His sister Ann has twice as many brothers as she has sisters. How many children are there in this family?  
**A** 3    **B** 4    **C** 5    **D** 6    **E** 7

- M22.** How many two-digit numbers are there in which the digit on the right is larger than the digit on the left?  
**A** 26    **B** 18    **C** 9    **D** 30    **E** 36

- M23.** One of the cube faces is cut along its diagonals (see the fig.). Which two of the following nets are impossible?  
**A** 1 and 3    **B** 1 and 5    **C** 3 and 4    **D** 3 and 5    **E** 2 and 4



- M24.** Seven cards are in a box. The numbers from 1 to 7 are written on these cards. The first sage takes at random 3 cards out of the box and the second sage takes 2 cards (2 cards are left in the box). Then, looking at his cards, the first sage says to the second one: “I know that the sum of the numbers of your cards is even”. What is the sum of card numbers of the first sage?  
**A** 10    **B** 12    **C** 6    **D** 9    **E** 15

## BENJAMIN (grades 5 and 6)

### 3-POINT QUESTIONS

**B1.** Which number is the smallest one?

A  $2 + 0 + 0 + 8$    B  $200 : 8$    C  $2 \cdot 0 \cdot 0 \cdot 8$    D  $200 - 8$    E  $8 + 0 + 0 - 2$

**B2.** By what can  be replaced to get:   $\cdot$   =  $2 \cdot 2 \cdot 3 \cdot 3$ ?

A 2   B 3   C 2 · 3   D 2 · 2   E 3 · 3

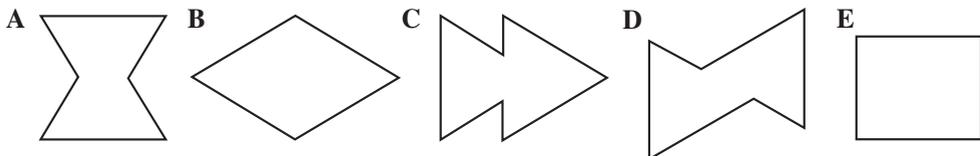
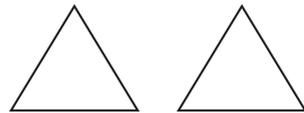
**B3.** John (J) likes to multiply by 3, Pete (P) likes to add 2, and Nick (N) likes to subtract 1. In what order should they perform their favourite actions to convert 3 into 14?

A JPN   B PJN   C JNP   D NJP   E PNJ

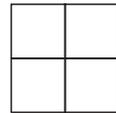
**B4.** To make the equality  $1 + 1\clubsuit 1 - 2 = 100$  correct, we should replace  $\clubsuit$  by

A +   B -   C :   D 0   E 1

**B5.** Carol is playing with two equilateral triangular cards shown. She puts one card beside or on the top of a part of the other and both on a sheet of paper. Then she draws on the paper around them, following the contour. She cannot get only one of the shapes. Which one is it?



**B6.** Numbers 2, 3, 4 and one more unknown number are written in the cells of  $2 \times 2$  table. It is known that the sum of the numbers in the first row is equal to 9, and the sum of the numbers in the second row is equal to 6. The unknown number is



A 5   B 6   C 7   D 8   E 4

**B7.** At a pirate school, each student had to sew a black and white flag. The condition was, that the black colour had to cover exactly three fifths of the flag. How many of the following flags fulfilled this condition?



A None   B One   C Two   D Three   E Four

**B8.** Before the snowball fight, Paul had prepared a few snowballs. During the fight, he has made another 17 snowballs and he threw 21 snowball at the other boys. After the fight, he had 15 snowballs left. How many snowballs had Paul prepared before the fight?

A 53   B 11   C 23   D 19   E 18

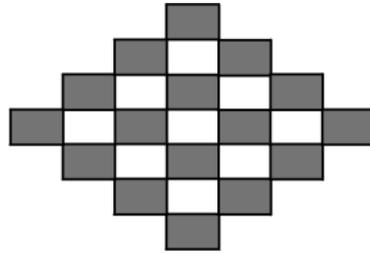
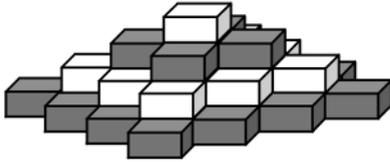
**B9.** This is a small piece of the multiplication table and another one, in which, unfortunately, some numbers are missing. What is the number in the square with the question mark?

A 54   B 56   C 65   D 36   E 42

×	4	3
5	20	15
7	28	21

×		
	35	63
	30	?

- B10.** In a shop selling toys a four-storey black and white “brickflower” is displayed (see picture on the left). Each storey is made of bricks of the same colour. In the picture on the right, the flower is shown from the top. How many white bricks were used to make the flower?



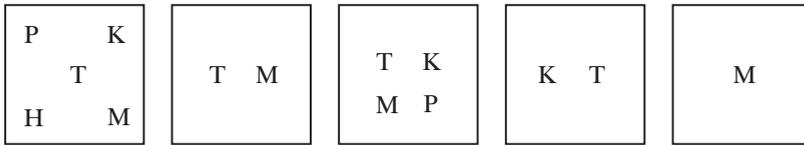
- A 9 B 10 C 12 D 13 E 14

#### 4-POINT QUESTIONS

- B11.** With what number of identical matches it is impossible to form a triangle?

- A 7 B 6 C 5 D 4 E 3

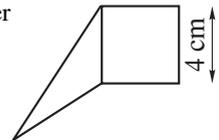
- B12.** There are 5 boxes and each box contains some cards labeled K, M, H, P, T, as shown below. Peter wants to remove cards out of each box so that at the end each box contained only one card, and different boxes contained cards with different letters. Which card remains in the first box?



- A It is impossible to do this B T C M D H E P

- B13.** The triangle and the square have the same perimeter. What is the perimeter of the whole figure (a pentagon)?

- A 12 cm B 24 cm C 28 cm D 32 cm  
E It depends on the lengths of triangle sides



- B14.** A circular table is surrounded by 60 chairs. What is the least number of people that could be seated at the table so that each of them had a neighbour?

- A 31 B 30 C 20 D 10 E None of the previous ones

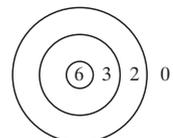
- B15.** A river starts at point A. As it flows the river splits into two. One branch takes  $\frac{1}{3}$  of the water and the second takes the rest. Later the second branch splits into two, one taking  $\frac{3}{4}$  of the branch's water, the other the rest. The map below shows the situation. What part of the original water flows at the point B?



- A  $\frac{1}{4}$  B  $\frac{2}{9}$  C  $\frac{1}{2}$  D  $\frac{1}{6}$  E Cannot be determined

- B16.** By shooting two arrows at the shown target on the wall, how many different scores can we obtain?

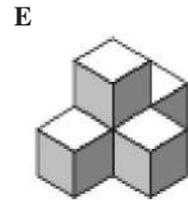
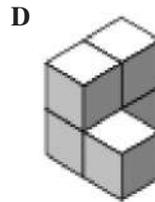
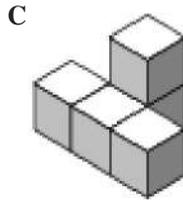
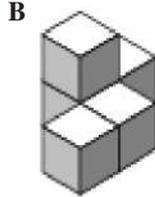
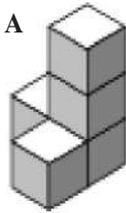
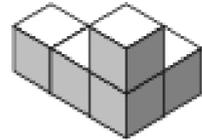
- A 4 B 6 C 8 D 9 E 10



**B17.** Rebeka wanted to put all her CDs on a shelf, but one third of them did not fit there. Those CDs that did not fit on the shelf were put into three cases. She put seven CDs into each, but there were still two more CDs, which did not fit into those cases, so she left them on the desk. How many CDs does Rebeka have?

- A 23   B 81   C 69   D 67   E 93

**B18.** Which of the “buildings” A–E, each consisting of 5 cubes, cannot be obtained from the building on the right, if you are allowed to move only one cube?



**B19.** Points  $A$ ,  $B$ ,  $C$  and  $D$  are marked on the straight line in some order. It is known that  $AB = 13$ ,  $BC = 11$ ,  $CD = 14$  and  $DA = 12$ . What is the distance between the farthest two points?

- A 14   B 38   C 50   D 25   E Another answer

**B20.** Two years later my son will be twice as old as he was two years ago. And three years later my daughter will be three times as old as she was three years ago. What is right?

- A The son is one year older   B The daughter is one year older  
 C They are of equal age   D The son is two years older  
 E The daughter is two years older

5-POINT QUESTIONS

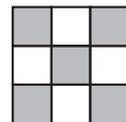
**B21.** The five signs @, \*, #, &,  $\nabla$  represent five different digits. Which digit does  $\nabla$  represent, if  $@ + @ + @ = *$ ,  $\# + \# + \# = \&$ ,  $* + \& = \nabla$ ?

- A 0   B 2   C 6   D 8   E 9

**B22.** 3 friends live on the same street: a doctor, engineer, and a musician. Their names are: Smith, Roberts, and Farrel. The doctor has neither sister, nor brother. He is the youngest among his friends. Farrel is older than the engineer and is married to the sister of Smith. The names of the doctor, engineer, and musician are as follows:

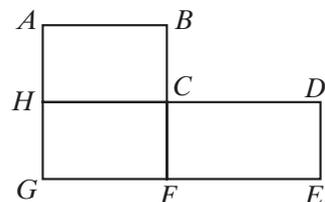
- A Smith, Roberts, Farrel   B Farrel, Smith, Roberts   C Roberts, Smith, Farrel  
 D Roberts, Farrel, Smith   E Smith, Farrel, Roberts

**B23.** Suppose you make a trip over the squared board shown, and you visit every square exactly once. Where must you start, if you can move only horizontally or vertically, but not diagonally?



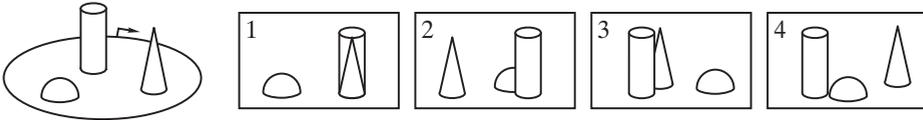
- A Only in the middle square   B Only at a corner square  
 C Only at an unshaded square   D Only at a shaded square   E At any square

**B24.** The picture shows the plan of a town. There are four circular bus routes in the town. Bus 1 follows the route  $CDEFGHC$ , which is 17 km long. Bus 2 goes  $ABCFGHA$ , and covers 12 km. The route of bus 3 is  $ABCDEFGHA$ , and is equal to 20 km. Bus 4 follows the route  $CFGHC$ . How long is this route?



- A 5 km   B 8 km   C 9 km   D 12 km   E 15 km

- B25.** Betty walked around the park once, starting from the marked point in the direction of the arrow. She took 4 pictures. In which order did she take the pictures?

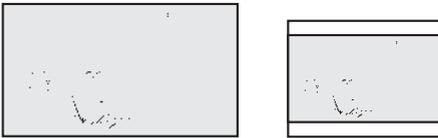


- A** 2 4 3 1   **B** 4 2 1 3   **C** 2 1 4 3   **D** 2 1 3 4   **E** 3 2 1 4

- B26.** Seven cards are in a box. The numbers from 1 to 7 are written on these cards. The first sage takes at random 3 cards out of the box and the second sage takes 2 cards (2 cards are left in the box). Then looking at his cards, the first sage says to the second one: "I know that the sum of the numbers of your cards is even". What is the sum of card numbers of the first sage?

- A** 10   **B** 12   **C** 6   **D** 9   **E** 15

- B27.** The new TV screens have the sides 16:9 and the old ones have the sides 4:3.



We have a DVD that occupies exactly all the screen 16:9. We want to watch this film on the old 4:3 screen. If the width of the film occupies exactly the width of the old screen, then the empty part of the screen is:

- A**  $\frac{1}{2}$    **B**  $\frac{1}{5}$    **C**  $\frac{1}{4}$    **D**  $\frac{1}{3}$    **E** It depends on the size of the screen

- B28.** For each 2-digit number, the digit of units was subtracted from the digit of tens. What is the sum of all the results?

- A** 90   **B** 100   **C** 55   **D** 45   **E** 30

- B29.** In the picture any letter stands for some digit (different letters for different digits, equal letters for equal digits). Find the value of the difference  $RN - KG$ .

$$\begin{array}{r} \text{KAN} \\ + \text{GA} \\ \hline \text{ROO} \end{array}$$

- A** 10   **B** 11   **C** 12   **D** 21   **E** 22

- B30.** How many digits can be erased at most from the 1000-digit number 2008 2008... 2008 so that the sum of the remaining digits were 2008?

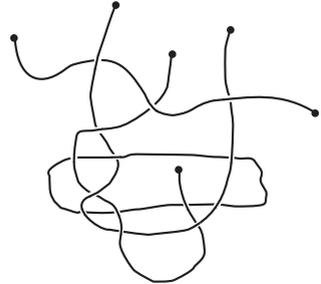
- A** 564   **B** 497   **C** 500   **D** 601   **E** 746

## CADET (grades 7 and 8)

### 3-POINT QUESTIONS

**C1.** How many pieces of string are there in the picture?

- A** 3   **B** 4   **C** 5   **D** 6   **E** 7



**C2.** There are 9 boys and 13 girls in a class. Half of the children in this class have got a cold. How many girls at least have a cold?

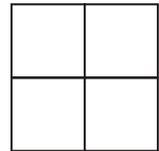
- A** 0   **B** 1   **C** 2   **D** 3   **E** 4

**C3.** 6 kangaroos eat 6 sacks of grass in 6 minutes. How many kangaroos will eat 100 sacks of grass in 100 minutes?

- A** 100   **B** 60   **C** 6   **D** 10   **E** 600

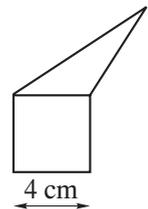
**C4.** Numbers 2, 3, 4 and one more unknown number are written in the cells of the  $2 \times 2$  table. It is known that the sum of numbers in the first row are equal to 9, and the sum of numbers in the second row is equal to 6. The unknown number is

- A** 5   **B** 6   **C** 7   **D** 8   **E** 4



**C5.** The triangle and the square are of the same perimeter. What is the perimeter of the whole figure (a pentagon)?

- A** 12 cm   **B** 24 cm   **C** 28 cm   **D** 32 cm  
**E** It depends on the lengths of triangle sides

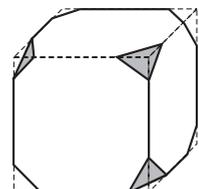


**C6.** The florist had 24 white, 42 red, and 36 yellow roses left. How many identical bunches can she make at most, if she wants to use all the remaining flowers?

- A** 4   **B** 6   **C** 8   **D** 10   **E** 12

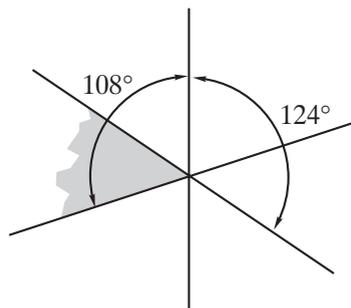
**C7.** A cube has all its corners cut off, as shown. How many edges does the resulting shape have?

- A** 26   **B** 30   **C** 36   **D** 40   **E** Another answer



**C8.** Three lines intersect at one point. Two angles are given in the figure. How many degrees does the grey angle have?

- A  $52^\circ$  B  $53^\circ$  C  $54^\circ$  D  $55^\circ$  E  $56^\circ$



**C9.** Dan has 9 coins, each being 2 litas; his sister Ann has 8 coins, each being 5 litas. What the least number of coins should they give to each other in order to equalize their money?

- A 4 B 5 C 8 D 12 E It is impossible to do

**C10.** How many squares can be drawn by joining the dots with line segments?

- A 2 B 3 C 4 D 5 E 6



**4-POINT QUESTIONS**

**C11.** With what number of identical matches is it impossible to form a triangle?

- A 7 B 6 C 5 D 4 E 3

**C12.** The famous mathematician Augustus de Morgan claimed that he was  $x$  years old in the year of  $x^2$ . He is known to have died in 1871. When was he born?

- A 1806 B 1848 C 1849 D 1899 E Another answer

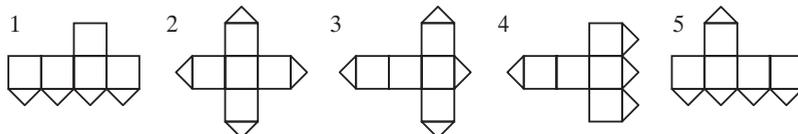
**C13.** We decided to visit four islands  $A$ ,  $B$ ,  $C$  and  $D$  by a ferry-boat starting from the mainland.  $B$  can be reached only from  $A$  or from the mainland,  $A$  and  $C$  are connected to each other and with the mainland, and  $D$  is connected only with  $A$ . What is the minimum necessary number of ferry runs, if we want to visit all the islands?

- A 6 B 5 C 8 D 4 E 7

**C14.** Tom and Jerry cut two equal rectangles. Tom got two rectangles with the perimeter of 40cm each, and Jerry got two rectangles with the perimeter of 50cm each. What were the perimeters of the initial rectangles?

- A 40cm B 50cm C 60cm D 80cm E 90cm

**C15.** One of the cube faces is cut along its diagonals (see the fig.). Which two of the following nets are impossible?

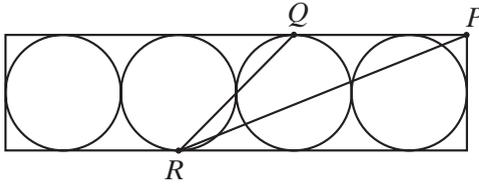


- A 1 and 3 B 1 and 5 C 3 and 4 D 3 and 5 E 2 and 4

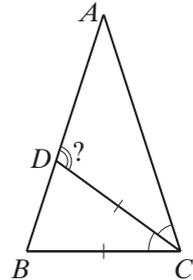
**C16.** Points  $A$ ,  $B$ ,  $C$ , and  $D$  are marked on the straight line in some order. It is known that  $AB = 13$ ,  $BC = 11$ ,  $CD = 14$  and  $DA = 12$ . What is the distance between the farthest two points?

- A 14 B 38 C 50 D 25 E Another answer

- C17. Four tangent congruent circles of radius 6 cm are inscribed in a rectangle.



- If  $P$  is a vertex and  $Q$  and  $R$  are the points of tangency, what is the area of triangle  $PQR$ ?  
 A  $27 \text{ cm}^2$  B  $45 \text{ cm}^2$  C  $54 \text{ cm}^2$  D  $108 \text{ cm}^2$  E  $180 \text{ cm}^2$
- C18. Seven cards are in a box. The numbers from 1 to 7 are written on these cards. The first sage takes at random 3 cards out of the box and the second sage takes 2 cards (2 cards are left in the box). Then, looking at his cards, the first sage says to the second one: "I know that the sum of the numbers of your cards is even". What is the sum of card numbers of the first sage?  
 A 10 B 12 C 6 D 9 E 15
- C19. In an isosceles triangle  $ABC$  ( $AB = AC$ ), the bisector  $CD$  of the angle  $C$  is equal to the base  $BC$ . Then the angle  $CDA$  is equal to  
 A  $90^\circ$  B  $100^\circ$  C  $108^\circ$  D  $120^\circ$   
 E Impossible to determine



- C20. A wooden cube  $5 \times 5 \times 5$  is obtained by sticking together  $5^3$  unit cubes. What is the largest number of unit cubes visible from some point?  
 A 75 B 74 C 60 D 61 E 62

### 5-POINT QUESTIONS

- C21. In the picture any letter stands for some digit (different letters for different digits, equal letters for equal digits). Find the largest possible value of the number KAN.

$$\begin{array}{r} \text{KAN} \\ - \text{GAR} \\ \hline \text{OO} \end{array}$$

- A 987 B 876 C 865 D 864 E 785
- C22. In a company of classmates, the girls make more than 45%, but less than 50%. What is the smallest possible number of girls in that company?  
 A 3 B 4 C 5 D 6 E 7
- C23. A boy always says the truth on Thursdays and Fridays, always tells lies on Tuesdays, and randomly tells the truth or lies on other days of the week. On seven consecutive days he was asked what his name was, and on the first six days he gave the following answers in turn: John, Bob, John, Bob, Pit, Bob. What did he answer on the seventh day?  
 A John B Bob C Pit D Kate E Another answer
- C24. Moving at constant speed, a lorry has driven from town  $A$  to town  $B$  in an hour and 30 min, and from town  $B$  to  $C$  in an hour. A car, moving by the same way also at constant speed, has driven from town  $A$  to  $B$  in an hour. How much time did its trip take from town  $B$  to  $C$ ?  
 A 45 min B 40 min C 35 min D 30 min E 90 min

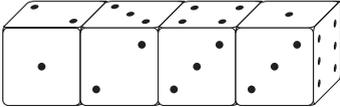
- C25.** Let us call three prime numbers special, if the product of these numbers is five times as great as their sum. How many special threes there exist?

**A** 0   **B** 1   **C** 2   **D** 4   **E** 6

- C26.** Two sets of five-digit numbers are given: set  $A$  of numbers, the product of digits of which is equal to 25, and set  $B$  of numbers, the product of digits of which is equal to 15. Which set consists of more numbers? How many times more numbers are there?

**A** Set  $A$ ,  $\frac{5}{3}$  times   **B** Set  $A$ , 2 times   **C** Set  $B$ ,  $\frac{5}{3}$  times  
**D** Set  $B$ , 2 times   **E** The numbers of elements are equal

- C27.** Four identical dice are arranged in a row (see the fig.).



Each dice has faces with 1, 2, 3, 4, 5 and 6 points, but the dice are not standard, i.e., the sum of the points on the opposite faces of the dice is not necessarily equal to 7. What is the total sum of the points in all the 6 touching faces of the dice?

**A** 19   **B** 20   **C** 21   **D** 22   **E** 23

- C28.** Some straight lines are drawn on the plane so that all angles  $10^\circ$ ,  $20^\circ$ ,  $30^\circ$ ,  $40^\circ$ ,  $50^\circ$ ,  $60^\circ$ ,  $70^\circ$ ,  $80^\circ$ ,  $90^\circ$  are among the angles between these lines. Determine the smallest possible number of these straight lines.

**A** 4   **B** 5   **C** 6   **D** 7   **E** 8

- C29.** The greatest common divisor of two positive integers  $m$  and  $n$  is 12, and their least common multiple is a square. How many squares are among the 5 numbers

$$\frac{n}{3}, \frac{m}{3}, \frac{n}{4}, \frac{m}{4}, m \cdot n?$$

**A** 1   **B** 2   **C** 3   **D** 4   **E** Impossible to determine

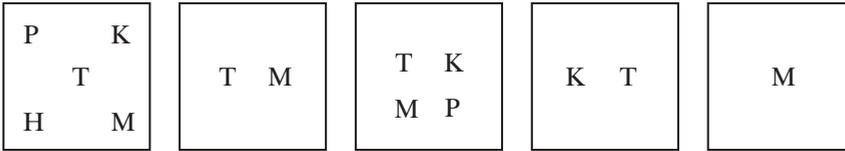
- C30.** Let  $M$  denote the product of the perimeter of a triangle and the sum of the three heights of the same triangle. Which of the following statements is false, if the area of the triangle is 1?

**A**  $M$  can be greater than 1000   **B** Always  $M > 6$    **C**  $M$  can be equal to 18  
**D** If the triangle is rectangular, then  $M > 16$    **E**  $M$  can be less than 12

## JUNIOR (grades 9 and 10)

### 3-POINT QUESTIONS

- J1.** There are 5 boxes and each box contains some cards labeled K, M, H, P, T, as shown below. Peter wants to remove cards out of each box so that at the end each box contained only one card, and different boxes contained cards with different letters. Which card remains in the first box?



- A** It is impossible    **B** T    **C** M    **D** H    **E** P
- J2.** Frank and Gabriel competed in running 200 meters. Gabriel ran the distance in half a minute, and Frank in a hundredth part of one hour. Who and by how many seconds was faster?
- A** Gabriel by 36 seconds    **B** Frank by 24 seconds    **C** Gabriel by 6 seconds  
**D** Frank by 4 seconds    **E** They did it by equal time
- J3.** To meet the New Year day 2008, Basil put on a T-shirt with  $\overline{2008}$  on it, and stood in front of a mirror on his hands, with his feet up. What number did Nick standing on his feet behind Basil see in the mirror?

**A**  $\overline{2008}$     **B**  $\overline{5008}$     **C**  $\overline{8002}$     **D**  $\overline{8005}$     **E**  $\overline{2005}$

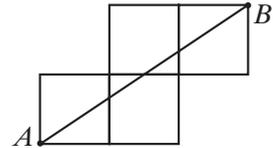
- J4.** How many of these results are not equal to 6?

$$2 - (-4); \quad (-2) \cdot (-3); \quad 0 - (-6); \quad 2 - 6; \quad (-12) : (-2).$$

**A** 0    **B** 1    **C** 2    **D** 4    **E** 5

- J5.** What is the length of line  $AB$  if the side of each of the four squares shown is 1?

**A** 5    **B**  $\sqrt{13}$     **C**  $\sqrt{5} + \sqrt{2}$     **D**  $\sqrt{5}$   
**E** None of the previous



- J6.** What the smallest number of letters should be removed from the word KANGOUROU so that the remaining letters were in the alphabetic order?

**A** 1    **B** 2    **C** 3    **D** 4    **E** 5

- J7.** In the picture any letter stands for some digit (different letters for different digits, equal letters for equal digits). Which digit is K?

**A** 0    **B** 1    **C** 2    **D** 8    **E** 9

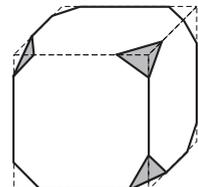
$$\begin{array}{r} \text{OK} \\ + \text{KO} \\ \hline \text{WOW} \end{array}$$

- J8.** Tom and Jerry cut two equal rectangles. Tom got two rectangles with the perimeter of 40 cm each, and Jerry got two rectangles with the perimeter of 50 cm each. What were the perimeters of the initial rectangles?

**A** 40 cm    **B** 50 cm    **C** 60 cm    **D** 80 cm    **E** 90 cm

- J9.** A cube has all its corners cut off, as shown. How many edges does the resulting shape have?

**A** 26    **B** 30    **C** 36    **D** 40    **E** 48



**J10.** On my first spelling test, I score one point out of five. If I now work hard and get full marks for every test, how many more tests should I take for my average to be four points?

- A 2 B 3 C 4 D 5 E 6

**4-POINT QUESTIONS**

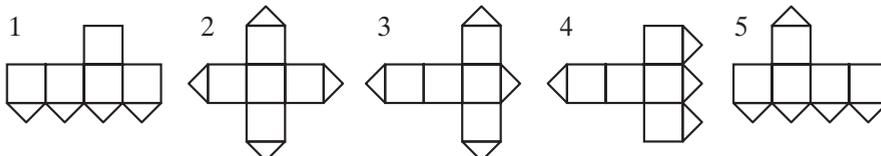
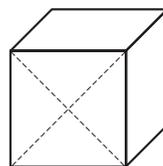
**J11.** Seven cards are in a box. The numbers from 1 to 7 are written on these cards. The first sage takes at random 3 cards out of the box and the second sage takes 2 cards (2 cards are left in the box). Then, looking at his cards, the first sage says to the second one: "I know that the sum of the numbers of your cards is even". What is the sum of card numbers of the first sage?

- A 10 B 12 C 6 D 9 E 15

**J12.** Bill has 10 cards, each of which bears exactly one of the numbers 3, 8, 13, 18, 23, 28, 33, 48, 53, 68. What the least number of these cards should Bill choose so that the sum of the numbers on the chosen cards were equal to 100?

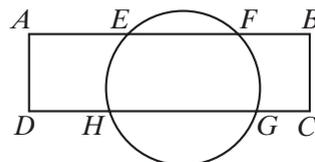
- A 2 B 3 C 4 D 5 E It is impossible to do

**J13.** One of the cube faces is cut along its diagonals (see the fig.). Which two of the following nets are impossible?



- A 1 and 3 B 1 and 5 C 3 and 4 D 3 and 5 E 2 and 4

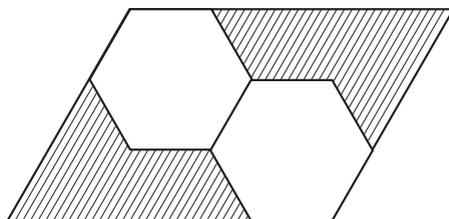
**J14.** Rectangle  $ABCD$  intersects the circle at points  $E, F, G, H$ . If  $AE = 4$  cm,  $EF = 5$  cm,  $DH = 3$  cm, then the length of  $HB$  is



- A 6 cm B 7 cm C  $\frac{20}{3}$  cm D 8 cm E 9 cm

**J15.** In the figure, two regular hexagons are equal to each other. What part of the parallelogram's area is shaded?

- A  $\frac{1}{2}$  B  $\frac{1}{3}$  C  $\frac{1}{4}$  D  $\frac{1}{5}$  E  $\frac{1}{6}$



**J16.** Six integers are marked on the real line (see the fig.). It is known that at least two of them are divisible by 3, and at least two of them are divisible by 5.



Which numbers are divisible by 15?

- A A and F B B and D C C and E D All the six numbers E Only one of them

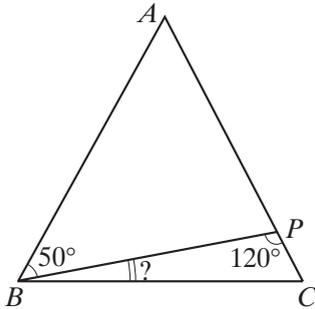
**J17.** 7 dwarfs were born on the same date, but in 7 consecutive years. The 3 youngest of them are 42 years old altogether. How many years old are the 3 oldest ones altogether?

- A 51 B 54 C 57 D 60 E 63

**J18.** How many digits can be erased at most from the 1000-digit number 2008 2008... 2008 so that the sum of the remaining digits were 2008?

A 564 B 497 C 500 D 601 E 746

**J19.** The picture shows an isosceles triangle with  $AB = AC$ .



If  $\angle BPC = 120^\circ$ ,  $\angle ABP = 50^\circ$ , then what is angle  $PBC$ ?

A  $5^\circ$  B  $10^\circ$  C  $15^\circ$  D  $20^\circ$  E  $25^\circ$

**J20.** How many pairs of real numbers there exist such that the sum, the product, and the quotient of these two numbers were equal?

A 0 B 1 C 2 D 4 E 8

### 5-POINT QUESTIONS

**J21.** Each digit, starting from the third one, in the decimal representation of a six-digit number is equal to the sum of two previous digits. How many six-digit numbers possess this property?

A No one B 1 C 2 D 4 E 6

**J22.** I have a wooden cube, with three red sides and three blue. When cutting this cube into  $3 \times 3 \times 3 = 27$  equal small cubes, how many of these have at least one side red and at least one side blue?

A 6 B 12 C 14 D 16

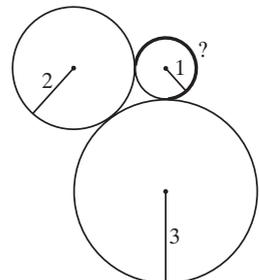
E It depends on which sides of the big cube are red and which blue

**J23.** If  $1 \cdot 2 \cdot 3 \cdot \dots \cdot (n-1) \cdot n = 2^{15} \cdot 3^6 \cdot 5^3 \cdot 7^2 \cdot 11 \cdot 13$ , then  $n =$

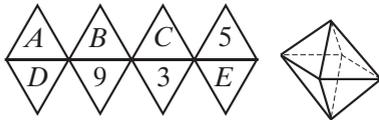
A 13 B 14 C 15 D 16 E 17

**J24.** Find the length of the arc denoted by the interrogation sign.

A  $\frac{5\pi}{4}$  B  $\frac{5\pi}{3}$  C  $\frac{\pi}{2}$  D  $\frac{3\pi}{2}$  E  $\frac{2\pi}{3}$



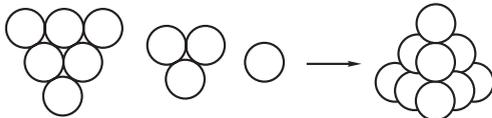
- J25.** This network of eight equilateral triangles can be folded to form a regular octahedron. To construct a magic octahedron, replace the letters  $A, B, C, D,$  and  $E$  with the numbers 2, 4, 6, 7, and 8 (without repetition) so that each sum of the four numbers on the four faces that share a vertex were the same.



On your magic octahedron, what does  $B + D$  equal?

- A** 6 **B** 7 **C** 8 **D** 9 **E** 10

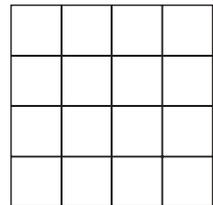
- J26.** A 3-pyramid is a stack of the following 3 layers of balls.



In the same way we have a 4-pyramid, a 5-pyramid, etc. All the outside balls of an 8-pyramid are removed. What kind of figure form the rest balls?

- A** 3-pyramid **B** 4-pyramid **C** 5-pyramid **D** 6-pyramid **E** 7-pyramid

- J27.** A square  $4 \times 4$  table is divided into 16 unit squares (see the fig.) Find the maximum possible number of diagonals one can draw in these unit squares so that neither two of them had any common point (including endpoints).



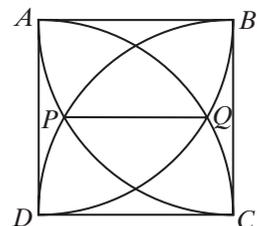
- A** 8 **B** 9 **C** 10 **D** 11 **E** 12

- J28.** Kanga always jumps 1 m or 3 m long. Kanga wants to go exactly 10 m. (We consider  $1 + 3 + 3 + 3$  and  $3 + 3 + 3 + 1$  as two different possibilities.) How many possibilities are there?

- A** 28 **B** 34 **C** 35 **D** 55 **E** 56

- J29.** In the picture  $ABCD$  is a square of side 1 and the semicircles have centers on  $A, B, C$  and  $D$ . What is the length of  $PQ$ ?

- A**  $2 - \sqrt{2}$  **B**  $\frac{3}{4}$  **C**  $\sqrt{5} - \sqrt{2}$  **D**  $\frac{\sqrt{3}}{3}$  **E**  $\sqrt{3} - 1$



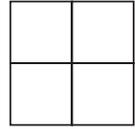
- J30.** How many 2008-digit numbers there exist, in which every two-digit number composed of two neighbouring digits is divisible either by 17 or by 23?

- A** 5 **B** 6 **C** 7 **D** 9 **E** More than 9

## STUDENT (grades 11 and 12)

### 3-POINT QUESTIONS

- S1.** Numbers 3, 4 and two other unknown numbers are written in the cells of the  $2 \times 2$  table. It is known that the sums of numbers in the rows are equal to 5 and 10, and the sum of numbers in one of the columns is equal to 9. The larger number of the two unknown ones is



A 5   B 6   C 7   D 8   E 3

- S2.** If  $x + y = 0$  and  $x \neq 0$ , then  $x^{2008} : y^{2008} =$

A  $-1$    B 0   C 1   D  $2^{2008}$    E  $\frac{x}{y}$

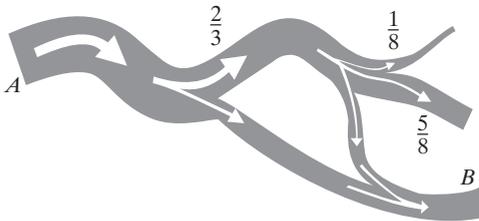
- S3.** An array contains 21 columns numbered 1, 2, ..., 21, and 33 rows numbered 1, 2, ..., 33. We erase the rows whose number is not a multiple of 3 and also the columns whose number is even. How many cells of the array remain after that?

A 110   B 121   C 115   D 119   E 242

- S4.** How many prime numbers  $p$  have the property that  $p^4 + 1$  is prime as well?

A 0   B 1   C 2   D 3   E Infinitely many

- S5.** A river starts at point  $A$ . As it flows the river splits into two. The first branch takes  $\frac{2}{3}$  of the water and the second takes the rest. Later the first branch splits into three, one taking  $\frac{1}{8}$  of the branch's water, the second  $\frac{5}{8}$  and the third one the rest. Further down this last branch meets again a branch of the river. The map below shows the situation.

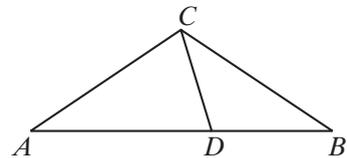


What part of the original water flows at point  $B$ ?

A  $\frac{1}{3}$    B  $\frac{5}{4}$    C  $\frac{2}{9}$    D  $\frac{1}{2}$    E  $\frac{1}{4}$

- S6.** Given an isosceles triangle  $ABC$ ,  $CA = CB$ ,  $AD = AC$ ,  $DB = DC$  (see the fig.). Find the value of the angle  $ACB$ .

A  $98^\circ$    B  $100^\circ$    C  $104^\circ$    D  $108^\circ$    E  $110^\circ$

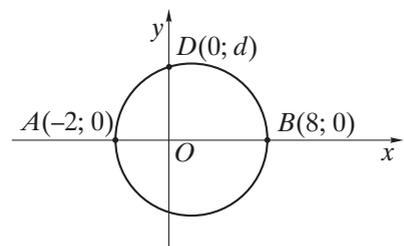


- S7.** The maximum value of  $f(x) = |5 \sin x - 3|$ ,  $x \in R$ , is

A 2   B 3   C  $\pi$    D  $5\pi$    E 8

- S8.** The figure shows a circle with the diameter  $AB$  and point  $D$  on it. Find  $d$ .

A 3   B  $2\sqrt{3}$    C 4   D 5   E 6



**S9.** We have five different points  $A_1, A_2, A_3, A_4$  and  $A_5$ , arranged in this order on a straight line. Point  $P$  is placed on the same line so that the sum of the distances  $PA_1 + PA_2 + PA_3 + PA_4 + PA_5$  were minimal. Then point  $P$  is

- A**  $A_1$    **B**  $A_2$    **C**  $A_3$    **D** any point between  $A_2$  and  $A_4$   
**E** any point between  $A_1$  and  $A_5$

**S10.** Nora wants to have two digits instead of the asterisks in  $2**8$  such that the complete four-digit number were divisible by 3. How many possibilities are there?

- A** 29   **B** 30   **C** 19   **D** 20   **E** 33

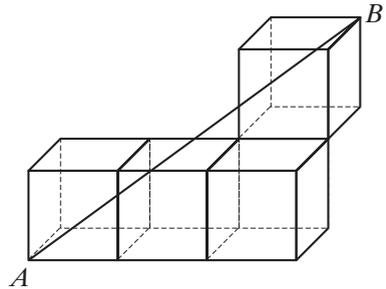
#### 4-POINT QUESTIONS

**S11.** Here are seven numbers:  $-9, 0, -5, 5, -4, -1, -3$ . We arranged six of them in groups of two so that the sum in each group is the same. Which number remains free?

- A** 5   **B** 0   **C**  $-3$    **D**  $-4$    **E**  $-5$

**S12.** Each of the cubes in the figure has the length of an edge equal to 1. What is the length of the segment  $AB$ ?

- A**  $\sqrt{17}$    **B** 7   **C**  $\sqrt{13}$    **D**  $\sqrt{7}$    **E**  $\sqrt{14}$



**S13.** Five problems are proposed for a mathematical competition. Since the problems are of different difficulty level, no two of them have the same point value (all point values are positive integers). Bill solved all the five problems and he obtained a total of 10 points for two problems with the lowest point values and a total of 18 points for two problems with the highest point values. How many points did Bill obtain?

- A** 30   **B** 32   **C** 34   **D** 35   **E** 40

**S14.** Mathilde drew 36 kangaroos using three different colours. 25 of the kangaroos contain some yellow, 28 some brown, and 20 some black colour. Only 5 of them have all the three colours. How many single-colour kangaroos did she draw?

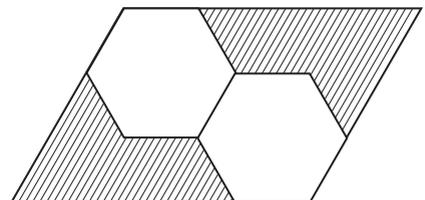
- A** None   **B** 4   **C** 12   **D** 31   **E** It's impossible to know

**S15.** If  $\sin x + \cos x = m$ , then  $\sin^4 x + \cos^4 x =$

- A**  $1 - \frac{(1-m^2)^2}{2}$    **B**  $1 + \frac{(1-m^2)^2}{2}$    **C**  $\frac{1-(1-m^2)^2}{2}$    **D**  $m^4$    **E**  $m^4 + 1$

**S16.** In the figure the two regular hexagons are congruent. What part of the parallelogram's area is shaded?

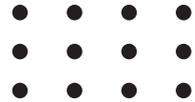
- A**  $\frac{1}{2}$    **B**  $\frac{1}{3}$    **C**  $\frac{1}{4}$    **D**  $\frac{1}{5}$    **E**  $\frac{1}{6}$



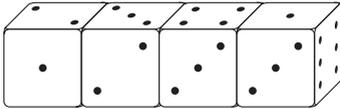
- S17.** The numerator and denominator of a fraction are negative numbers, and the numerator is larger by one than the denominator. Which of the following is true about the fraction?
- A** The fraction is a number less than  $-1$   
**B** The fraction is a number between  $-1$  and  $0$   
**C** The fraction is a positive number less than  $1$   
**D** The fraction is a number greater than  $1$   
**E** It cannot be determined whether the fraction is positive or negative

- S18.** Suppose  $x^2yz^3 = 7^3$  and  $xy^2 = 7^9$ . Then  $xyz =$
- A**  $7^4$    **B**  $7^6$    **C**  $7^8$    **D**  $7^9$    **E**  $7^{10}$

- S19.** We take three points from the grid so that they were col-linear. How many possibilities do we have?
- A** 18   **B** 20   **C** 22   **D** 220   **E** 14



- S20.** Four identical dice are arranged in a row (see the fig.).



Each dice has faces with 1, 2, 3, 4, 5 and 6 points, but the dice are not standard, i.e., the sum of the points on the opposite faces of the dice is not necessarily equal to 7. What is the total sum of the points in all the 6 touching faces of the dice?

- A** 19   **B** 20   **C** 21   **D** 22   **E** 23

### 5-POINT QUESTIONS

- S21.** The lengths of the edges of a block (rectangular parallelepiped) in centimetres are integers and they form a geometric progression with the quotient  $q = 2$ . Which of the following numbers can be the volume of this solid?

- A** 120   **B** 188   **C** 216   **D** 350   **E** 500

- S22.** In the figure each asterisk stands for one digit. The sum of the digits of the product is equal to

- A** 16   **B** 20   **C** 26   **D** 30   **E** Another answer

$$\begin{array}{r}
 \times \quad * * * \\
 \quad \quad 1 * * \\
 \hline
 \quad \quad 2 2 * * \\
 + \quad 9 0 * \\
 \quad \quad * * 2 \\
 \hline
 5 6 * * *
 \end{array}$$

- S23.** Find the value of the expression  $x^2 + y^2 + z^2$ , if  $x + y + z = 1$ , and  $\frac{1}{x} + \frac{1}{y} + \frac{1}{z} = 0$ .

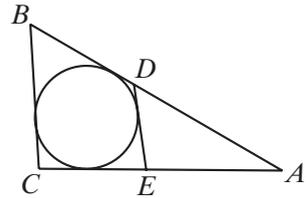
- A** 0   **B** 1   **C** 2   **D** 3   **E** It is impossible to determine

- S24.** A sequence is defined by  $a_1 = 0$  and  $a_{n+1} = a_n + (-1)^n \cdot n$ ,  $n \geq 1$ . If  $a_k = 2008$ , then the value of  $k$  is

- A** 2008   **B** 2009   **C** 4017   **D** 4018   **E** Other

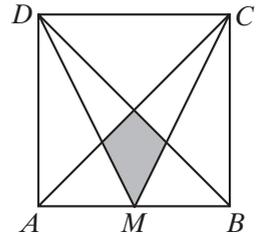
- S25.** A circle is inscribed in the triangle  $ABC$  (see the figure),  $AC = 5$ ,  $AB = 6$ ,  $BC = 3$ . The segment  $ED$  is tangent to the circle. The perimeter of the triangle  $ADE$  is

**A** 7   **B** 4   **C** 9   **D** 6   **E** 8



- S26.** The square  $ABCD$  has a side of length 1 and  $M$  is the midpoint of  $AB$ . The area of the shaded region is

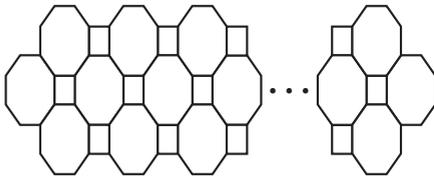
**A**  $\frac{1}{24}$    **B**  $\frac{1}{16}$    **C**  $\frac{1}{8}$    **D**  $\frac{1}{12}$    **E**  $\frac{2}{13}$



- S27.** Seven cards are in a box. The numbers from 1 to 7 are written on these cards. The first sage takes at random 3 cards out of the box and the second sage takes 2 cards (2 cards are left in the box). Then, looking at his cards, the first sage says to the second one: “I know that the sum of the numbers of your cards is even”. What is the sum of card numbers of the first sage?

**A** 10   **B** 12   **C** 6   **D** 9   **E** 15

- S28.** We used metal rods to build this nice ensemble. We know there are 61 octagons.



How many rods are there?

**A** 488   **B** 400   **C** 328   **D** 244   **E** 446

- S29.** The number  $3^{32} - 1$  has exactly two divisors which are larger than 75 and smaller than 85. What is the product of these two divisors?

**A** 5852   **B** 6560   **C** 6804   **D** 6888   **E** 6972

- S30.** How many 2008-digit numbers there exist, in which every two-digit number composed of two sequential digits is divisible either by 17 or by 23?

**A** 5   **B** 6   **C** 7   **D** 9   **E** More than 9

# International Mathematics Contest 2008

## Answer of Questions

Q. No.	Ecolier Level
1	B
2	B
3	A
4	A
5	A
6	B
7	A
8	A
9	B
10	B
11	B
12	A
13	A
14	A
15	A
16	A
17	A
18	B
19	B
20	B

Q. No.	Benjamin Level
1	C
2	C
3	B
4	C
5	B
6	D
7	A
8	D
9	D
10	C
11	B
12	A
13	D
14	A
15	C
16	D
17	D
18	B
19	D
20	C

Q. No.	Cadet Level
1	A
2	C
3	C
4	B
5	A
6	B
7	B
8	A
9	B
10	B
11	B
12	A
13	B
14	C
15	D
16	C
17	D
18	B
19	B
20	C
21	C
22	A
23	B
24	B
25	B

Q. No.	Junior Level
1	D
2	C
3	B
4	B
5	B
6	D
7	A
8	C
9	C
10	B
11	B
12	D
13	D
14	B
15	A
16	A
17	B
18	E
19	A
20	B
21	D
22	E
23	D
24	D
25	B
26	B
27	C
28	A
29	E
30	D

Q. No.	Student Level
1	B
2	C
3	B
4	B
5	D
6	D
7	E
8	C
9	C
10	E
11	E
12	A
13	D
14	B
15	A
16	A
17	C
18	A
19	B
20	B
21	C
22	A
23	B
24	C
25	E
26	D
27	B
28	E
29	B
30	A

**Kangaroo of Mathematics 2009**  
**Level Écolier ( Grades 3. and 4.)**  
**Austria - 23.3.2009**



**- 3 point questions -**

1)  $2 \times 9 + 200 + 9 =$

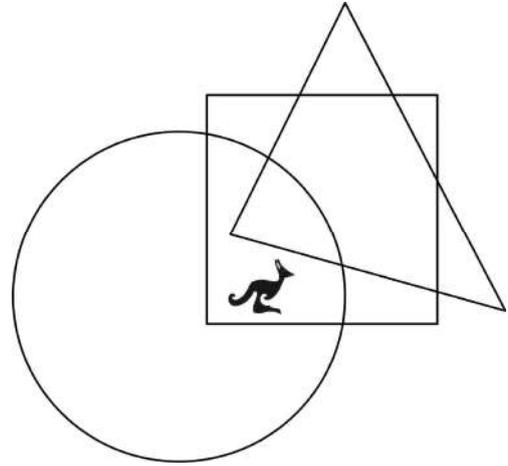
- A) 292    B) 209    C) 290    D) 272    E) 227

2) Four sticks have 8 ends. How many ends do 7 sticks have?

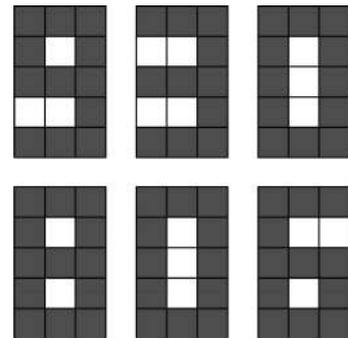
- A) 6    B) 8    C) 12    D) 13    E) 14

3) Where is the Kangaroo?

- A) In the circle and in the triangle but not in the square.  
 B) In the circle and in the square but not in the triangle.  
 C) In the triangle and in the square but not in the circle.  
 D) In the circle but in neither the square or the triangle.  
 E) In the square but in neither the circle or the triangle.



4) In the picture you see the number 930. How many small squares must be changed so that the number becomes 806?

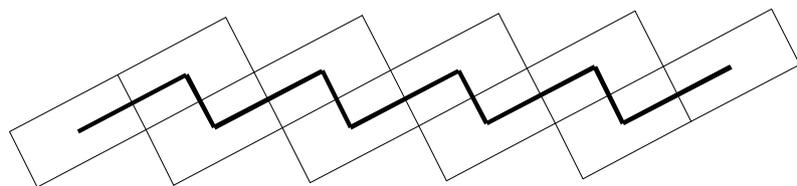


- A) 5    B) 6    C) 7    D) 8    E) 9

5) Mother bought 16 mandarins. Karl ate half of them, Eva ate two, und Dana ate the rest. How many mandarins did Dana eat?

- A) 4    B) 6    C) 8    D) 10    E) 12

6) In his garden Tony made a pathway using 10 paving stones . Each paver was 4 dm wide and 6 dm long. He then drew a black line connecting the middle points of each paving stone. How long is the black line?



- A) 24 dm    B) 40 dm    C) 46 dm    D) 50 dm    E) 56 dm

7) Sophie rolled a die four times and scored a total of 23 points. How often did she roll a six?

- A) 0      B) 1      C) 2      D) 3      E) 4

8) A certain film lasts 90 minutes. It begins at 17:10. During the film there are two advert breaks, one lasting eight minutes and the other five minutes. At what time will the film end?

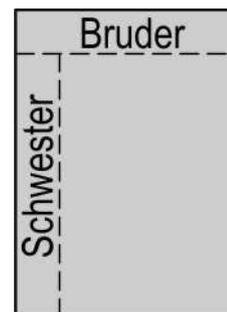
- A) um 18:13    B) um 18:27    C) um 18:47    D) um 18:53    E) um 19:13

**- 4 point questions -**

9) In a dance group there are 25 boys and 19 girls. Every week 2 more boys and 3 more girls join the group. After how many weeks will there be the same number of boys as girls in the dance group?

- A) 6      B) 5      C) 4      D) 3      E) 2

10) Peter shared a bar of chocolate. First he broke off a row with five pieces for his brother. Then he broke off a column with 7 pieces for his sister. How many pieces were there in the entire bar of chocolate?

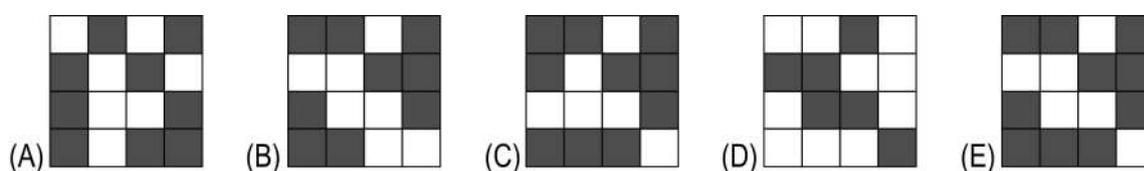
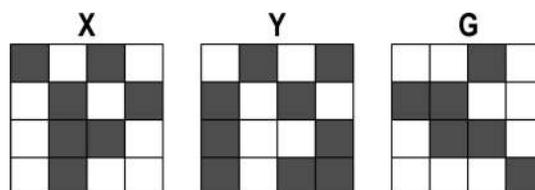


- A) 28      B) 32      C) 35      D) 40      E) 54

11) A farmer has 30 cows, some chickens and no other animals. The total number of chickens legs is equal to the total number of cows legs. How many animals does the farmer have?

- A) 60      B) 90      C) 120      D) 180      E) 240

12) Picture X is paired with picture Y. Which of the following pictures is paired with picture G?

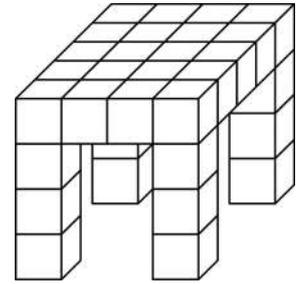


13) The length of a rectangle is 8cm. The width is half as long. How long are the sides of a square that has the same perimeter as the rectangle?

- A) 4 cm    B) 6 cm    C) 8 cm    D) 12 cm    E) 24 cm

14) Thomas has made a table out of small cubes. How many small cubes did he use?

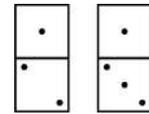
- A) 24    B) 26    C) 28    D) 32    E) 36



15) Three squirrels Anni, Asia and Elli have collected 7 nuts. They have all collected a different amount of nuts, and everybody has collected at least one nut. Anni has collected the least and Asia the most. How many nuts has Elli collected?

- A) 1    B) 2    C) 3    D) 4    E) Not possible to answer.

16) Which of the following diagrams is impossible to make with the two dominos?



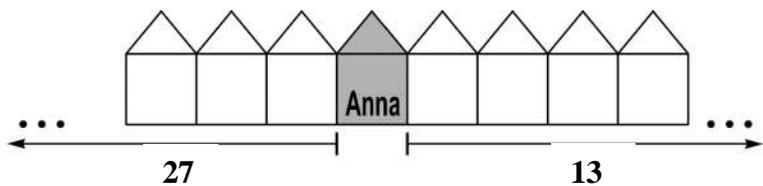
- (A) (B) (C) (D) (E)

**- 5 point Questions -**

17) A white and a black pig weigh together 320 kg. The black pig weighs 32kg more than the white one. How much does the white pig weigh?

- A) 128 kg    B) 144 kg    C) 160 kg    D) 176 kg    E) 192 kg

18) Anna and Peter live in the same street. On one side of Anna's house there are 27 houses, and on the other side 13 houses. Peter lives in the house right in the middle of the street. How many houses are there between Anna's and Peter's houses?



- A) 6    B) 7    C) 8    D) 14    E) 21

19) A secret agent wants to crack a six digit code. He knows that the sum of the digits in the even positions is equal to the sum of the digits in the odd positions. Which of the following numbers is the code?

- A) 81\*\*61    B) 7\*727\*    C) 4\*4141    D) 12\*9\*8    E) 181\*2\*

20) Meta collects pictures of famous sports people. Each year she collects as many pictures as she did in the previous two years. In 2008 she had 60 photos and this year she has 96. How many photos did she have in 2006?

- A) 20      B) 24      C) 36      D) 40      E) 48

21) In a vase there is one red, one blue, one yellow and one white flower. Maja the bee visits each flower exactly once. She begins with the red flower and she never flies directly from the yellow to the white flower. In how many different ways can she visit each flower?

- A) 1      B) 2      C) 3      D) 4      E) 6

22) In a haunted house the house ghost suddenly disappears. At that moment in time all clocks show 6:15 o'clock. However, there is also one strange clock in the house that shows the correct time before that event. Starting from the disappearance it starts to count backwards. At 19:30 o'clock according to the real time the house ghost reappears. What time does the odd clock show at that time?

- A) 17:00    B) 17:45    C) 18:30    D) 19:00    E) 19:15

23) Sylvia draws shapes made up of straight lines which are each 1cm long. At the end of each line she continues in a right angle either to the left or right. At every turn she notes down either a ♥ or a ♠ on a piece of paper. The same symbol always indicates a turn in the same direction. Today her notes show ♥♠♠♥♥♥. Which of the following shapes could she have drawn today if A indicates her starting point?



24) In Funny-Foot-Land men and women wear the same sort of shoes. Each man has a left foot that is two sizes bigger than the right foot. Each woman has a left foot that is one size bigger than the right foot. However, shoes are only sold in pairs of the same size. To save money some friends decide to buy shoes together. After putting on their new shoes two shoes are left over ó one of size 36 and one of size 45. What is the minimum number of people in that group?

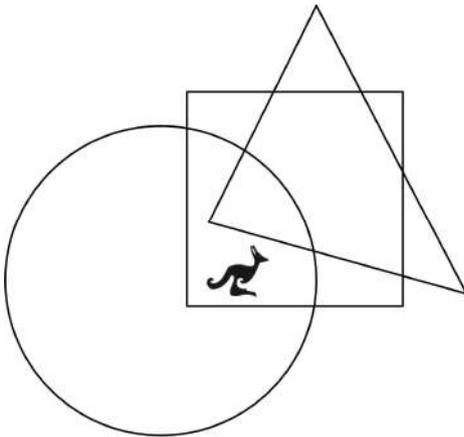
- A) 5      B) 6      C) 7      D) 8      E) 9

**Kangaroo of Mathematics 2009**  
**Level Benjamin (Grades 5. and 6.)**  
**Austria - 23.3.2009**



**- 3 Point Questions -**

1) Where is the Kangaroo?



- A) In the circle and in the triangle but not in the square.
- B) In the circle and in the square but not in the triangle.
- C) In the triangle and in the square but not in the circle.
- D) In the circle but in neither the square or the triangle.
- E) In the square but in neither the circle or the triangle.

2) Which of the following numbers is even?

- A) 2009      B)  $2 + 0 + 0 + 9$       C)  $200 \div 9$       D)  $200 \times 9$       E)  $200 + 9$

3) How many Natural numbers lie between 2·009 und 23·03?

- A) 20      B) 21      C) 22      D) 23      E) mehr als 23

4) What is the minimum number of digits that must be removed from the number 12323314, so that the resulting number is the same when read from either left to right or right to left?

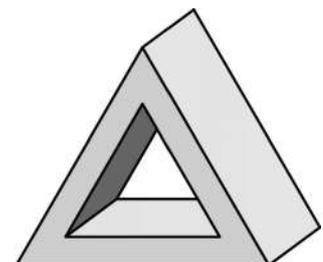
- A) 1      B) 2      C) 3      D) 4      E) 5

5) In front of me there are three boxes, one white, one red and one green. In one box there is a chocolate bar, in another an apple and one box is empty. The chocolate bar is in either the white or red box. And the apple is in neither the white or the green box. In which box is the chocolate bar?

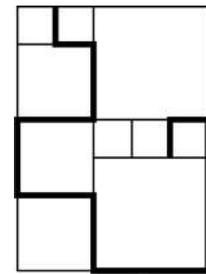
- A) White      B) Red      C) Green  
D) red or green      E) not possible to answer.

6) How many faces has the object shown?  
(Prism with a hole)

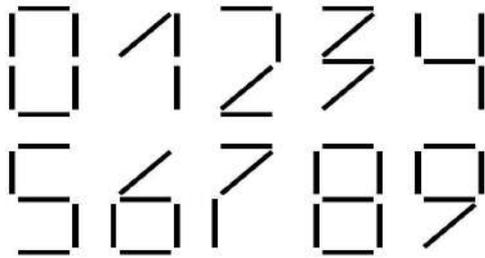
- A) 3      B) 5      C) 6      D) 8      E) 12



7) The diagram shows squares of different sizes. The side length of the smallest square is 20 cm. How long is the black line?



- A) 380 cm B) 400 cm C) 420 cm D) 440 cm E) 1680 cm



8) The different digits are build using sticks as shown. The õweightö of a number describes the number of sticks used to build it. How heavy is the heaviest two digit number?

- A) 10 B) 11 C) 12 D) 13 E) 14

**- 4 Point Questions -**

9) A bridge is being build over a 120m wide river. One quarter of the bridge continues on land on the left bank, another quarter continues on land on the right bank. How long is the bridge?

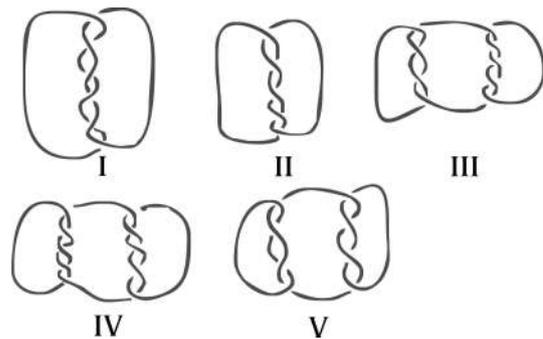
- A) 150 m B) 180 m C) 210 m D) 240 m E) 270 m

10) In a park there are some cats and dogs. The number of cats feet is double the size of the number of dogs noses. The number of cats is  $\frac{1}{6}$  of the number of dogs.

- A) double the size B) half the size C) the same size  
D) a quarter the size E) a sixth of the size.

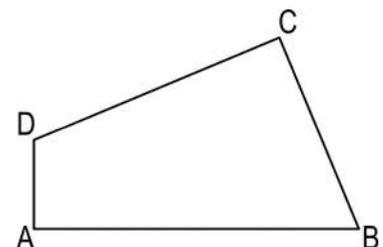
11) Which of the following is made using more than one piece of string?

- A) I, III, IV and V B) III, IV and V  
C) I, III and V D) all  
E) None of these answers



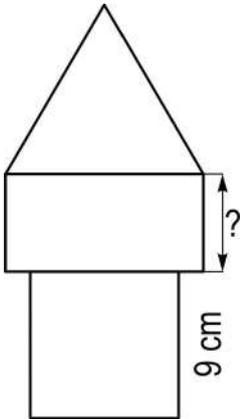
12) The quadrilateral on the right has the following side lengths:  $AB = 11$ ,  $BC = 7$ ,  $CD = 9$  and  $DA = 3$ . The angles at points A and C are right angles. What is the area of the quadrilateral?

- A) 30 B) 44 C) 48 D) 52 E) 60



13) In a dance group there are 39 boys and 23 girls. Every week 6 more boys and 8 more girls join the group. After a few weeks there will be the same number of boys as girls in the dance group. How many boys and girls will be in the dance group at that time?

- A) 144      B) 154      C) 164      D) 174      E) 184



14) The štowerõ in the diagram on the left is made up of a square, a rectangle and an equilateral triangle. Each of those three shapes has the same perimeter. The side length of the square is 9cm. How long is the side of the rectangle indicated?

- A) 4 cm      B) 5 cm      C) 6 cm      D) 7 cm      E) 8 cm

15) We want to build a box with the measurements  $40 \times 40 \times 60$  using all identical cubes. What is the minimum number of cubes needed?

- A) 6      B) 12      C) 96      D) 1200      E) 96000

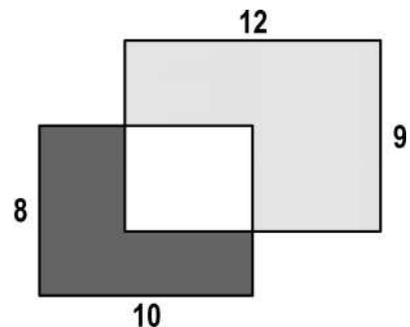
16) Today is Sunday. Francis starts to read a book with 290 pages today. Sundays he reads 25 pages and on all other days he reads 4 pages, with no exception. How many days does it take him to read the entire book?

- A) 5      B) 46      C) 40      D) 35      E) 41

**- 5 Point Questions -**

17) Two rectangles with measurements  $8 \times 10$  and  $9 \times 12$  overlap to some extent. The dark grey area is 37. What is the area of the light grey part?

- A) 60      B) 62      C) 62,5      D) 64      E) 65



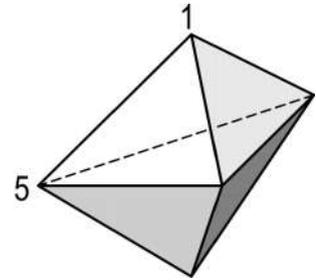
18) Eight cards that are numbered 1 to 8 are inside two boxes A and B so that the sum of the cards in both boxes is identical. If there are exactly 3 cards in box A then which of the following statements is definitely true:

- A) Three cards in B are odd numbers.  
 B) Four cards in B are even numbers.  
 C) The card numbered 1 is not in B.  
 D) The card numbered 2 is in B.  
 E) The card numbered 5 is in B.

19) Andrea, Branimir, Celestin and Doris (but not necessarily in this order) are ranked one to four in a fencing tournament. If you add Andrea's, Branimir's and Doris's rank, your total is 6. You obtain the same number if you add Branimir's and Celestin's rank. Who won the tournament, if Branimir did better than Andrea?

- A) Andrea B) Branimir C) Celestin D) Doris E) It cannot be determined.

20) In the diagram opposite there is an object with 6 triangular faces. On each corner there is a number (two are shown). The sum of the numbers on the corners of each triangle is the same. What is the sum of all 5 numbers?

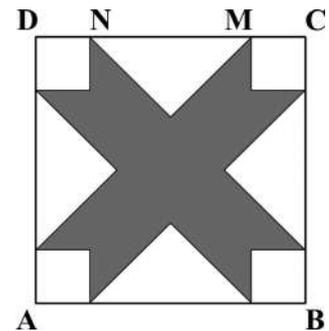


- A) 9 B) 12 C) 17 D) 18 E) 24

21) The rooms in a hotel are numbered with three digit numbers each. The first digit determines the floor and the last two digits the number of the room on each floor; e.g. room 125 is on the 1<sup>st</sup> floor, room number 25. The hotel has 5 floors (from 1 to 5) and 35 rooms on each floor, i.e. on the 1<sup>st</sup> floor you have room numbers 101 to 135 etc. How often does the digit 2 appear in all room numbers of the hotel?

- A) 60 times B) 65 times C) 95 times  
D) 100 times E) 105 times

22) ABCD is a square with side length 10cm. The distance of N to M measures 6cm. Each area not shaded grey is either a square or an isosceles triangle. How big is the area shaded in grey?



- A) 42 cm<sup>2</sup> B) 46 cm<sup>2</sup> C) 48 cm<sup>2</sup> D) 52 cm<sup>2</sup> E) 58 cm<sup>2</sup>

■	□	■	11
□	■	△	8
□	△	■	8
10	8	9	

23) In the diagram on the left the total of each row and column is given. What is the value of □ ?

- A) 3 B) 4 C) 5 D) 6 E) 7

24) We want to paint each square in the grid with the colours A, B, C and D, so that neighbouring squares always have different colours. (Squares which share the same corner point also count as neighbouring.) Some of the squares are already painted. In which colour(s) could the grey square be painted?

A	B		C	D

- A) A B) B C) C D) D E) There are two possibilities.

**Kangaroo of Mathematics 2009**  
**Level Kadett ( Grades 7. and 8. )**  
**Austria - 23.3.2009**



- 3 point questions -

1) Which of the following is an even number?

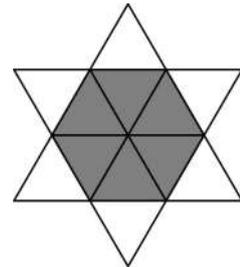
- A) 2009    B)  $2 + 0 + 0 + 9$     C)  $200 \div 9$     D)  $200 \times 9$     E)  $200 + 9$

2) At a party there were 4 boys and 4 girls. Boys only danced with girls and girls only danced with boys. At the end of the evening each person was asked how many people they had danced with. The boys gave the answers 3, 1, 2, 2 and three of the girls answered 2. Which answer did the fourth girl give?

- A) 0    B) 1    C) 2    D) 3    E) 4

3) The star shown in the picture is made by fitting together 12 congruent equilateral triangles. The perimeter of the star is 36cm. What is the perimeter of the grey hexagon?

- A) 6 cm    B) 12 cm    C) 18 cm    D) 24 cm    E) 30 cm

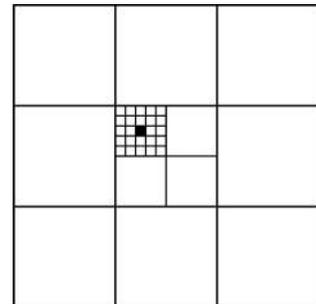


4) Harry delivers newspapers in Long street. He must deliver a paper to every house with an odd house number. If the first house is number 15 and the last is number 53, to how many houses does Harry deliver?

- A) 19    B) 20    C) 27    D) 38    E) 53

5) In the picture the large square has an area of 1. What is the area of the small black square?

- A)  $\frac{1}{100}$     B)  $\frac{1}{300}$     C)  $\frac{1}{600}$     D)  $\frac{1}{900}$     E)  $\frac{1}{1000}$



6) The product of four different natural numbers is 100. What is the sum of the four numbers?

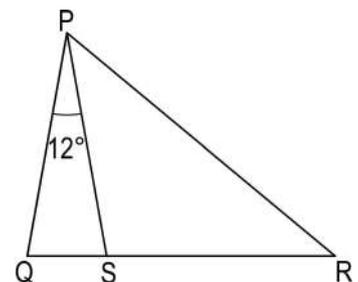
- A) 10    B) 12    C) 15    D) 18    E) 20

7) In a park there are some cats and dogs. The number of cats feet is double the size of the number of dogs noses. The number of cats is  $\frac{1}{11} \cdot \frac{1}{11} \cdot \frac{1}{11} \cdot \frac{1}{11}$  of the number of dogs.

- A) double the size    B) half the size    C) the same size  
D) a quarter the size    E) a sixth of the size.

8) In the diagram QSR is a straight line.  $\angle QPS = 12^\circ$  and  $PQ = PS = RS$ . How big is  $\angle QPR$ ?

- A)  $36^\circ$     B)  $42^\circ$     C)  $54^\circ$     D)  $60^\circ$     E)  $84^\circ$

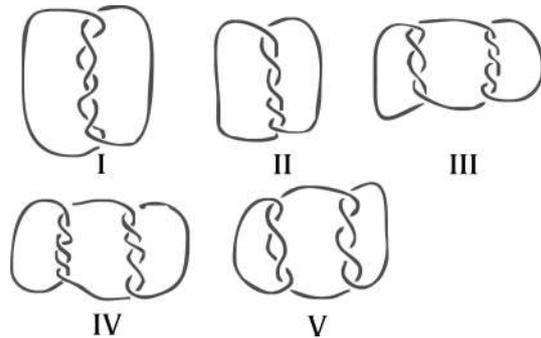


9) A lift can carry either 12 adults or 20 children. What is the maximum number of children that could travel in the lift with 9 adults?

- A) 3    B) 4    C) 5    D) 6    E) 8

10) Which of the following is made using more than one piece of string?

- A) I, III, IV and V    B) I, III and V  
 C) III, IV and V    D) all  
 E) None of these answers

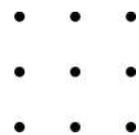


**- 4 point questions -**

11) For how many positive whole numbers does  $a^2$  and  $a^3$  have the same number of digits?

- A) 0    B) 3    C) 4    D) 9    E) infinitely many

12) What is the minimum number of dots that must be taken away from the picture so that no three of the remaining dots lie on a straight line?



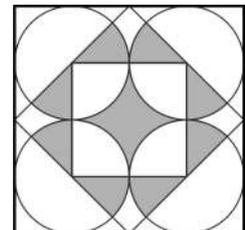
- A) 1    B) 2    C) 3    D) 4    E) 7

13) Nick measured all 6 angles in two triangles. One of the triangles was acute angled and the other obtuse angled. He noted four of the angles to be:  $120^\circ$ ,  $80^\circ$ ,  $55^\circ$  and  $10^\circ$ . What is the size of the smallest angle in the acute angled triangle?

- A)  $45^\circ$     B)  $10^\circ$     C)  $5^\circ$     D)  $55^\circ$     E) not possible to answer.

14) What fraction of the largest square is grey?

- A)  $\frac{1}{4}$     B)  $\frac{1}{5}$     C)  $\frac{2}{5}$     D)  $\frac{3}{8}$     E)  $\frac{1}{3}$

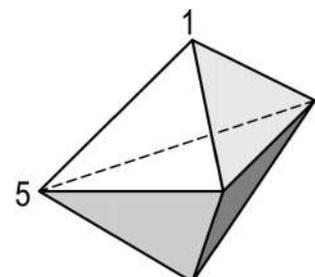


15) On the island of the truth tellers and the liars, there are 25 people standing in a line. The person at the front claims that everybody standing behind him is a liar. Everybody else claims that the person standing in front of them is a liar. How many liars are standing in the line? (Truth tellers always tell the truth and liar always lie.)

- A) 0    B) 12    C) 13    D) 24    E) not possible to answer.

16) In the diagram opposite there is an object with 6 triangular faces. On each corner there is a number (two are shown). The sum of the numbers on the corners of each face is the same. What is the sum of all 5 numbers?

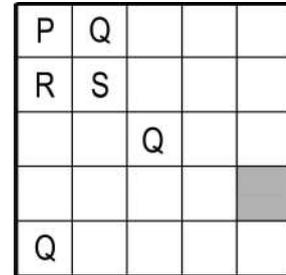
- A) 9    B) 12    C) 17    D) 18    E) 24



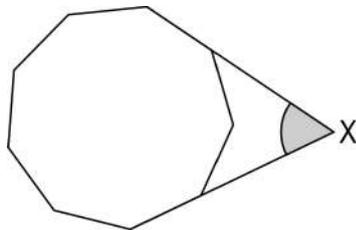
17) In the equation  $\frac{E \times I \times G \times H \times T}{F \times O \times U \times R} = T \times W \times O$  each letter represents a certain digit (the same letter represents the same digit each time). How many different values can the expression  $T \cdot H \cdot R \cdot E \cdot E$  have?

- A) 1      B) 2      C) 3      D) 4      E) 5

18) We want to paint each square in the grid with the colours P, Q, R and S, so that neighbouring squares always have different colours. (Squares which share the same corner point also count as neighbouring.) Some of the squares are already painted. In which colour(s) could the grey square be painted?



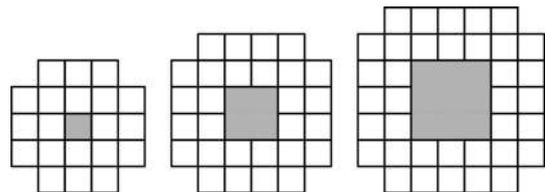
- A) only Q    B) only R    C) only S    D) either R or S    E) it is not possible.



19) The diagram opposite shows a regular nonagon. What is the size of the angle marked X?

- A) 40°    B) 45°    C) 50°    D) 55°    E) 60°

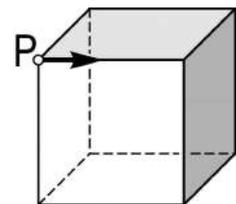
20) A pattern is made out of white, square tiles. The first three patterns are shown. How many tiles will be needed for the tenth pattern?



- A) 76      B) 80      C) 84      D) 92      E) 100

**- 5 point questions -**

21) A beetle walks along the edges of a cube. Starting from point P it first moves in the direction shown. At the end of each edge it changes the direction in which it turns, turning first right then left, then right etc. Along how many edges will it walk before it returns to point P?

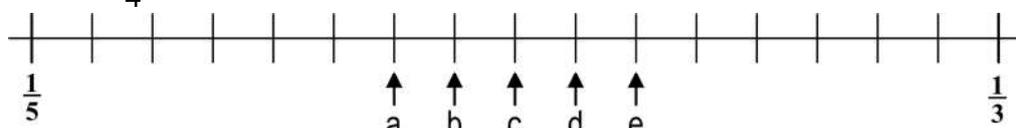


- A) 2      B) 4      C) 6      D) 9      E) 12

22) How many 10 digit numbers are there which use only the digits 1, 2 and 3 (not necessarily all) and are written in such a way that consecutive digits always have a difference of 1.

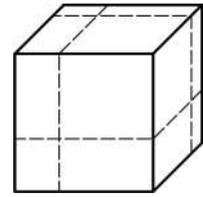
- A) 16      B) 32      C) 64      D) 80      E) 100

23) The fractions  $\frac{1}{3}$  and  $\frac{1}{5}$  are shown on the number line. In which position should  $\frac{1}{4}$  be shown?



- A) a      B) b      C) c      D) d      E) e

24) A cube is cut in three directions as shown, to produce eight cuboids (each cut is parallel to one of the faces of the cube). What is the ratio of the total surface area of the eight cuboids to the surface area of the original cube?



A) 1:1      B) 4:3      C) 3:2      D) 2:1      E) 4:1

25) All factors of a number  $N$  (with the exception of 1 and  $N$  itself) are written down one after the other. It turns out that the biggest factor is 45 times as big as the smallest factor. For how many numbers  $N$  is that true?

A) 0    B) 1    C) 2    D) more than 2    E) not possible to answer.

26) A square is cut into 2009 smaller squares. The side length of each smaller square is a whole number. What is the minimum possible side length of the original square?

A) 44      B) 45      C) 46      D) 503  
E) Its not possible to cut a square into 2009 smaller squares.

27) In the quadrilateral PQRS  $PQ = 2006$ ,  $QR = 2008$ ,  $RS = 2007$  und  $SP = 2009$ . At which corners must the interior angle definitely be smaller than  $180^\circ$ ?

A) P, Q, R    B) Q, R, S    C) P, Q, S    D) P, R, S    E) P, Q, R, S

28) I have a  $6 \text{ cm} \times 6 \text{ cm}$  square and a certain triangle. If I lay the square on top of the triangle I can cover up to 60% of the area of the triangle. If I lay the triangle on top of the square I can cover up to  $\frac{2}{3}$  of the area of the square. What is the area of the triangle?

A)  $22.8 \text{ cm}^2$     B)  $24 \text{ cm}^2$     C)  $36 \text{ cm}^2$     D)  $40 \text{ cm}^2$     E)  $60 \text{ cm}^2$

29) Friday writes different positive whole numbers that are all less than 11 next to each other in the sand. Robinson Crusoe looks at the sequence and notices with amusement that adjacent numbers are always divisible by each other. What is the maximum amount of numbers he could possibly have written in the sand?

A) 6      B) 7      C) 8      D) 9      E) 10

30) In triangle ABC the interior angle B equals  $20^\circ$  and C  $40^\circ$ . The length of the angle bisector through A is 2. What is the difference of the side lengths of BC and AB?

A) 1      B) 1.5      C) 2      D) 4      E) Not possible to answer.

**Kangaroo of Mathematics 2009**  
**Level Junior (Grades 9 and 10)**  
**Austria - 23.3.2009**



- 3 Points Questions -

1) Which of the following number is divisible by 3?  
**A) 2009**      **B)  $2 + 0 + 0 + 9$**       **C)  $200 \overline{) 69}$**       **D)  $2^9$**       **E)  $(2 + 0) \cdot (0 + 9)$**

2) What is the minimum number of points which have to be removed from the adjacent diagram so that in the remaining picture no three points lie in one line?  
• • •  
• • •  
• • •  
**A) 1**      **B) 2**      **C) 3**      **D) 4**      **E) 7**

3) 2009 people are taking part in a public fun run. The number of people Hans beat is three times as big as the number of people that have finished before him. In which place did Hans finish the race?  
**A) 503.**      **B) 501.**      **C) 500.**      **D) 1503.**      **E) 1507.**

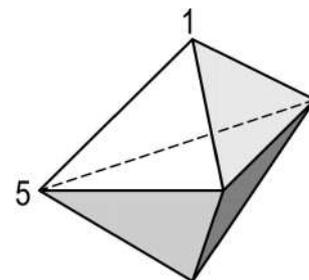
4) Harry does his paper round in Long Street. He has to deliver one newspaper to each house with an odd number. The first house with an odd number is 15 and the final house has the number 53. How many houses does Harry have to visit?  
**A) 19**      **B) 20**      **C) 27**      **D) 38**      **E) 53**

5) The product of four different natural numbers is 100. What is the sum of the four numbers?  
**A) 10**      **B) 12**      **C) 15**      **D) 18**      **E) 20**

6) What is the value of  $\frac{1}{2} \cdot \frac{2}{3} \cdot \frac{3}{4} \cdot \frac{4}{5} \cdot \frac{5}{6} \cdot \frac{6}{7} \cdot \frac{7}{8} \cdot \frac{8}{9} \cdot \frac{9}{10} \cdot 1000$ ?  
**A) 250**      **B) 200**      **C) 100**      **D) 50**      **E) a different number**

7) A long number is build by writing the number 2009, 2009 times in a line. How big is the sum off all odd number within this number that are immediately to the left of an even number?  
**A) 2**      **B) 9**      **C) 4018**      **D) 18072**      **E) 18081**

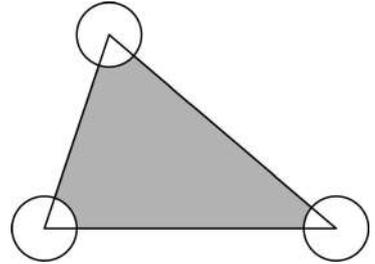
8) The diagram on the right shows a solid made up of 6 triangles. Each vertex is assigned a number, two of which are indicated. The total of the three numbers on each triangle is the same. What is the total of all five numbers?  
**A) 9**      **B) 12**      **C) 17**      **D) 18**      **E) 24**



9) For how many positive whole numbers a do  $a^2$  and  $a^3$  have the same amount of digits?  
**A) 0**      **B) 3**      **C) 4**      **D) 9**      **E) infinite many**

10) The area of the shown triangle equals  $80\text{m}^2$ . Each circle has a radius of  $2\text{m}$  and its centre is in one of the vertices of the triangles. What is the area of the grey shaded region (in  $\text{m}^2$ )?

- A)  $76$     B)  $80 - 2\pi$     C)  $40 - 4\pi$     D)  $80 - \pi$     E)  $78\pi$



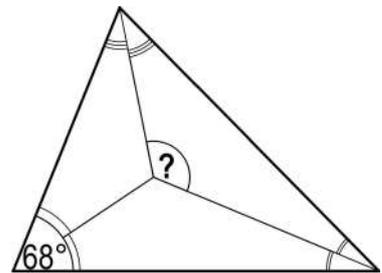
**- 4 Points Questions -**

11) Leonhard made up a sequence where, starting with the third term, each term is the sum of the previous two numbers. The fourth number is 6 and the sixth number is 15. What is the seventh number in the sequence?

- A) 9    B) 16    C) 21    D) 22    E) 24

12) In the triangle illustrated one internal angle measures  $68^\circ$ . The three angle bisectors of the triangle are shown. What is the size of the angle indicated with a question mark?

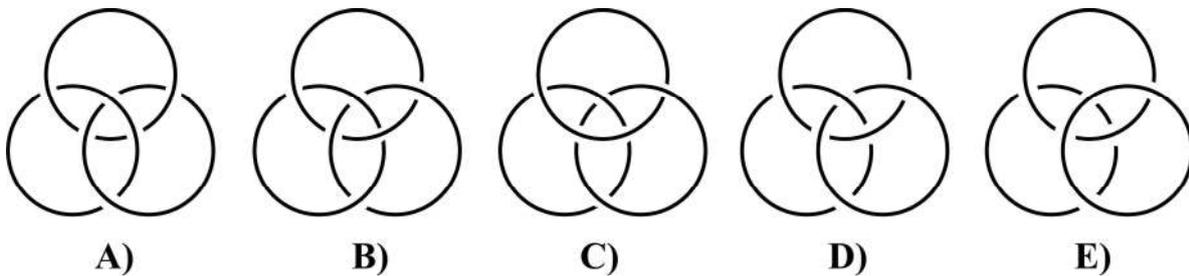
- A)  $120^\circ$     B)  $124^\circ$     C)  $128^\circ$     D)  $132^\circ$     E)  $136^\circ$



13) Maria can achieve 0, 1, 2, 3, 4 or 5 points in a test. After 4 tests she has a mean of exactly 4. One of the following sentences can therefore not be true. Which one is it?

- A) Maria achieved 4 in each test.    B) Maria achieved 3 exactly twice.  
 C) Maria achieved 4 exactly twice.    D) Maria achieved 1 exactly once.  
 E) Maria achieved 3 exactly three times.

14) The ðBorromaic Ringsö have an extraordinary property. Although no two are interlocked, they are strongly connected within each other. If one ring is cut through, the other two fall apart. Which of the following diagrams shows the picture of ðBorromaic Ringsö?



15) On the island of the nobles and liars 25 people are standing in a queue. The first person in the line claims that everybody behind him is a liar. Each of the other people claims that the person in front of him is a liar. How many liars are actually in the queue? (Nobles are always telling the truth and liars are always lying.)

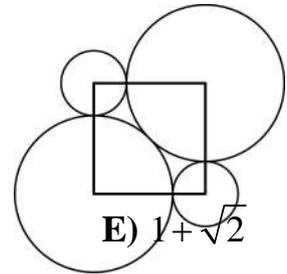
- A) 0    B) 12    C) 13    D) 24    E) it cannot be determined

16) If  $a \square b = ab + a + b$  and  $3 \square 5 = 2 \square x$ , then  $x$  equals

- A) 3                      B) 6                      C) 7                      D) 10                      E) 12

17) The centres of the four illustrated circles are in the corners of the square. The two big circles touch each other and also the two little circles. With which factor do you have to multiply the radii of the little circles to obtain the radius of the big circles?

- A)  $\frac{2}{9}$                       B)  $\sqrt{5}$                       C)  $0,8 \cdot \pi$                       D) 2,5



18) The difference of  $\sqrt{n}$  and 10 is less than 1. How many whole numbers  $n$  are there with this characteristic?

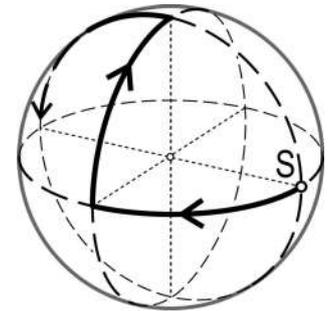
- A) 19                      B) 20                      C) 39                      D) 40                      E) 41

19) Friday writes different positive whole number that are all less than 11 next to each other in the sand. Robinson Crusoe looks at the sequence and notices with amusement that adjacent numbers are always divisible by each other. What is the maximum amount of numbers he could possibly have written in the sand?

- A) 6                      B) 7                      C) 8                      D) 9                      E) 10

20) There are three great circles on a sphere that intersect each other in a right angle. Starting in point S a little bug moves along the great circles in the direction indicated. At crossings it turns alternately to the right or left. How many quarter circles does it crawl along until it is back in point S?

- A) 6                      B) 9                      C) 12                      D) 15                      E) 18



**- 5 Points Questions -**

21) How many 0s have to replace the Star \* in the decimal number  $1.*1$  to obtain a number that is smaller than  $\frac{2009}{2008}$ , but bigger than  $\frac{20009}{20008}$  ?

- A) 1                      B) 2                      C) 3                      D) 4                      E) 5

22) How many 10-digit numbers exist that are solely made up of the numbers 1, 2 and 3 (but not necessary all of them) and where adjacent numbers always differ by exactly 1?

- A) 16                      B) 32                      C) 64                      D) 80                      E) 100

23) If  $a = 2^{25}$ ,  $b = 8^8$  and  $c = 3^{11}$  then

- A)  $a < b < c$                       B)  $b < a < c$                       C)  $b < c < a$                       D)  $c < a < b$                       E)  $c < b < a$

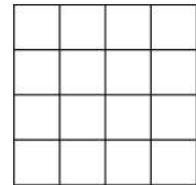
24) All factors of a number  $N$  (with the exception of 1 and  $N$  itself) are written down one after the other. It turns out that the biggest factor is 45 times as big as the smallest number. For how many numbers  $N$  is that true?

A) 0    B) 1    C) 2    D) more than 2    E) it cannot be determined

25) Kangoo has 2009 unit dice that he is putting together to a big cuboid. He has also got 2009 square unit sticker with the measurements  $1 \times 1$  with which he tries to paste up the surface area of the cuboid. He manages to do that and even has got some spare stickers. How many are there left over?

A) more than 1000    B) 763    C) 476    D) 49    E) it is not achievable

26) Robert wants to place stones on a  $4 \times 4$  gameboard so that the number of stones in each row and column is different; i.e. there are 8 different amounts. To achieve this he can place one or several stones in any one field or even leave single fields empty. What is the minimum number of stones needed to do this?



A) 14    B) 16    C) 20    D) 24    E) 25

27) A number of oranges, peaches, apples and bananas are put down in a row. What is the minimum number of fruits needed to lay them down so that each fruit lies next to each other fruit at least once in that row?

A) 4    B) 5    C) 8    D) 11    E) this is not achievable

28) What is the smallest whole number  $n$  for which the expression  $(2^2-1) \cdot (3^2-1) \cdot (4^2-1) \cdot \dots \cdot (n^2-1)$  is a square number?

A) 6    B) 8    C) 16    D) 27    E) a different number

29) A kangaroo is sitting in the origin of a kartesian co-ordinate system. With each bounce it can jump one unit in the horizontal or vertical direction. How many points are there, where the kangaroo could be after 10 jumps?

A) 121    B) 100    C) 400    D) 441    E) a different number

30) A single digit prime number is called 'strange'. A prime number with more than one digit is called 'strange' if the numbers that are obtained by cancelling the first and the last digit respectively are both strange prime numbers again. How many strange prime numbers are there?

A) 6    B) 7    C) 8    D) 9    E) 11

**Kangaroo of Mathematics 2009**  
**Level Student (Grade 11+)**  
**Austria - 23.3.2009**



**- 3 Points Questions -**

1) There are 200 fish in an aquarium. Of which 1% are blue, the rest are yellow. How many yellow fish have to be removed to make the number of blue fish equal 2% of the entire amount of fish?

- A) 2      B) 4      C) 20      D) 50      E) 100

2) Which of the following numbers is biggest?

- A)  $\sqrt{2} - \sqrt{1}$       B)  $\sqrt{3} - \sqrt{2}$       C)  $\sqrt{4} - \sqrt{3}$       D)  $\sqrt{5} - \sqrt{4}$       E)  $\sqrt{6} - \sqrt{5}$

3) For how many positive whole numbers  $n$  is  $n^2 + n$  a prime number?

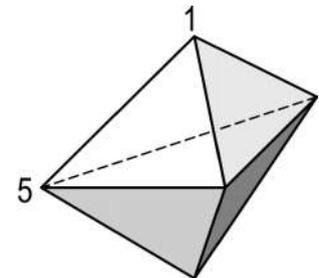
- A) 0      B) 1      C) 2      D) for a finite amount more than 2      E) for infinite many

4) Mari, Ville and Ossi are going to a coffee shop. Each of them has 3 glasses of juice, 2 cups of ice cream and 5 biscuits. What value could the total bill come up to in the end?

- A) € 39,20      B) € 38,20      C) € 37,20      D) € 36,20      E) € 35,20

5) The diagram on the right shows a solid made up of 6 triangles. Each vertex is assigned a number, two of which are indicated. The total of the three numbers on each triangle is the same. What is the total of all five numbers?

- A) 9      B) 12      C) 17      D) 18      E) 24



6) The circles  $k_1$  (with centre  $M_1$  and radius 13) and  $k_2$  (with centre  $M_2$  and radius 15) intersect each other in the points P and Q. The length of the distance PQ is 24. What possible value could the distance  $M_1M_2$  be?

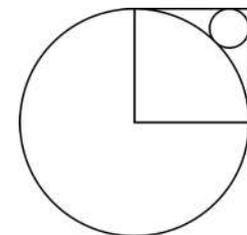
- A) 2      B) 5      C) 9      D) 14      E) 18

7) In a draw there are 2 white, 3 red and 4 blue socks. Lisa knows that one third of the socks have holes but she does not know the colour of the faulty socks. She randomly picks socks from the draw until she has a pair that is useable i.e. she has a pair without holes and of equal colour. What is the minimum amount of socks she has to draw to be certain to get a useable pair?

- A) 2      B) 3      C) 6      D) 7      E) 8

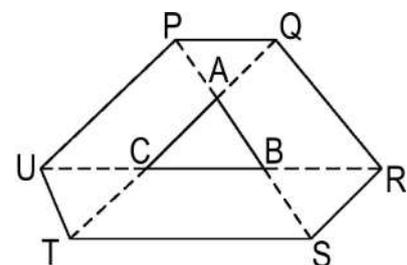
8) The square in the diagram has side length 1. The radius of the small circle would then be of the length

- A)  $\sqrt{2} - 1$       B)  $\frac{1}{4}$       C)  $\frac{\sqrt{2}}{4}$       D)  $1 - \frac{\sqrt{2}}{2}$       E)  $(\sqrt{2} - 1)^2$

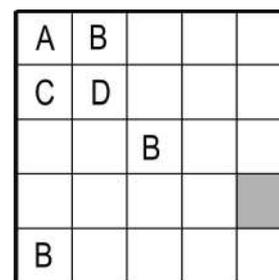


9) Each side of a triangle ABC is being extended to the points P, Q, R, S, T and U, so that  $PA = AB = BS$ ,  $TC = CA = AQ$  and  $UC = CB = BR$ . The area of ABC is 1. How big is the area of the hexagon PQRSTU?

- A) 9      B) 10      C) 12      D) 13      E) the value can not be determined for definite



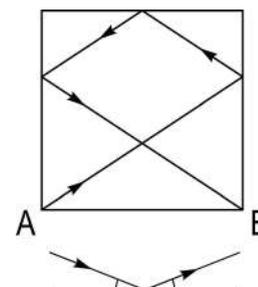
10) In the diagram on the right we want to colour the fields with the colours A, B, C and D so that adjacent fields are always in different colours. (Even fields that share only one corner, count as adjacent.) Some fields have already been coloured in. In which colour can the grey field be coloured in?



- A) either A or B      B) only C      C) only D  
 D) either C or D      E) A, B, C or D

**- 4 Points Questions -**

11) A (very small) ball is kicked off from point A on a square billiard table with side length 2m. After moving along the shown path and touching the sides three times as indicated, the path ends in point B. How long is the path that the ball travels from A to B? (As indicated on the right: incident angle = emergent angle.)

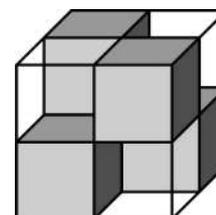


- A) 7      B)  $2\sqrt{13}$       C) 8      D)  $4\sqrt{3}$       E)  $2 \cdot (\sqrt{2} + \sqrt{3})$

12) In a group of 2009 kangaroos each one is either light or dark. The smallest of the light kangaroos is bigger than exactly 8 dark kangaroos. One light one is bigger than exactly 9 dark ones, another light one is bigger than exactly 10 dark ones, and so on. Exactly one light kangaroo is bigger than all dark kangaroos. How many light kangaroos are there?

- A) 1000    B) 1001    C) 1002    D) 1003    E) the situation described is impossible

13) In the diagram to the right a  $2 \times 2 \times 2$  cube is made up of four transparent  $1 \times 1 \times 1$  cubes and four non-transparent black  $1 \times 1 \times 1$  cubes. They are placed in a way so that the entire big cube is non-transparent; i.e. looking at it from the front to the back, the right to the left, the top to the bottom, at no point you can look through the cube. What is the minimum number of black  $1 \times 1 \times 1$  cubes needed to make a  $3 \times 3 \times 3$  cube non-transparent in the same way?



- A) 6      B) 9      C) 10      D) 12      E) 18

14) On the island of the nobles and liars 25 people are standing in a queue. The first person in the line claims that everybody behind him is a liar. Each of the other people claims that the person in front of him is a liar. How many liars are actually in the queue? (Nobles are always telling the truth and liars are always lying.)

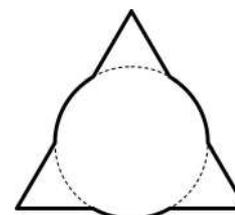
- A) 0    B) 12    C) 13    D) 24    E) it cannot be determined

15) Determine the unit digit of the number  $1^2 - 2^2 + 1^2 - 2008^2 + 2009^2$ .

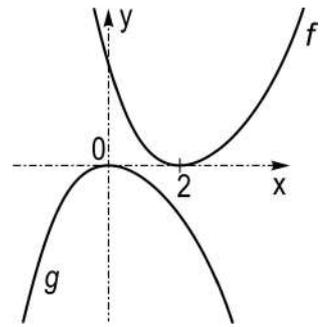
- A) 1      B) 2      C) 3      D) 4      E) 5

16) An equilateral triangle with side length 3 and a circle with radius 1 have the same centre. What is the perimeter of the figure that is created when the two are being put together?

- A)  $6 + \pi$       B)  $3 + 2\pi$       C)  $9 + \frac{\pi}{3}$       D)  $3\pi$       E)  $9 + \pi$



17) The adjacent diagram illustrates the graphs of the two functions  $f$  and  $g$ . How can we describe the relationship between  $f$  and  $g$ ?

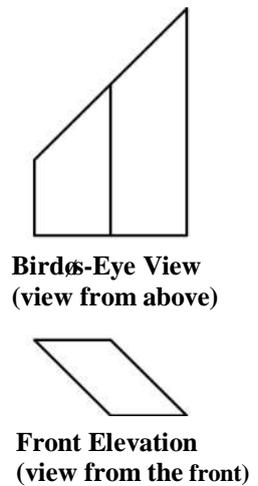
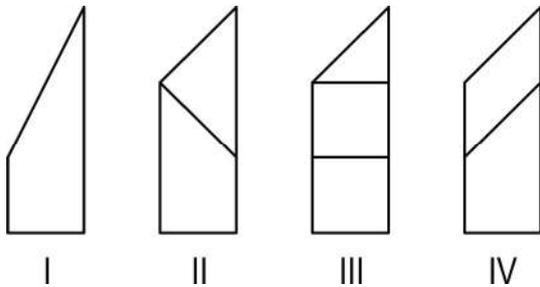


- A)  $g(x - 2) = -f(x)$     B)  $g(x) = f(x + 2)$     C)  $g(x) = -f(-x + 2)$   
 D)  $g(-x) = -f(-x - 2)$     E)  $g(2 - x) = -f(x)$

18) 100 students take an exam with 4 questions. 90 solve the first question, 85 the second, 80 the third and 70 the fourth. Determine the smallest possible number of students that have solved all four questions.

- A) 10                      B) 15                      C) 20                      D) 25                      E) 30

19) In the diagram on the right we see the bird's-eye view and front elevation of a solid that is defined by flat surfaces (i.e. view from above and the front respectively). Which of the outlines I to IV can be the side elevation (i.e. view from the left) of the same object?



- A) I                      B) II                      C) III                      D) IV                      E) none of them

20) The sum of the number in each line, column and diagonal in the magic square on the right is always constant. Only two numbers are visible. Which number is missing in field  $a$ ?

$a$		
		47
	63	

- A) 16                      B) 51                      C) 54                      D) 55                      E) 110

**- 5 Points Questions -**

21) Two runners each run with constant speed rounds around a racetrack. Both start at the same time at the same point. A is faster than B, takes 3 minutes to cover one lap and overtakes B for the first time after 8 minutes. How long does B take to cover one lap?

- A) 6 min    B) 8 min    C) 4 min 30 sec    D) 4 min 48 sec    E) 4 min 20 sec

22) Let  $Z$  be the amount of 8-digit numbers that are made up of all different digits not equal to 0. How many of those number are divisible by 9?

- A)  $\frac{Z}{8}$                       B)  $\frac{Z}{3}$                       C)  $\frac{Z}{9}$                       D)  $\frac{8Z}{9}$                       E)  $\frac{7Z}{8}$

23) How many 10-digit numbers exist that are solely made up of the numbers 1, 2 and 3 and where adjacent numbers always differ by exactly 1?

- A) 16                      B) 32                      C) 64                      D) 80                      E) 100

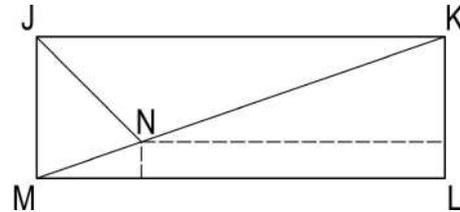
24) For how many whole numbers  $n \geq 3$  exists a convex polygon, whose angles are in the ratio  $1 : 2 : \dots : n$ ?

- A) 1      B) 2      C) 3      D) 5      E) more than 5

25) 55 pupils are taking part in a competition. A jury indicates each question with a  $\checkmark$  if it is solved correctly, with a  $\times$  if it is solved incorrectly and a  $\emptyset$  if it was not attempted. It turns out that no two students had the same amount of  $\checkmark$  as well as the same amount of  $\times$ . What is the minimum number of questions that had to be asked in the competition?

- A) 6    B) 9    C) 10    D) 11    E) 12

26) In a rectangle JKLM the angle bisector in J intersects the diagonal KM in N. The distance of N to LM is 1 and the distance of N to KL is 8.



How long is LM?

- A)  $8 + 2\sqrt{2}$     B)  $11 - \sqrt{2}$     C) 10    D)  $8 + 3\sqrt{2}$     E)  $11 + \frac{\sqrt{2}}{2}$

27) If  $k = \frac{a}{b+c} = \frac{b}{c+a} = \frac{c}{a+b}$ . How many possible real values exist for k?

- A) 1      B) 2      C) 3      D) 4      E) 6

28) The number 1, 2, 3, ..., 99 are divided up into  $n$  groups. The following rules apply:

- ⊠ Each number is in exactly one group.
- ⊠ There are at least two numbers in each group.
- ⊠ If there are two number in the same group then their sum is not divisible by 3.

Determine the smallest  $n$  which fulfills those rules

- A) 3      B) 9      C) 33      D) 34      E) 66

29) Samantha and her three sisters go to the theater. They have reserved a loge with four seats. Samantha and two of her sisters arrive early and they sit down without paying attention to their seat numbers. Marie arrives later and insists to sit on the seat that is indicated on her ticket. What is the probability that Samantha has to change her seat, if now every sister who has to swap seats insists on sitting on the seat indicated on her ticket.

- A)  $\frac{3}{4}$       B)  $\frac{1}{2}$       C)  $\frac{1}{3}$       D)  $\frac{1}{4}$       E)  $\frac{1}{6}$

30) A sequence of whole numbers is defined by  $a_0 = 1$ ,  $a_1 = 2$  and  $a_{n+2} = a_n + (a_{n+1})^2$  for  $n \geq 0$ . When  $a_{2009}$  is divided by 7 the remainder is

- A) 0      B) 1      C) 2      D) 5      E) 6

2009

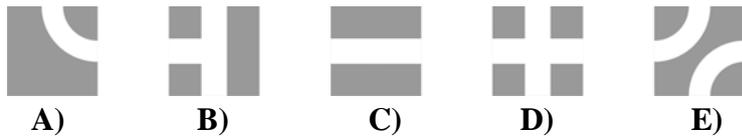
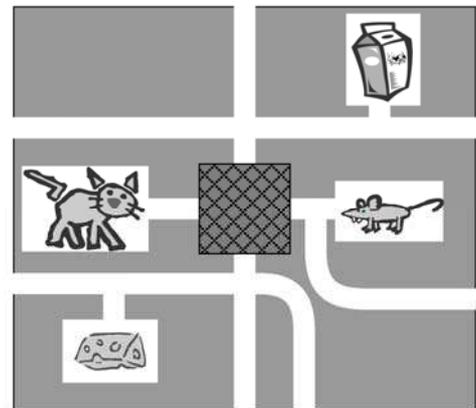
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Écolier	E	E	B	B	B	C	D	D	A	D	B	E	B	D	B	E	B	A	D	B	D	A	E	A						
Benjamin	B	D	B	C	A	D	C	E	D	B	C	C	D	C	B	E	E	D	D	C	E	C	A	A						
Kadett	D	C	C	B	D	D	B	C	C	B	B	C	A	A	C	C	A	D	E	D	C	C	A	D	C	B	D	D	D	C
Junior	E	C	A	B	D	C	D	C	B	B	E	B	E	B	C	C	E	C	D	A	C	C	E	C	B	A	C	B	A	D
Student	E	A	B	C	C	D	D	E	D	D	B	B	B	C	E	A	A	D	D	D	D	C	C	B	B	A	B	C	B	B

# Känguru der Mathematik 2010 Group Écolier (Grades 3. and 4. ) Austria - 18.3.2010



## - 3 Point Questions -

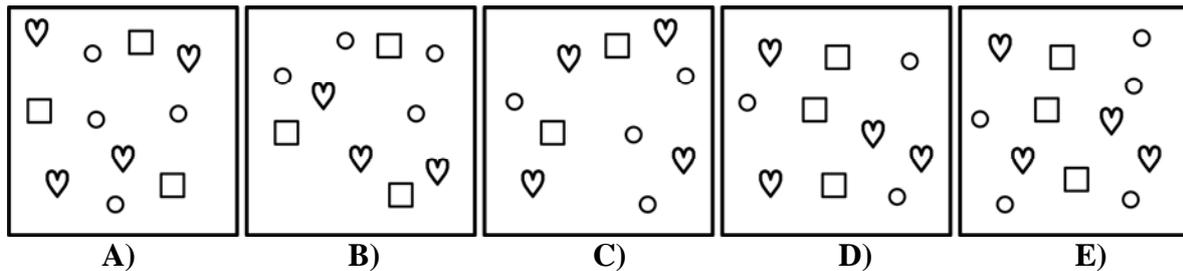
1) In the picture on the right you see a map. In the middle a piece is missing. The cat should be able to reach the milk, and the mouse the cheese, but the cat and the mouse must not meet each other. What should the piece in the middle look like?



2) A 40 minute long lesson began at 11:50 hours. Exactly in the middle of the lesson a bird flew into the classroom. At what time did this happen?

- A) 11:30 hours    B) 12:00 hours    C) 12:10 hours    D) 12:20 hours    E) 12:30 hours

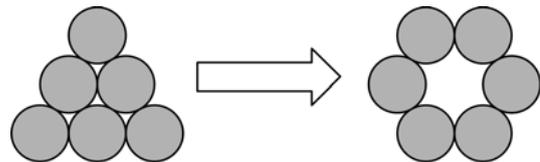
3) Which square contains 3 quadrilaterals, 3 circles and 4 hearts?



4) In a cafe the soup costs € 4, the main course € 9 and the dessert € 5. The three courses when ordered together cost € 15. How many Euro's cheaper is this, than ordering the same three courses separately?

- A) € 3    B) € 4    C) € 5    D) € 6    E) € 7

5) Six coins build a triangle (see picture). What is the smallest number of coins that must be moved to create the circle?

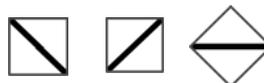


- A) 1    B) 2    C) 3    D) 4    E) 5

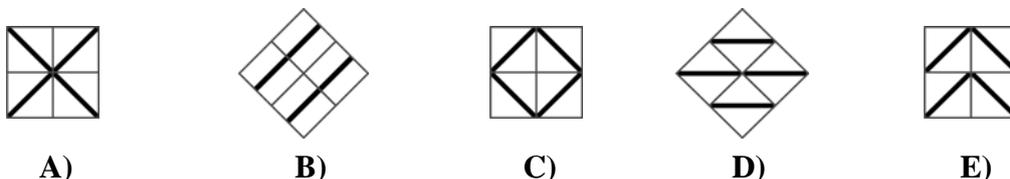
6) Four friends each eat some icecream. Mike eats more than Franz, Jaroslav eats more than Veit and Jaroslav eats less than Franz. Put the friends in order according to how much icecream they have eaten. Begin with the largest amount.

- A) Mike, Jaroslav, Veit, Franz    B) Veit, Mike, Franz, Jaroslav    C) Mike, Franz, Jaroslav, Veit  
D) Jaroslav, Veit, Mike, Franz    E) Jaroslav, Mike, Veit, Franz

7) I have tiles that look like this...



Which pattern can I not create with them?



8) Eva is a centipede with exactly 100 feet. Yesterday she bought 16 pairs of shoes and wore them straight away. Even so she still had 14 feet with no shoes. On how many feet did she already wear shoes before going shopping yesterday?

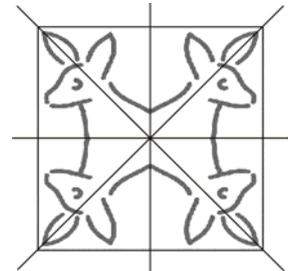
- A) 27      B) 40      C) 54      D) 70      E) 77

**- 4 Point Questions -**

9) Given that  $\blacktriangle + \blacktriangle + 6 = \blacktriangle + \blacktriangle + \blacktriangle + \blacktriangle$ . Which number should replace  $\blacktriangle$ ?

- A) 2      B) 3      C) 4      D) 5      E) 6

10) Maria folds a square piece of paper in such a way that the kangaroos exactly overlap each other. Along how many of the lines shown is this possible?

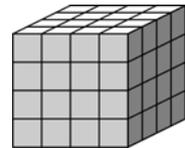


- A) 0    B) 1    C) 2    D) 3    E) 6

11) Matthias and Klara live in a tower block. Klara lives 12 floors above Matthias. One day Matthias climbs the staircase to visit Klara. When halfway he is on the 8th floor. On which floor does Klara live?

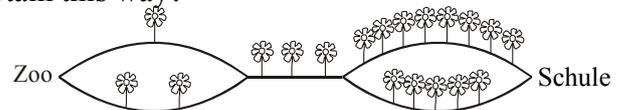
- A) 12th    B) 14th    C) 16th    D) 20th    E) 24th

12) A large cube is made from 64 small cubes. The 5 visible faces of the large cube are green, the bottom face is red. How many of the small cubes have 3 green faces?



- A) 4      B) 8      C) 16      D) 20      E) 24

13) Kangi walks directly from the zoo to school (Schule) and counts the flowers along the way. Which of the following numbers can he not obtain this way?



- A) 9      B) 10      C) 11      D) 12      E) 13

14) A ferry boat can transport, in one journey, either 10 cars or 6 lorries. Yesterday the boat crossed the river 5 times. It was always fully loaded and transported a total of 42 vehicles. How many of these were cars?

- A) 10      B) 12      C) 20      D) 22      E) 30

15) Hans began a chain-email. He sent an e-mail to his friend Peter, who sent it on to 2 more people. Each person that receives the e-mail should send it to 2 more people. After 3 rounds  $1+2+4 = 7$  people have received the e-mail. How many people have received the e-mail after 5 rounds?

- A) 15      B) 16      C) 31      D) 33      E) 63

16) On the playground some children measure the length of the playground with their strides. Anni makes 15 Strides, Betty 17, Denis 12 und Ivo 14. Who has the longest stride?

- A) Anni    B) Betty    C) Denis    D) Ivo    E) Not possible to answer.

**- 5 Point Questions -**

17) Which number must replace the questionmark, if the total of the numbers in each row is the same?

1	2	3	4	5	6	7	8	9	10	199
11	12	13	14	15	16	17	18	19	20	?

- A) 99      B) 100      C) 209      D) 289      E) 299

18) The number  $60 \times 60 \times 24 \times 7$  is the same as

- A) The number of minutes in seven weeks      B) The number of hours in sixty days  
 C) The number of seconds in seven hours    D) The number of seconds in one week  
 E) The number of minutes in 24 weeks

19) Two years ago the cats Tim and Tom were together 15 years old. Now Tom is 13 years old. In how many years will Tim be 9 years old?

- A) 1      B) 2      C) 3      D) 4      E) 5

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20

20) Kamilla wrote down all of the numbers from 1- 100 one after the other in a table with 5 columns. A part of the table is shown. Her brother cut out a piece of the table and erased some of the numbers. Which of the following could this piece have been?

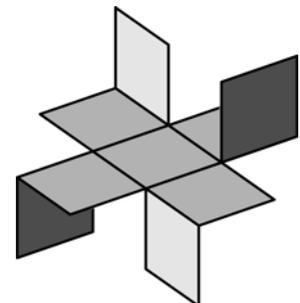
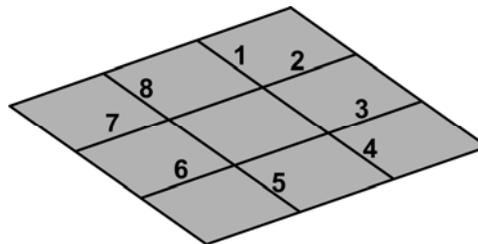
43				
		58		
	48			
		52		
		72		
			69	
			81	
			86	
				90
				94

- A)      B)      C)      D)      E)

21) The teacher said „in our school library there are roughly 2010 books.“ The pupils then guessed exactly how many there are. Artur guesses 2010, Beate 1998 and Carlos 2015. They are wrong by 12, 7 and 5, but not in this order. How many books are in the library?

- A) 2003    B) 2005    C) 2008    D) 2020    E) 2022

22) Lines are drawn on a piece of paper and some of the lines are given numbers. The paper is cut along some of these lines and then folded as shown in the picture. What is the total of the numbers on the lines that were cut?



- A) 16    B) 17    C) 18    D) 20    E) 21

23) Andrew, Stefan, Robert and Marko meet each other at a concert in Zagreb. They come from different cities: Paris, Dubrovnik, Rome and Berlin (not necessarily in this order)

- Andrew and the friend from Berlin arrive first in Zagreb. Neither of the two have been to Paris or Rome
- Robert is not from Berlin, but he arrives with the friend from Paris.
- Marko and the friend from Paris enjoyed the concert very much.

From which city does Marko come?

- A) Paris      B) Rom      C) Dubrovnik    D) Berlin    E) Zagreb

24) Berti's friends add together the day and the month of their birthdays. They each get the answer 35, but no two have the same birthday. What is the maximum number of friends Berti has?

- A) 7      B) 8      C) 9      D) 10      E) 12

# KÄNGURU DER MATHEMATIK 2010

## 18.3.2010

Categorie: Écolier, Grades: 3-4

Name:	
School:	
Class:	

Time allowed: 60 min.

Each correct answer, questions 1.-8.: 3 Points

Each correct answer, questions 9.-16.: 4 Points

Each correct answer, questions 17.-24.: 5 Points

Each question with no answer given: 0 Points

Each incorrect answer: Lose  $\frac{1}{4}$  of the points for than question.

You begin with 24 points.



**Please write the letter (A, B, C, D, E) of the correct answer  
under the question number (1 to 24).  
Write neatly and carefully!**

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>

<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>13</b>	<b>14</b>	<b>15</b>	<b>16</b>

<b>17</b>	<b>18</b>	<b>19</b>	<b>20</b>	<b>21</b>	<b>22</b>	<b>23</b>	<b>24</b>

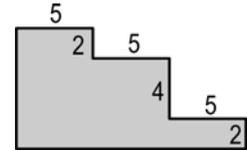
Information über den Känguruwettbewerb: [www.kaenguru.at](http://www.kaenguru.at)  
Wenn Du mehr in dieser Richtung machen möchtest, gibt es  
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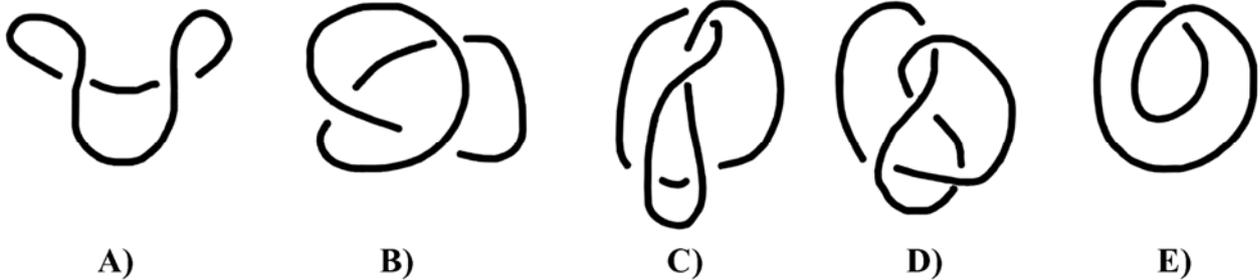
- 4 Points Questions -

9) What is the perimeter of the figure shown (all angles are right angles)?

- A) 23      B) 31      C) 38      D) 42      E) 46



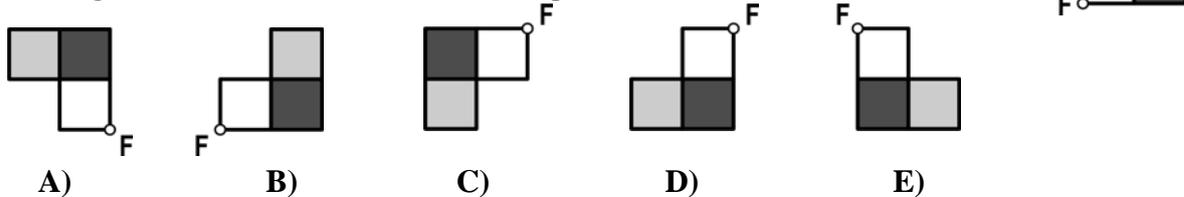
10) In the following figures you see five elastic bands, only one of which is tied in a knot. Which one?



11) Which of the following expressions has a value that differs from the others?

- A)  $20 \times 10 + 20 \times 10$       B)  $(20 \div 10) \times 20 \times 10$       C)  $20 \times 10 \times (20 \div 10)$   
 D)  $20 \times 10 + 10 \times 20$       E)  $(20 \div 10) \cdot 20 + 10$

12) The figure should be rotated  $180^\circ$  around point F. What is the result?

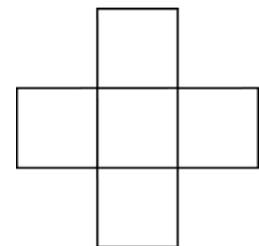


13) Benjamin chooses a number, divides it by 7, adds 7 to the result and multiplies that result with 7. He obtains the number 777. Which number did he start with?

- A) 7      B) 111      C) 722      D) 567      E) 728

14) The numbers 1, 4, 7, 10 and 13 should be written into the squares so that the sum of the three numbers in the horizontal row is equal to the sum of the three numbers in the vertical column. What is the largest possible value of these sums?

- A) 18      B) 20      C) 21      D) 22      E) 24

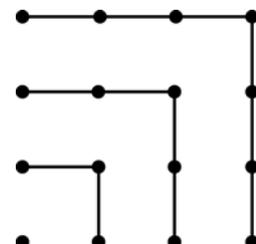


15) In order to produce a newspaper with 60 pages, you need 15 sheets that are stuck within each other. In one such newspaper page 7 is missing. Which other pages are also missing from this newspaper?

- A) 8, 9 and 10      B) 8, 42 and 43      C) 8, 48 and 49      D) 8, 52 and 53  
 E) 8, 53 and 54

16) In the adjacent picture we see that  $1+3+5+7 = 4 \times 4$ . How big is  $1+3+5+7+\dots+17+19$ ?

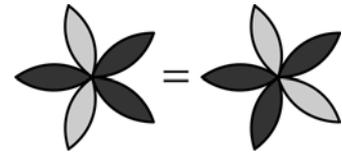
- A)  $10 \times 10$       B)  $11 \times 11$       C)  $12 \times 12$       D)  $13 \times 13$       E)  $14 \times 14$



- 5 Point Questions -

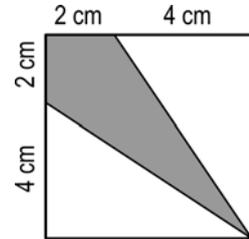
17) Lydia draws a flower with 5 petals. She wants to colour in the flower using the colours white and black. How many different flowers can she draw with these two colours if the flower can also be just one colour?

- A) 6    B) 7    C) 8    D) 9    E) 10



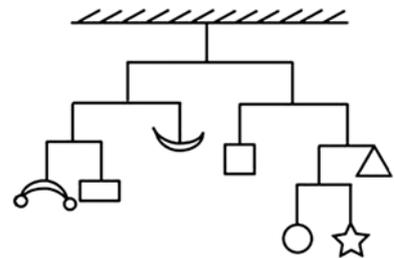
18) What fraction of the square is grey?

- A)  $\frac{1}{3}$     B)  $\frac{1}{4}$     C)  $\frac{1}{5}$     D)  $\frac{3}{8}$     E)  $\frac{2}{9}$



19) The picture shows a hanging mobile. The mobile weighs 112 grams in total. (The weight of the sticks and threads is not taken into account.) How much does the star weigh?

- A) 6 g    B) 7 g    C) 12 g    D) 16 g  
E) It cannot be calculated.



20) In a pizzeria there is a basic pizza with tomato and cheese that can be ordered with only one or two of the following toppings: anchovies, artichokes, mushrooms or capers. The pizza comes in three sizes. How many different types of pizza are offered in total?

- A) 30    B) 12    C) 18    D) 48    E) 72

21) In order to decide who will get the last piece of Leni's birthday cake, five children use a rhyme. Leni, Sara, Hannes, Petra and Arno stand in this order, clockwise in a circle. They count in a clockwise direction: KAN – GA – ROO – OUT – ARE – YOU. For each syllable one child is counted and whoever is counted at YOU is out. They continue this until only one child is left. Leni can choose who starts. Who does she have to choose if she wants Arno to get the piece of cake?

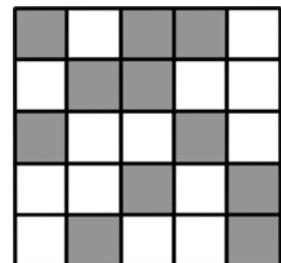
- A) Leni    B) Sara    C) Hannes    D) Petra    E) Arno

22) In the multiplication of a three-digit number with a single-digit number  $PPQ \times Q = RQ5Q$ , P, Q and R represent different digits.  $P + Q + R =$

- A) 13    B) 15    C) 16    D) 17    E) 20

23) In the grid, how many grey squares have to be coloured white, so that in each row and each column there is exactly one grey square?

- A) 4    B) 5    C) 6    D) 7    E) This is not possible.



24) Six-legged, seven-legged and eight-legged octopuses serve Neptune, the king of the sea. The seven-legged ones always lie and the six-legged and eight-legged ones always speak the truth. One day four octopuses meet. The blue one says: „We have 28 legs altogether.“ The green one says: „We have 27 legs altogether.“ The yellow one says: „We have 26 legs altogether.“ The red one says: „We have 25 legs altogether.“ What colour is the octopus that speaks the truth?

- A) red    B) blue    C) green    D) yellow    E) Nobody speaks the truth.

# KÄNGURU DER MATHEMATIK 2010

## 18.3.2010

Categorie: Benjamin, Grades: 5-6

Name:	
School:	
Class:	

Time allowed: 60 min.

Each correct answer, questions 1.-8.: 3 Points

Each correct answer, questions 9.-16.: 4 Points

Each correct answer, questions 17.-24.: 5 Points

Each question with no answer given: 0 Points

Each incorrect answer: Lose  $\frac{1}{4}$  of the points for than question.

You begin with 24 points.



**Please write the letter (A, B, C, D, E) of the correct answer  
under the question number (1 to 24).  
Write neatly and carefully!**

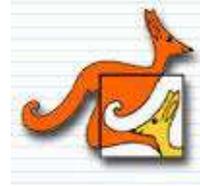
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>

<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>13</b>	<b>14</b>	<b>15</b>	<b>16</b>

<b>17</b>	<b>18</b>	<b>19</b>	<b>20</b>	<b>21</b>	<b>22</b>	<b>23</b>	<b>24</b>

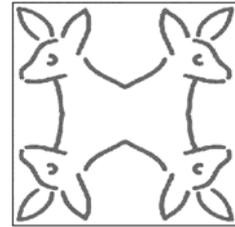
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# Känguru der Mathematik 2010 Group Kadett (Grades 7. und 8.) Austria - 18.3.2010

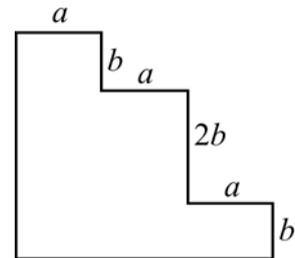


## - 3 Point Questions -

- 1) How much is  $12 + 23 + 34 + 45 + 56 + 67 + 78 + 89$ ?  
A) 389    B) 396    C) 404    D) 405    E) another number
- 2) How many lines of symmetry does this figure have?  
A) 0    B) 1    C) 2    D) 4    E) infinitely many
- 3) A fly has 6 legs and a spider has 8. Together 2 flies and 3 spiders have as many legs as 10 birds and.....  
A) 2 cats    B) 3 cats    C) 4 cats    D) 5 cats    E) 6 cats
- 4) For transport, games are packed in several equally sized, cube shaped boxes. Every eight of which are packed in a bigger cubic box. How many of the small boxes are on the bottom level of the bigger box?  
A) 1    B) 2    C) 3    D) 4    E) 5
- 5) The perimeter of the figure pictured on the right is.....  
A)  $3a+4b$     B)  $3a+8b$     C)  $6a+4b$     D)  $6a+6b$     E)  $6a+8b$

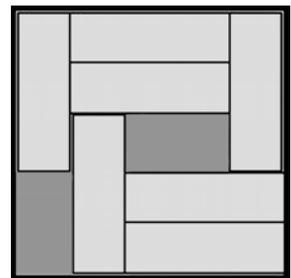


- 6) Martina draws the six cornerpoints of a regular hexagon and then connects some of them to obtain a geometric figure. Which of the following figures cannot be generated?  
A) trapezium    B) right angled triangle    C) square  
D) kite    E) obtuse triangle
- 7) I write down seven consecutive whole numbers. The sum of the smallest three is 33. What is the sum of the biggest three numbers?  
A) 39    B) 37    C) 42    D) 48    E) 45



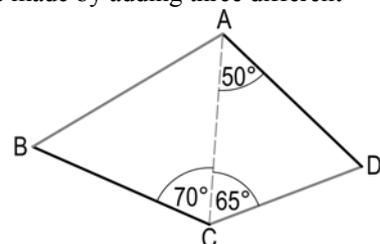
- 8) Herbert has cut firewood. After he has made 53 cuts, he realises that he has 72 pieces of wood. How many pieces of wood did he have to start with?  
A) 17    B) 18    C) 19    D) 20    E) 21
- 9) In the box are seven blocks. It is possible to slide the blocks around so that another block can be added to the box. What is the minimum number of blocks that must be moved?  
A) 2    B) 3    C) 4    D) 5    E) It is not possible.

- 10) The sum of the first hundred positive odd numbers is deducted from the sum of the first hundred positive even numbers. What is the result?  
A) 0    B) 50    C) 100    D) 10100    E) 15150



## - 4 Point Questions -

- 11) Grandma has baked a cake for her grandchildren. She does not know if today 3, 5 or all 6 grandchildren will come. Into how many pieces does she have to cut the cake in order to be sure that all grandchildren present will get the same amount of cake?  
A) 12    B) 15    C) 18    D) 24    E) 30
- 12) Which of the following two-digit numbers is the smallest which cannot be made by adding three different single-digit natural numbers?  
A) 10    B) 15    C) 23    D) 25    E) 28
- 13) In the quadrilateral ABCD  $AD = BC$ ,  $\angle DAC = 50^\circ$ ,  $\angle DCA = 65^\circ$  and  $\angle ACB = 70^\circ$ . How big is  $\angle ABC$ ?  
A)  $50^\circ$     B)  $55^\circ$     C)  $60^\circ$     D)  $65^\circ$     E) It is not clear.
- 14) In order to sew together three short strips of cloth to get one long strip

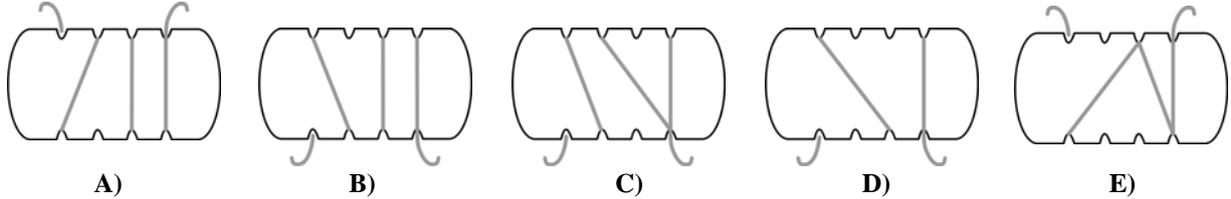


Cathy needs 18 minutes. How much time does she need to sew together a really long piece consisting of six short strips?

- A) 27 minutes    B) 30 minutes    C) 36 minutes  
D) 45 minutes    E) 60 minutes

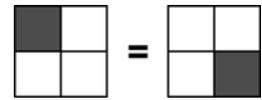


15) Andrea wraps a band around a piece of wood. She then turns the wood around as pictured. What does the wood now look like?



16) A square is split into 4 smaller squares. All small squares should either be coloured in white or black. How many ways are there to colour the big square? (patterns are the same if they can be – as shown in the picture – transformed into one another by rotation.)

- A) 5    B) 6    C) 7    D) 8    E) 9

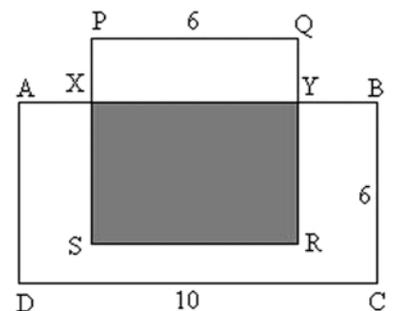


17) In a box are 50 counters: white ones, blue ones and red ones. There are eleven times as many white ones as blue ones. There are less red ones than white ones, but more red ones than blue ones. By how much is the number of red counters less than the number of white counters in the box?

- A) 2    B) 11    C) 19    D) 22    E) 30

18) In the figure ABCD is a rectangle and PQRS a square. The area of the grey part is half as big as the area of ABCD. How long is the side PX?

- A) 1    B) 1.5    C) 2    D) 2.5    E) 4



19) What is the smallest number of straight lines with which a plane can be divided into exactly 5 sections?

- A) 3    B) 4    C) 5    D) 6    E) another number

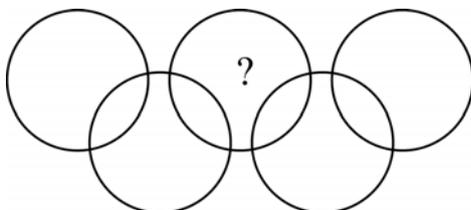
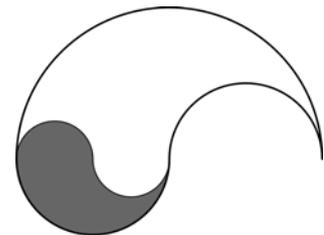
20) Which of the numbers a, b, c, d and e is biggest if  $a - 1 = b + 2 = c - 3 = d + 4 = e - 4$ ?

- A) a    B) b    C) c    D) d    E) e

**- 5 Point Questions -**

21) In the figure we see semicircles with radii 2 cm, 4 cm or 8 cm. What fraction of the area is grey?

- A)  $\frac{1}{3}$     B)  $\frac{1}{4}$     C)  $\frac{1}{5}$     D)  $\frac{3}{4}$     E)  $\frac{2}{3}$



22) In the figure there are nine regions inside the circles. The numbers 1 to 9 should be written in the regions so that the sum of the numbers in each circle is exactly 11. Which number has to go in the region with the question mark?

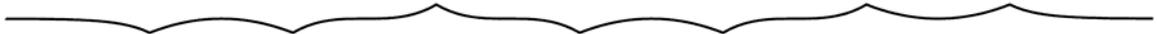
- A) 5    B) 6    C) 7    D) 8    E) 9

23) At the Lumpimarket only exchanges can be made. A cock is worth 4 hens, 3 cocks are worth 1 goose and 2 hens and 5 cocks are worth 5 turkeys. Mister Gagač goes to the market with a load of hens in order to buy a goose, a turkey and a cock. What is the least amount of hens he has to take with him?

- A) 15    B) 27    C) 34    D) 41    E) 42

24 A paperstrip is folded three times in the middle. It is then opened again and looked at from the side so that one can see all 7 folds from the side at the same time. Which of the following views is not a possible result?

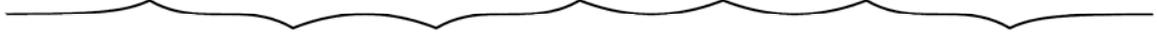
A)



B)



C)



D)



E)



25) On every one of 18 cards either a 4 or 5 is written. The sum of the numbers on all cards is divisible by 17. On how many cards is the number 4 written?

A) 4

B) 5

C) 6

D) 7

E) 9

26) The numbers from 1 to 10 are written 10 times each on a board. Now the children play the following game: One child deletes two numbers off the board and writes instead the sum of the two numbers minus 1. Then a second child does the same, and so on until there is only one number left on the board. The last number is

A) less than 11 B) 11 C) 46 D) greater than 46 E) depends on the course of the game.

27) In Tautostadt there are only nobles and liars. Each sentence that is spoken by a noble is true. Each one that is spoken by a liar is false. One day some of them meet in a room and three speak as follows:

The first one says: „ There are no more than three in this room. We are all liars.“

The second one says: „ There are no more than four in this room. We are not all liars.“

The third one says: „In this room we are five. Three of us are liars.“

How many people are in the room and how many of them are liars?

A) three people, one of which is a liar

B) four people, one of which is a liar

C) four people, two of which are liars

D) five people, two of which are liars

E) four people, three of which are liars

28) A kangaroo who is interested in geometry has a collection of  $1 \times 1 \times 1$  dice. Each die has a certain colour. It wants to make a  $3 \times 3 \times 3$  cube out of the dice so that small dice that meet at the very least on one corner are always of a different colour. What is the smallest amount of colours it needs to use?

A) 6

B) 8

C) 9

D) 12

E) 27

29) The big equilateral triangle consists of 36 small equilateral triangles which each have an area of  $1 \text{ cm}^2$ . Determine the area of ABC.

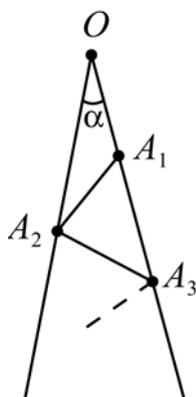
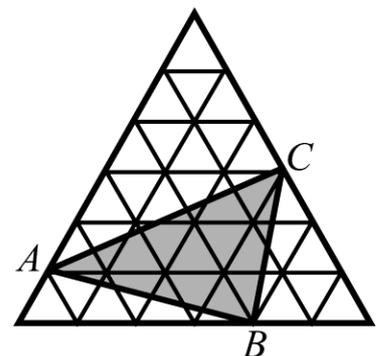
A)  $11 \text{ cm}^2$

B)  $12 \text{ cm}^2$

C)  $15 \text{ cm}^2$

D)  $9 \text{ cm}^2$

E)  $10 \text{ cm}^2$



30) In the figure  $\alpha = 7^\circ$ . All lines  $OA_1, A_1A_2, A_2A_3, \dots$  are equally long. What is the maximum number of lines that can be drawn in this way if no two lines are allowed to intersect each other?

A) 10

B) 11

C) 12

D) 13

E) As many as we want.

# KÄNGURU DER MATHEMATIK 2010

## 18.3.2010

Categorie: Kadett, Grades: 7-8

Name:	
School:	
Class:	

Time allowed: 75 min.

Each correct answer, questions 1.-10.: 3 Points

Each correct answer, questions 11.-20.: 4 Points

Each correct answer, questions 21.-30.: 5 Points

Each question with no answer given: 0 Points

Each incorrect answer: Lose  $\frac{1}{4}$  of the points for than question.

You begin with 30 points



**Please write the letter (A, B, C, D, E) of the correct answer  
under the question number (1 to 24).**

**Write neatly and carefully!**

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>

<b>11</b>	<b>12</b>	<b>13</b>	<b>14</b>	<b>15</b>	<b>16</b>	<b>17</b>	<b>18</b>	<b>19</b>	<b>20</b>

<b>21</b>	<b>22</b>	<b>23</b>	<b>24</b>	<b>25</b>	<b>26</b>	<b>27</b>	<b>28</b>	<b>29</b>	<b>30</b>

Information über den Känguruwettbewerb: [www.kaenguru.at](http://www.kaenguru.at)

Wenn Du mehr in dieser Richtung machen möchtest, gibt es  
die Österreichische Mathematikolympiade; Infos unter:

[www.oemo.at](http://www.oemo.at)

# Känguru der Mathematik 2010

## Group Junior (Grades 9. and 10. )

### Austria - 18.3.2010



#### - 3 Point Questions -

1) What is the result when 20102010 is divided by 2010?

- A) 11                      B) 101                      C) 1001                      D) 10001                      E) not an integer

2) Ivan gains 85% of the points in a test. Tibor gains in the same test 90% of the points but only one point more than Ivan. What is the maximum number of points that can be gained in this test?

- A) 5                      B) 17                      C) 18                      D) 20                      E) 25

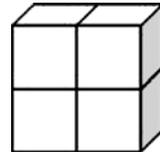
3) Which number goes in the cell with the question mark if the sum of the numbers in both rows is equal?

1	2	3	4	5	6	7	8	9	10	2010
11	12	13	14	15	16	17	18	19	20	?

- A) 1010                      B) 1020                      C) 1910                      D) 1990                      E) 2000

4) The object pictured is made up of four equally sized cubes. Each cube has a surface area of 24 cm<sup>2</sup>. What is the surface area of the object pictured?

- A) 80 cm<sup>2</sup>                      B) 64 cm<sup>2</sup>                      C) 40 cm<sup>2</sup>                      D) 32 cm<sup>2</sup>                      E) 24 cm<sup>2</sup>

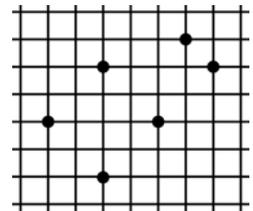


5) On each birthday Rosa gets as many roses as she is old in years. She still has all the dried flowers and there are now 120 of them. How old is she?

- A) 10                      B) 12                      C) 14                      D) 15                      E) 20

6) Six points are marked on a square grid as pictured. Which geometric figure cannot be drawn if only the marked points are allowed to be used as cornerpoints of the figure?

- A) square                      B) parallelogram with different long sides  
 C) acute triangle                      D) obtuse triangle  
 E) all figures are possible

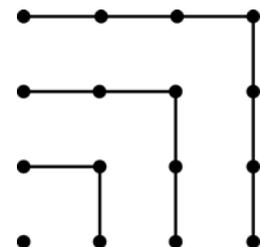


7) In the picture opposite we see that  $1+3+5+7 = 4 \times 4$ . How big is  $1+3+5+7+\dots+17+19$ ?

- A)  $10 \times 10$                       B)  $11 \times 11$                       C)  $12 \times 12$                       D)  $13 \times 13$                       E)  $14 \times 14$

8) Brigitte goes on holiday to Verona and plans to cross all five of the famous old bridges over the Etsch (Adige) at least once. She starts at the train station and when she returns there she has crossed each of the five bridges but no others. During her walk she has crossed the river n times. What is a possible value for n?

- A) 3                      B) 4                      C) 5                      D) 6                      E) 7



9) In a box are 50 counters: white ones, blue ones and red ones. There are eleven times as many white ones as blue ones. There are less red ones than white ones, but more red ones than blue ones. By how much is the number of red counters less than the number of white ones in the box?

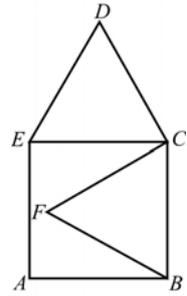
- A) 2                      B) 11                      C) 19                      D) 22                      E) 30

10) Which of the numbers a, b, c, d and e is biggest if  $a - 1 = b + 2 = c - 3 = d + 4 = e - 4$ ?

- A) a                      B) b                      C) c                      D) d                      E) e

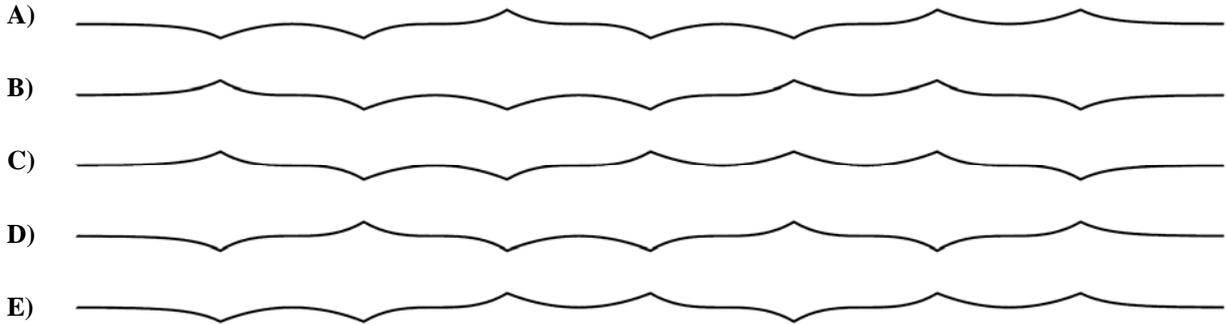
**- 4 Point Questions -**

11) In the figure, ABCE is a square. CDE and BCF are equilateral triangles. The length of AB is 1. How long is FD?



- A)  $\sqrt{2}$       B)  $\frac{\sqrt{3}}{2}$       C)  $\sqrt{3}$       D)  $\sqrt{5} - 1$       E)  $\sqrt{6} - 1$

12) A paperstrip is folded three times in the middle. It is then opened again and looked at from the side so that one can see all 7 folds from the side at the same time. Which of the following views is not a possible result?



13) My teacher says that the product of his age and the age of his father is 2010. In which year could my teacher have been born?

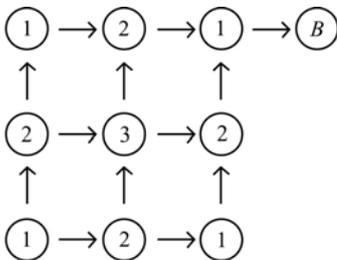
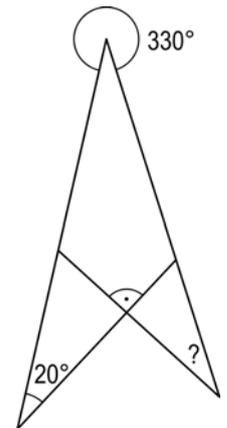
- A) 1943      B) 1953      C) 1980      D) 1995      E) 2005

14) How big is the angle indicated with a question mark?

- A)  $10^\circ$       B)  $20^\circ$       C)  $30^\circ$       D)  $40^\circ$       E)  $50^\circ$

15) How many whole numbers are there, whose digits sum to 2010 and have a product of 2?

- A) 2010      B) 2009      C) 2008      D) 1005      E) 1004



16) In the diagram one should go from A to B along the arrows. Along the way calculate the sum of the numbers that are stepped on. How many different results can be obtained?

- A) 1      B) 2      C) 3      D) 4      E) 6

17) In one month three Tuesdays fall on even days. Which day of the week is the 21st of the month?

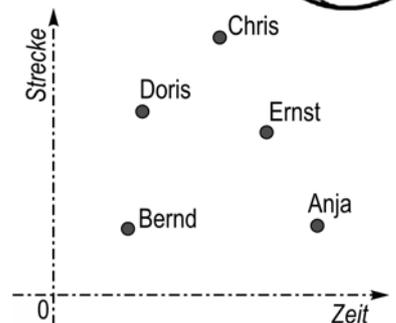
- A) Wednesday      B) Thursday      C) Friday      D) Saturday      E) Sunday

18) A circle of radius 4 cm is divided, as shown, by four semicircles with radius 2 cm into four congruent parts. What is the perimeter of one of these parts?

- A)  $2\pi$       B)  $4\pi$       C)  $6\pi$       D)  $8\pi$       E)  $12\pi$

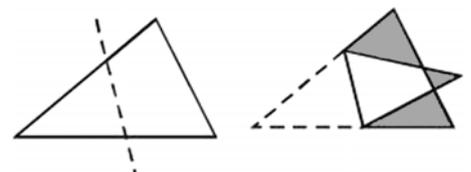
19) Five students carry out a run. Their results are recorded in the graph opposite, according to the time taken (Zeit) and the distance covered (Strecke). Who had the greatest average speed?

- A) Anja      B) Bernd      C) Chris      D) Doris      E) Ernst



20) A triangle is folded along the dashed line as shown. The area of the triangle is 1.5 times the area of the resulting figure. We know that the total area of the grey parts is 1. Determine the area of the starting triangle.

- A) 2      B) 3      C) 4      D) 5      E) It cannot be determined.

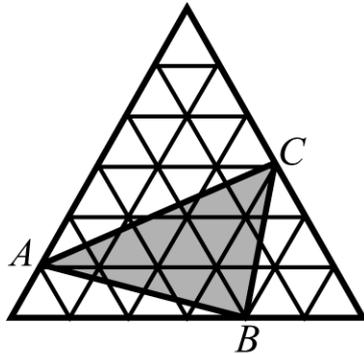


**- 5 Point Questions -**



21) In front of a supermarket there are two rows of interconnected trolleys. The first one is 2.9 m long and consists of 10 trolleys. The second one is 4.9 m long and consists of twenty trolleys. How long is one trolley?

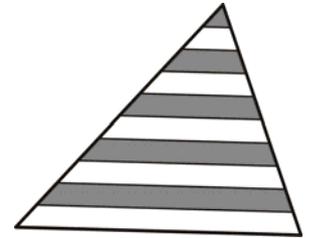
- A) 0.8 m    B) 1 m    C) 1.1 m    D) 1.2 m    E) 1.4 m



22) The big equilateral triangle consists of 36 small equilateral triangles which each have an area of 1 cm<sup>2</sup>. Determine the area of ABC.

- A) 11 cm<sup>2</sup>    B) 12 cm<sup>2</sup>    C) 13 cm<sup>2</sup>    D) 14 cm<sup>2</sup>    E) 15 cm<sup>2</sup>

23) Lines drawn parallel to the base of the triangle pictured, separate the other two sides into 10 equally large parts. What percentage of the triangle is grey?



- A) 41.75 %    B) 42.5 %    C) 45 %    D) 46 %    E) 47.5 %

24) For how many integers n where  $1 \leq n \leq 100$  is  $n^n$  a square number?

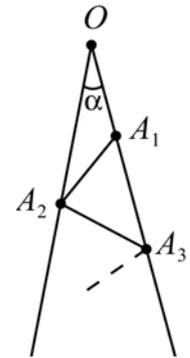
- A) 5    B) 50    C) 55    D) 54    E) 15

25) Six-legged, seven-legged and eight-legged octopuses serve the king of the sea Neptun. The seven-legged ones always lie and the six-legged and the eight-legged ones always speak the truth. One day four octopuses meet. The blue one says: „We have 28 legs altogether.“ The green one says: „We have 27 legs altogether.“ The yellow one says: „We have 26 legs altogether.“ The red one says: „We have 25 legs altogether.“ How many legs does the red octopus have?

- A) 6    B) 7    C) 8    D) 6 or 8    E) cannot be determined.

26) In the figure  $\alpha = 7^\circ$ . All lines  $OA_1, A_1A_2, A_2A_3, \dots$  are equally long. What is the maximum number of lines that can be drawn in this way if no two lines are allowed to intersect each other?

- A) 10    B) 11    C) 12    D) 13    E) infinitely many



27) In a sequence the first three terms are 1, 2 and 3. From the fourth term onwards each subsequent term is calculated from the three previous terms. The rule is that the third term is subtracted from the sum of the first two. This way we obtain the sequence 1, 2, 3, 0, 5, -2, 7, ... What is the 2010th term of this sequence?

- A) -2006    B) 2008    C) -2002    D) -2004    E) another number

28) Along each side of a pentagon a positive integer is written. Numbers of adjacent sides never have a common factor bigger than 1 and non-adjacent sides always have a common factor bigger than 1. There are several possibilities for this situation but one of the following numbers can never be at one of the sides of the pentagon. Which one?

- A) 15    B) 18    C) 19    D) 21    E) 22

29) How many three-digit numbers have the properties that their middle digit is the average of the two other digits?

- A) 9    B) 12    C) 16    D) 25    E) 45

30) A barcode as pictured is made up of alternate black and white stripes. The code always starts and ends with a black stripe. Each stripe (black or white) has the width 1 or 2 and the total width of the barcode is 12. How many different barcodes of this kind are there if one reads from left to right?

- A) 24    B) 132    C) 66    D) 12    E) 116



# KÄNGURU DER MATHEMATIK 2010

## 18.3.2010

Categorie: Junior, Grades: 9-10

Name:	
School:	
Class:	

Time allowed: 75 min.

Each correct answer, questions 1.-10.: 3 Points

Each correct answer, questions 11.-20.: 4 Points

Each correct answer, questions 21.-30.: 5 Points

Each question with no answer given: 0 Points

Each incorrect answer: Lose  $\frac{1}{4}$  of the points for than question.

You begin with 30 points



**Please write the letter (A, B, C, D, E) of the correct answer  
under the question number (1 to 30).  
Write neatly and carefully!**

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>

<b>11</b>	<b>12</b>	<b>13</b>	<b>14</b>	<b>15</b>	<b>16</b>	<b>17</b>	<b>18</b>	<b>19</b>	<b>20</b>

<b>21</b>	<b>22</b>	<b>23</b>	<b>24</b>	<b>25</b>	<b>26</b>	<b>27</b>	<b>28</b>	<b>29</b>	<b>30</b>

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die Österreichische Mathematikolympiade; Infos unter:  
[www.oemo.at](http://www.oemo.at)

# Känguru der Mathematik 2010 Group Student (From Grade 11.) Austria - 18.3.2010



## - 3 Point Questions -

1) In the picture opposite we see that  $1+3+5+7 = 4 \times 4$ . How big is  $1+3+5+7+\dots+17+19$ ?

- A)  $10 \times 10$       B)  $11 \times 11$       C)  $12 \times 12$       D)  $13 \times 13$       E)  $14 \times 14$

2) Which number goes in the cell with the question mark if the sum of the numbers in both rows is equal?

1	2	3	4	5	6	7	8	9	10	2010
11	12	13	14	15	16	17	18	19	20	?

- A) 1010      B) 1020      C) 1910      D) 1990      E) 2000

3) The hollow spaces of two empty containers are cubic and have a base area of  $1 \text{ dm}^2$  and  $4 \text{ dm}^2$  respectively. The big container is to be filled with water, using the small one as a scoop. How many full scoops are necessary to fill the big cube?

- A) 2      B) 4      C) 6      D) 8      E) 16

4) How many four-digit numbers, made up of odd digits only, are divisible by 5?

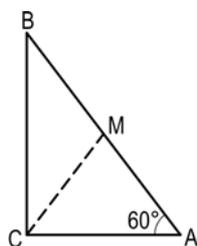
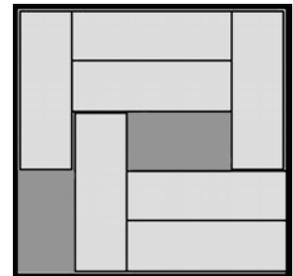
- A) 900      B) 625      C) 250      D) 125      E) 100

5) The managing director of a company claims „Every one of our employees is at least 25 years old.“ It turns out, he is wrong. Which of the following statements is correct?

- A) All employees of the company are exactly 25 years old.  
 B) All employees of the company are more than 26 years old.  
 C) No employee of the company is already 25 years old.  
 D) One of the employees of the company is less than 25 years old.  
 E) One of the employees of the company is exactly 26 years old.

6) In the box are seven blocks. You want to rearrange the blocks so that another block can be placed. What is the minimum number of blocks that have to be moved?

- A) 2    B) 3    C) 4    D) 5    E) It is not possible.



7) The triangle pictured is right-angled. M is the midpoint of the hypotenuse AB and  $\angle BCA = 90^\circ$ . How big is  $\angle BMC$ ?

- A)  $105^\circ$       B)  $108^\circ$       C)  $110^\circ$       D)  $120^\circ$       E)  $125^\circ$

8) Which of the following numbers could be the number of edges of a prism?

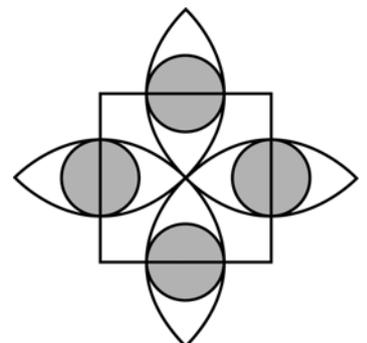
- A) 100      B) 200      C) 2008      D) 2009      E) 2010

9) How many two-digit numbers with x in the tens-column and y in the unit-column have the properties  $(x-3)^2 + (y-2)^2 = 0$ ?

- A) 1      B) 2      C) 6      D) 32      E) none

10) In the figure the square has side length 2. The semi-circles pass through the midpoint of the square and have their centres on the corners of the square. The grey circles have their centres on the sides of the square and touch the semi-circles. How big is the total area of the grey parts?

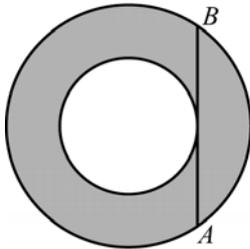
- A)  $4 \cdot (3 - 2\sqrt{2}) \cdot \pi$     B)  $\sqrt{2} \cdot \pi$     C)  $\frac{\sqrt{3}}{4} \cdot \pi$     D)  $\pi$     E)  $\frac{1}{4} \cdot \pi$



**- 4 Point Questions -**

11) The numbers  $\sqrt{7}$ ,  $\sqrt[3]{7}$  und  $\sqrt[5]{7}$  are, in this order consecutive terms of a geometric sequence. Determine the next term.

- A)  $\sqrt[7]{7}$       B)  $\sqrt[12]{7}$       C)  $\sqrt[5]{7}$       D)  $\sqrt[10]{7}$       E) 1



12) The chord AB touches the smaller of the two concentric circles. The length AB = 16. How big is the area of the grey part?

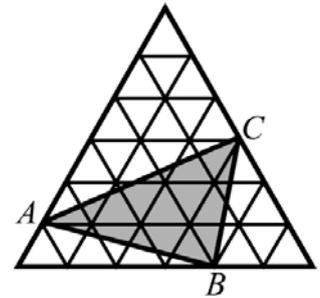
- A)  $32\pi$     B)  $63\pi$     C)  $64\pi$     D)  $32\pi^2$     E) It depends on the radius of the circles.

13) The integers x and y fulfill the condition  $2x = 5y$ . Only one of the following numbers can be considered for x+y. Which?

- A) 2011    B) 2010    C) 2009    D) 2008    E) 2007

14) The big equilateral triangle consists of 36 small equilateral triangles which each have an area of  $1\text{ cm}^2$ . Determine the area of ABC.

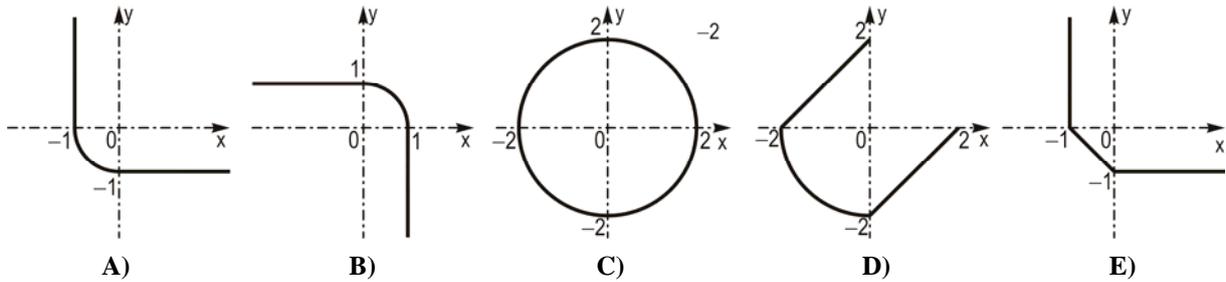
- A)  $11\text{ cm}^2$     B)  $12\text{ cm}^2$     C)  $13\text{ cm}^2$     D)  $14\text{ cm}^2$     E)  $15\text{ cm}^2$



15) In a bag are blue, green and red balls (at least one ball of each colour). If we randomly take five balls out of the bag, we know: At least two balls are red and at least three are of the same colour. How many blue balls are in the bag?

- A) 1    B) 2    C) 3    D) 4    E) Not possible to answer.

16) Which of the following graphs represents the solution set of  $(x-|x|)^2 + (y-|y|)^2 = 4$ ?



17) If we connect three cornerpoints of a regular 14-sided polygon then a triangle is created. How many of those triangles are right-angled?

- A) 42    B) 84    C) 88    D) 98    E) 168

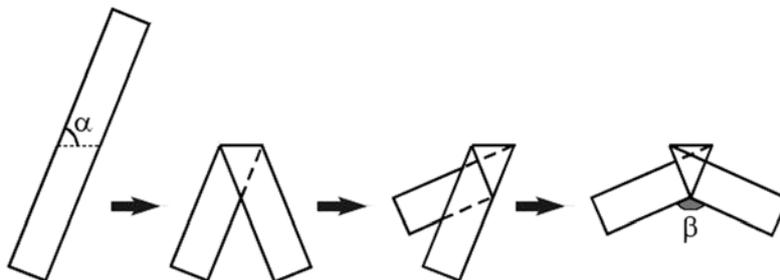
18) Each star in the expression  $1*2*3*4*5*6*7*8*9*10$  is either replaced by a „+“ or a „x“. Let N be the biggest number possible that can be obtained this way. What is the smallest prime factor of N?

- A) 2    B) 3    C) 5    D) 7    E) Another number

19) The side-lengths of a triangle in cm are given by the natural numbers 13, x and y. Determine the perimeter of the triangle if  $xy = 105$ .

- A) 35    B) 39    C) 51    D) 69    E) 119

20) A strip of paper is folded three times as shown. Determine  $\beta$  if  $\alpha = 70^\circ$ .

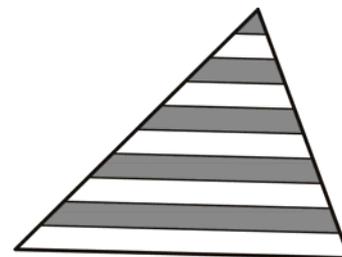


- A)  $140^\circ$     B)  $130^\circ$     C)  $120^\circ$     D)  $110^\circ$     E)  $100^\circ$

**- 5 Point Questions -**

21) Lines drawn parallel to the base of the triangle pictured separate the two other sides into 10 sized parts. What percentage of the triangle is grey?

- A) 42.5 %      B) 45 %      C) 46 %      D) 47.5 %      E) 50 %



22) 100 people take part in a race where no-one can tie. Everybody is questioned after the race as to which place they have achieved and all answer with a number between 1 and 100. The sum of all answers is 4000. What is the minimum number of people who have lied about their result?

- A) 9      B) 10      C) 11      D) 12      E) 13

23) I roll an ordinary die once. What is the probability that I rolled '2' at least once under the condition that the third number is equal to the sum of the first two?

- A)  $\frac{1}{6}$       B)  $\frac{91}{216}$       C)  $\frac{1}{2}$       D)  $\frac{8}{15}$       E)  $\frac{7}{12}$

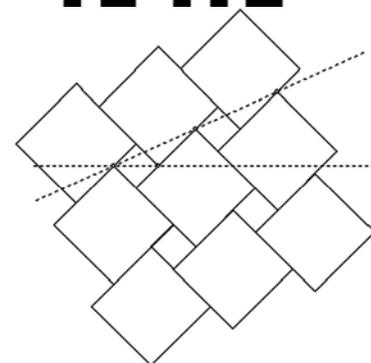
24) A barcode as pictured is made up of alternate black and white stripes. The code always starts and ends with a black stripe. Each strip (black or white) has the width 1 or 2 and the total width of the barcode is 12. How many different barcodes of this kind are there if one reads from left to right?

- A) 24      B) 132      C) 66      D) 12      E) 116



25) The picture on the right shows a tile pattern. The side length of the bigger tiles is a and of the smaller ones b. The dotted lines (horizontal and tilted) include an angle of 30°. How big is the ratio a:b?

- A)  $(2 \cdot \sqrt{3}):1$       B)  $(2 + \sqrt{3}):1$       C)  $(3 + \sqrt{2}):1$   
 D)  $(3 \cdot \sqrt{2}):1$       E) 2:1



26) The numbers from 1 to 10 are written 10 times each on a board. Now the children play the following game: One child deletes two numbers off the board and writes instead the sum of the two numbers minus 1. Then a second child does the same, and so forth until there is only one number left on the board. The last number is

- A) less than 440.      B) 451.      C) 460.      D) 488.      E) greater than 500.

27) The expression  $\frac{(2+3)(2^2+3^2)\dots(2^{1024}+3^{1024})(2^{2048}+3^{2048})+2^{4096}}{3^{2048}}$  is equal to

- A)  $2^{2048}$       B)  $2^{4096}$       C)  $3^{2048}$       D)  $3^{4096}$       E)  $3^{2048} + 2^{2048}$

28)  $\sqrt[100]{0.44\dots4}$  is written as a decimal. What is the 100th digit after the decimal point?

- A) 1      B) 2      C) 3      D) 4      E) 6

29) A function maps all positive real numbers to real numbers. For all x the following holds true:  $x \in \mathbb{R}^+$  :

$$2f(x) + 3f\left(\frac{2010}{x}\right) = 5x . \text{ Determine the value of } f(6).$$

- A) 993      B) 1      C) 2009      D) 1013      E) 923

30) On the two catheti of a right-angled triangle (with lengths a and b respectively) points P and Q respectively are chosen. Let K and H be the endpoints of the perpendicular lines from P and Q respectively, to the hypotenuse of the triangle. How big is the smallest possible value of KP + PQ + QH?

- A) a+b      B)  $\frac{2ab}{a+b}$       C)  $\frac{2ab}{\sqrt{a^2+b^2}}$       D)  $\frac{(a+b)^2}{\sqrt{a^2+b^2}}$       E)  $\frac{(a+b)^2}{2ab}$

# KÄNGURU DER MATHEMATIK 2010

## 18.3.2010

Categorie: Student, Grades: 11-13

Name:	
School:	
Class:	

Time allowed: 75 min.

Each correct answer questions 1.-10.: 3 Points

Each correct answer questions 11.-20.: 4 Points

Each correct answer questions 21.-30.: 5 Points

Each question with no answer given: 0 Points

Each incorrect answer: Lose  $\frac{1}{4}$  of the points for that question

Therefore 30 starting points



**Please write the letter (A, B, C, D, E) of the correct answer under the question number (1 to 30)**

**Write neatly and clearly!**

1	2	3	4	5	6	7	8	9	10

11	12	13	14	15	16	17	18	19	20

21	22	23	24	25	26	27	28	29	30

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[www.oemo.at](http://www.oemo.at)

**2010**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
<b>Écolier</b>	E	C	D	A	B	C	B	C	B	C	B	A	C	E	C	C	A	D	C	C	A	D	D	B						
<b>Benjamin</b>	B	C	C	C	C	C	B	B	E	D	E	C	E	E	E	A	C	A	B	A	B	D	C	C						
<b>Kadett</b>	C	C	C	D	E	C	E	C	B	C	E	D	B	D	B	B	C	A	B	E	B	B	C	D	B	C	C	B	A	D
<b>Junior</b>	D	D	C	B	D	E	A	D	C	E	A	D	C	D	B	B	E	C	D	B	C	A	C	C	B	D	A	C	E	E
<b>Student</b>	A	C	D	D	D	B	D	E	A	A	E	C	C	A	A	A	B	E	A	C	B	D	D	E	B	B	C	E	A	C

# MATHEMATICS KANGAROO 2011

## Austria - 17.3.2011

Group: Écolier, Grades: 3-4

Name:	
School:	
Class:	

Time allowed: 60 min.

Each correct answer, questions 1.-8.: 3 Points

Each correct answer, questions 9.-16.: 4 Points

Each correct answer, questions 17.-24.: 5 Points

Each question with no answer given: 0 Points

Each incorrect answer: Lose  $\frac{1}{4}$  of the points for that question.

You begin with 24 points.



**Please write the letter (A, B, C, D, E) of the correct answer under the questions number (1 to 24)**  
**Write neatly and carefully!**

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>

<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>13</b>	<b>14</b>	<b>15</b>	<b>16</b>

<b>17</b>	<b>18</b>	<b>19</b>	<b>20</b>	<b>21</b>	<b>22</b>	<b>23</b>	<b>24</b>

Information über den Känguruwettbewerb: [www.kaenguru.at](http://www.kaenguru.at)  
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# Mathematics Kangaroo 2011

## Group Écolier (Grades 3 and 4)

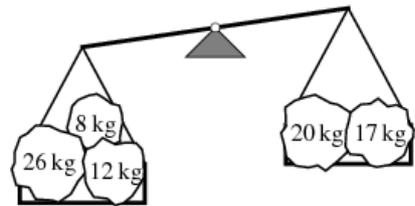
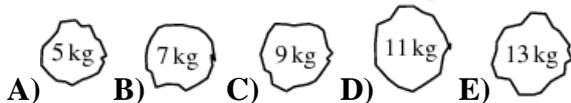
### Austria - 17.3.2011



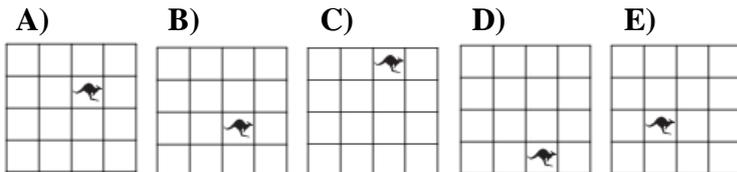
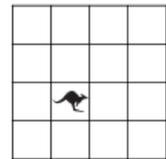
- 3 Point Questions -

- 1) Bernd wants to paint the word KANGAROO. He begins on a Wednesday and paints one letter each day. On which day will he paint the last letter?  
 A) Monday    B) Tuesday    C) Wednesday    D) Thursday    E) Friday

- 2) Which stone should Mr Flintstone place on the right side of the scales, so that both sides weigh the same?



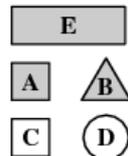
- 3) A game is played on a board as shown in the picture. I move the counter from square to square according to the following rules. First, one square to the right, then one square up, then one square left, then one square down, and then once again one square right. Which picture shows where the counter can then be found?



- 4) Simon awoke one and a half hours ago. In three and a half hours he will catch a train to go to his grandma. How long before the time his train leaves, did he wake up?

- A) Two hours    B) Three and a half hours    C) Four hours  
 D) Four and a half hours    E) Five hours

- 5) Maria describes one of these five shapes in the following way: „It is not a square. It is grey. It is either round or three sided.“ Which shape did she describe?



- A) A    B) B    C) C    D) D    E) E

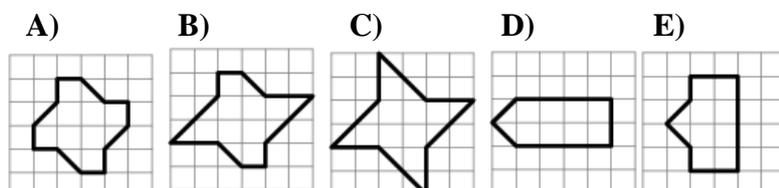
- 6) Lenka paid 1 Euro and 50 Cents for three scoops of ice cream. Miso paid 2 Euro's and 40 Cents for two chocolate bars. How much did Igor pay for one scoop of ice cream and one chocolate bar?

- A) 1 €70 c    B) 1 €90 c    C) 2 €20 c    D) 2 €70 c    E) 3 €90 c

- 7) The bell of a clocktower rings every full hour (8:00, 9:00, 10:00 etc.) and rings as many times as the number of hours. It also rings once on every half hour (8:30, 9:30, 10:30 etc). How often will it ring between 7:55 and 10:45?

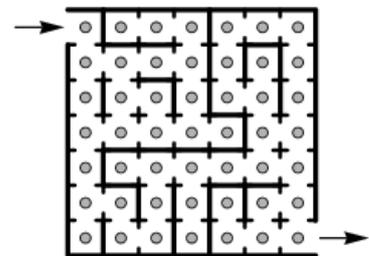
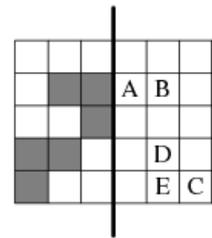
- A) 6 times    B) 18 times    C) 27 times    D) 30 times    E) 33 times

- 8) Which shape has the biggest area?



**- 4 Point Questions -**

- 9) A chicken farmer packs eggs in boxes of 6 and boxes of 12. What is the smallest number of boxes he needs to pack 66 eggs?  
 A) 5      B) 6      C) 9      D) 11      E) 13
- 10) All the children in a class at school have at least one pet, and at most two pets. They write down how many pets they have together. Two children each have a dog and a fish. Three have each a cat and a dog. No child has two cats. Altogether they have eight cats, six dogs, and two fish. How many children are in the class?  
 A) 11      B) 12      C) 13      D) 14      E) 17
- 11) Johannes has only 5 Cent coins and 10 Cent coins in his pocket. Altogether he has 13 coins. Which of the following amounts cannot be the total of his coins?  
 A) 80 c      B) 60 c      C) 70 c      D) 115 c      E) 125 c
- 12) A page is folded along the thick line as shown. Which letter will not be covered by a grey square?  
 A) A      B) B      C) C      D) D      E) E
- 13) Anna, Bob, Cleo, Dido, Eva, and Ferdl each roll a dice. Each person rolls a different number. Anna's number is twice as big as Bob's. Anna's number is three times as big as Cleo's. Dido's number is four times as big as Eva's. Which number did Ferdl roll?  
 A) 2      B) 3      C) 4      D) 5      E) 6
- 14) A quizshow has the following rules: Each contestant begins with 10 points. They must answer 10 questions. For each correct answer they get a point and for each incorrect answer they lose a point. Mrs Blandorfer finished the show with 14 points. How many questions had she answered incorrectly?  
 A) 7      B) 4      C) 5      D) 3      E) 6
- 15) In each square of the maze there is a piece of cheese. Ronnie the mouse wants to enter and leave the maze as shown in the picture. He doesn't want to visit a square more than once, but would like to eat as much cheese as possible. What is the maximum number of pieces of cheese that he can eat?  
 A) 17      B) 33      C) 37      D) 41      E) 49
- 16) During a party, two identical cakes were each cut into four identical pieces. Each of these pieces was then cut into three identical pieces. Each person at the party got a piece of cake, and there were three pieces left over. How many people were at the party?  
 A) 24      B) 21      C) 18      D) 27      E) 13



**- 5 Point Questions -**

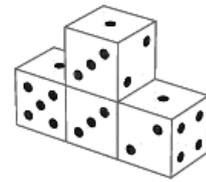
- 17) Four friends Masha, Sasha, Dasha and Pasha are sitting on a bench. At first Masha swapped places with Dasha. Then Dasha swapped places with Pasha. After this the four friends are sitting from left to right in the order: Masha, Sasha, Dasha, Pasha. In what order, from left to right were they sitting to begin with?  
 A) Masha, Sasha, Dasha, Pasha      B) Masha, Dasha, Pasha, Sasha  
 C) Dasha, Sasha, Pasha, Masha      D) Sasha, Masha, Dasha, Pasha  
 E) Pasha, Masha, Sasha, Dasha

18) How often in a day does a digital clock display four identical digits? The picture shows a digital clock that is displaying exactly two different digits.

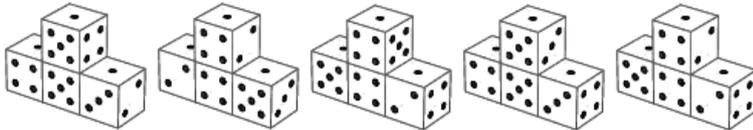


- A) 1 time    B) 24 times    C) 3 times    D) 5 times    E) 12 times

19) Four identical dice were put together to make a tower as shown. The sum of the numbers on opposite faces of each dice is always 7. What would the tower look like from behind?



- A)                  B)                  C)                  D)                  E)

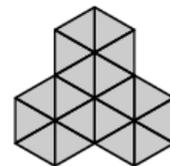


20) You can place together the cards pictured, to make different three digit numbers, for instance 989 or 986. How many different three digit numbers can you make with these cards?

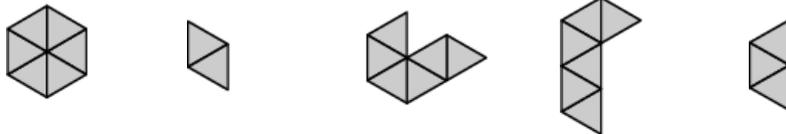


- A) 4                  B) 6                  C) 8                  D) 9                  E) 12

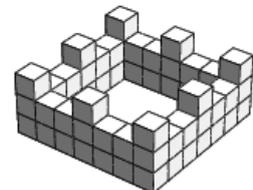
21) Andrea made the pattern in the picture out of several identical tiles. None of the tiles overlap each other. Which of the following tiles could she definitely not have used?



- A)                  B)                  C)                  D)                  E)

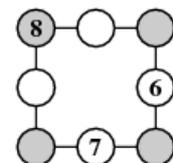


22) The picture shows a Fortress made from cubes. How many cubes were used to make it?



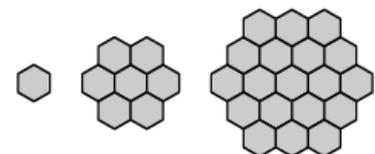
- A) 56                  B) 60                  C) 64                  D) 68                  E) 72

23) Johannes wrote the numbers 6, 7 and 8 in the circles as shown. He wants to write the numbers 1, 2, 3, 4 and 5 in the remaining circles so that the sum of the numbers along each side of the square is 13. What will be the sum of the numbers in the grey circles?



- A) 12                  B) 13                  C) 14                  D) 15                  E) 16

24) Sylvia draws patterns with hexagons as shown. If she carries on drawing in this way, how many hexagons will there be in the fifth pattern?



- A) 37                  B) 49                  C) 57                  D) 61                  E) 64

# MATHEMATICS KANGAROO 2011

## Austria - 17.3.2011

Group: Benjamin, Grades: 5-6

Name:	
School:	
Class:	

Time allowed: 60 min.

Each correct answer, questions 1.-8.: 3 Points

Each correct answer, questions 9.-16.: 4 Points

Each correct answer, questions 17.-24.: 5 Points

Each question with no answer given: 0 Points

Each incorrect answer: Lose  $\frac{1}{4}$  of the points for that question.

You begin with 24 points.



**Please write the letter (A, B, C, D, E) of the correct answer under the questions number (1 to 24)**  
**Write neatly and carefully!**

1	2	3	4	5	6	7	8

9	10	11	12	13	14	15	16

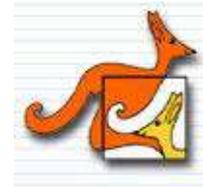
17	18	19	20	21	22	23	24

Information über den Känguruwettbewerb: [www.kaenguru.at](http://www.kaenguru.at)  
Wenn Du mehr in dieser Richtung machen möchtest, gibt es die Österreichische Mathematikolympiade; Infos unter: [www.oemo.at](http://www.oemo.at)

# Mathematics Kangaroo 2011

## Group Benjamin (Grades 5 and 6)

### Austria - 17.3.2011



- 3 Point Questions -

1) Bernd wants to paint the word KANGAROO. He begins on a Wednesday and paints one letter each day. On which day will he paint the last letter?  
 A) Monday    B) Tuesday    C) Wednesday    D) Thursday    E) Friday

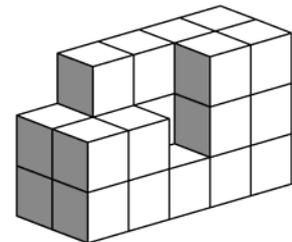
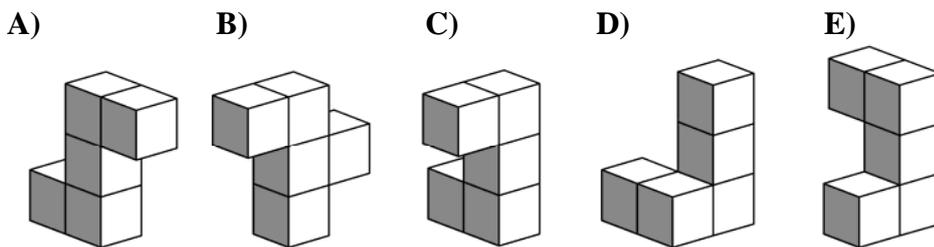
2) A motorcycle driver covers a distance 28km in 30 minutes. What was his average speed in km/h?  
 A) 28            B) 36            C) 56            D) 58            E) 62

3) A square piece of paper is cut in a straight line into two pieces. Which of the following shapes can not be created?  
 A) A Square            B) A rectangle            C) A right-angled triangle  
 D) A pentagon            E) An equilateral triangle



4) In Crazytown the houses on the right hand side of the street all have odd numbers. The Crazytowners don't use any numbers with the digit 3 in them. The first house on the right hand side has the number 1. Which number does the fifteenth house on the right hand side have?  
 A) 29            B) 41            C) 43            D) 45            E) 47

5) Which of the following pieces do I need to complete the cuboid?

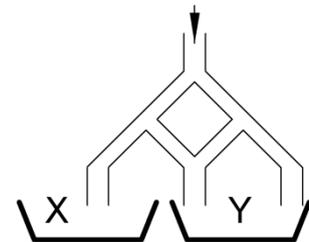


6) 1000 litres of water is passed through the water system as shown, into two identical tanks. At each junction the water separates into two equal amounts. How many litres of water end up in Tank Y?

A) 800            B) 750            C) 666.67            D) 660            E) 500

7) The date 01-03-05 (1st March 2005) has three consecutive odd numbers. This is the first day in the 21st Century with this property. How many days with this property are there in total in the 21st Century?

A) 5            B) 6            C) 16            D) 13            E) 8

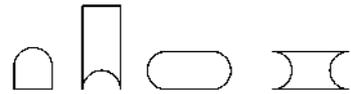


8) Andrew writes the letters from the word KANGAROO in the fields of a table. He can begin where he wants and then must write each consecutive letter in a field that shares at least one point with the previous field. Which of the following tables could Andrew not produce?

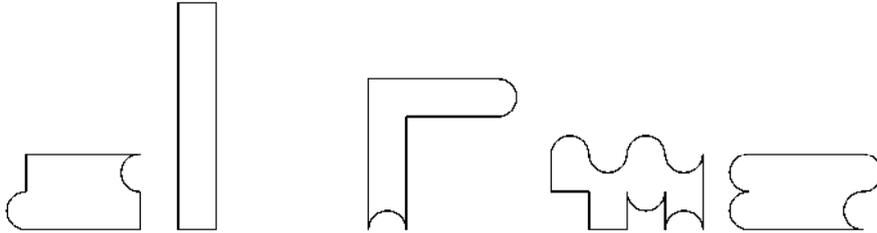
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**- 4 Point Questions -**

9) A shape is made by fitting together the four pieces of card with no overlaps. Which of the following shapes is not possible?



- A)                      B)                      C)                      D)                      E)

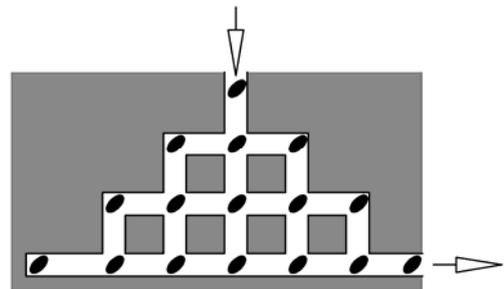


10) When Liza the cat is very lazy and sits around the whole day, she drinks 60 ml of milk. When she chases mice she drinks a third more milk. In the past two weeks, she has chased mice on every second day. How much milk has she drunk in the past two weeks?

- A) 840 ml    B) 980 ml    C) 1050 ml    D) 1120 ml    E) 1960 ml

11) Fridolin the hamster runs through the maze in the picture. 16 pumpkin seeds are laying on the path. He is only allowed to cross each junction once. What is the maximum number of pumpkin seeds that he can collect?

- A) 12    B) 13    C) 14    D) 15    E) 16

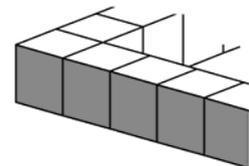


12) All the four digit numbers with the same digits as 2011 (i.e. 0, 1, 1, 2) are written in a row in ascending order. What is the difference between the two numbers that are next to 2011 in this list?

- A) 890    B) 891    C) 900    D) 909    E) 990

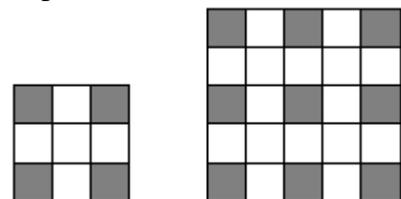
13) Nina made a wall around a square area, using 36 identical cubes. A section of the wall is shown in the picture. How many cubes will she now need to completely fill the square area.

- A) 36    B) 49    C) 64    D) 81    E) 100



14) Black and white tiles can be laid on square floors as shown in the pictures. We can see floors with 4 black and 9 black tiles respectively. In each corner there is a black tile, and each black tile touches only white tiles. How many white tiles would there be on a floor that had 25 black tiles?

- A) 25    B) 39    C) 45    D) 56    E) 72



15) Paul wanted to multiply a whole number by 301, but forgot to include the zero and multiplied by 31 instead. His answer was 372. What should his answer have been?

- A) 3010    B) 3612    C) 3702    D) 3720    E) 30720

16) In a tournament FC Barcelona scored a total of three goals, and conceded one goal. In the tournament the team had won one game, lost one game and drawn one game. What was the score in the game that FC Barcelona won?

- A) 2:0    B) 3:0    C) 1:0    D) 4:1    E) 0:1

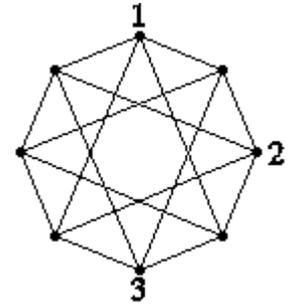
**- 5 Point Questions -**

17) If you are given the three corner points of a triangle and want to add a fourth point to make the four corners of a parallelogram. In how many places can the fourth point be placed?

- A) 1    B) 2    C) 3    D) 4    E) That depends on the triangle.

18) The 8 corners of the shape in the picture are to be labelled with the numbers 1, 2, 3 or 4, so that the numbers at the ends of each of the lines shown are different. How often does the number 4 appear on the shape?

- A) 1    B) 2    C) 3    D) 4    E) 5



19) Daniel wants to make a complete square using pieces only like those shown. What is the minimum number of pieces he must use?

- A) 9    B) 10    C) 12    D) 16    E) 20

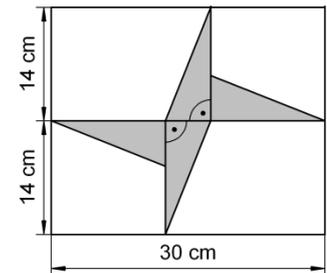


20) 10 children are at a judo club. Their teacher has 80 sweets. If he gives each girl the same amount of sweets, there are three sweets left over. How many boys are at the club?

- A) 1    B) 2    C) 3    D) 5    E) 7

21) A cat had 7 kittens. The kittens had the colours white, black, ginger, black-white, ginger-white, ginger-black, and ginger-black-white. In how many ways can you choose 4 cats so that each time two of them have a colour in common.

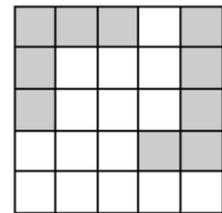
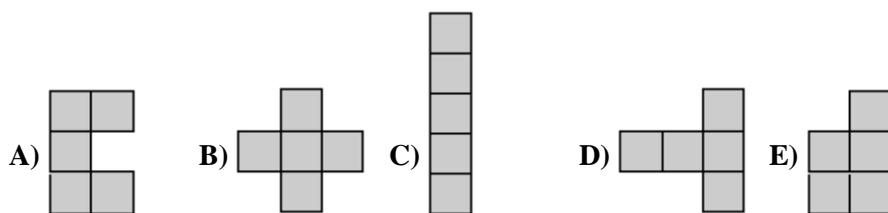
- A) 1    B) 3    C) 4    D) 6    E) 7



22) The picture shows a rectangle with four identical triangles. Determine the total area of the triangles.

- A) 46 cm<sup>2</sup>    B) 52 cm<sup>2</sup>    C) 54 cm<sup>2</sup>    D) 56 cm<sup>2</sup>    E) 64 cm<sup>2</sup>

23) Lina has already laid two shapes on a square playing board. Which of the 5 shapes can she add to the board so that none of the remaining four shapes will have space to fit.



24) Numbers are to be built using only the digits 1, 2, 3, 4 and 5 in such a way that each digit is only used once in each number. How many of these numbers will have the following property; The first digit is divisible by one, The first 2 digits make a number which is divisible by 2, the first 3 digits make a number which is divisible by three, the first 4 digits make a number which is divisible by 4 and all 5 digits make a number which is divisible by 5.

- A) It's not possible    B) 1    C) 2    D) 5    E) 10

# MATHEMATICS KANGAROO 2011

## Austria - 17.3.2011

Group: Kadett, Grades: 7-8

Name:	
School:	
Class:	

Time allowed: 75 min.

Each correct answer, questions 1.-10.: 3 Points

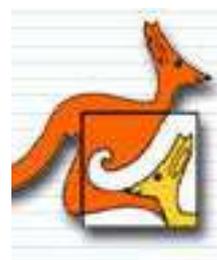
Each correct answer, questions 11.-20.: 4 Points

Each correct answer, questions 21.-30.: 5 Points

Each question with no answer given: 0 Points

Each incorrect answer: Lose  $\frac{1}{4}$  of the points for that question.

You begin with 30 points.



**Please write the letter (A, B, C, D, E) of the correct answer under the questions number (1 to 24)**  
**Write neatly and carefully!**

1	2	3	4	5	6	7	8	9	10

11	12	13	14	15	16	17	18	19	20

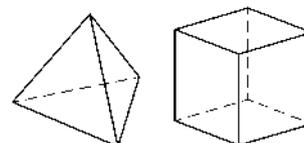
21	22	23	24	25	26	27	28	29	30

Information über den Känguruwettbewerb: [www.kaenguru.at](http://www.kaenguru.at)  
Wenn Du mehr in dieser Richtung machen möchtest, gibt es die  
Österreichische Mathematikolympiade; Infos unter:  
[www.oemo.at](http://www.oemo.at)

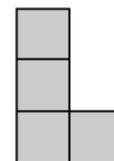
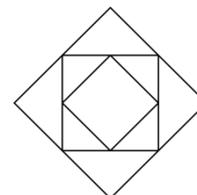
# Mathematics Kangaroo 2011

## Group Kadett (Grades 7 and 8)

### Austria - 17.3.2011



- 1) Which of the following calculations give the biggest result?  
 A)  $201 \times 1$     B)  $20 \times 1 \times 1$     C)  $1 \times 2011$     D)  $1 + 2011$     E)  $1 \div 2011$
- 2) Elsa has 3 tetrahedra and 5 dice. How many faces do these eight objects have altogether?  
 A) 42    B) 48    C) 50    D) 52    E) 56
- 3) A zebra crossing has alternating white and black stripes each 50 cm wide. The first stripe is white and the last one is white. The zebra crossing in front of our school has 8 white stripes. How wide is the road?  
 A) 7 m    B) 7.5 m    C) 8 m    D) 8.5 m    E) 9 m
- 4) My calculator has gone mad. If I want to multiply, it divides and if I want to add, it subtracts. I type in  $(12 \times 3) + (4 \times 2) =$ . Which result will it give me?  
 A) 2    B) 6    C) 12    D) 28    E) 38
- 5) My digital clock just showed 20:11. In how many minutes will it again show the digits 0, 1, 1, 2 in any order?  
 A) 40    B) 45    C) 50    D) 55    E) 60
- 6) In the picture on the right we can see three squares. The corners of the middle square are on the midpoints of the sides of the larger square, and the corners of the smaller square are on the midpoints of the sides of the middle square. The area of the small square is  $6 \text{ cm}^2$ . What is the area of the big square?  
 A)  $24 \text{ cm}^2$     B)  $18 \text{ cm}^2$     C)  $15 \text{ cm}^2$     D)  $12 \text{ cm}^2$     E)  $9 \text{ cm}^2$
- 7) The 17 houses in my street are numbered consecutively on one side with the odd numbers 1, 3, 5... and on the other side with the numbers 2, 4, 6, .... My house is the last one on the even side and has the number 12. Yours is the last one on the odd side. Which number does your house have?  
 A) 5    B) 7    C) 13    D) 17    E) 21
- 8) Felix the Tomcat catches 12 fish in 3 days. On the second day he catches more than on the first. On the third day he catches more than on the second but less than on the first two days together. How many fish does he catch on day three?  
 A) 5    B) 6    C) 7    D) 8    E) 9
- 9) From all whole numbers between 100 and 1000 whose digits sum to 8, the smallest and the largest number are chosen. How big is the sum of those two numbers?  
 A) 707    B) 907    C) 916    D) 1000    E) 1001
- 10) In the picture on the right we see an L-shaped object which is made up of four squares. We would like to add another equally big square so that the new object has a line of symmetry. How many ways are there to achieve this?  
 A) 1    B) 2    C) 3    D) 5    E) 6



#### - 4 Point Questions -

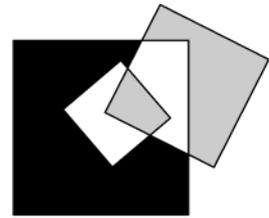
- 11)  $\frac{2011 \times 2 \cdot 011}{201 \cdot 1 \times 20 \cdot 11} =$  A) 0.01    B) 0.1    C) 1    D) 10    E) 100
- 12) Marie has 9 pearls which weigh in order 1 g, 2 g, 3 g, 4 g, 5 g, 6 g, 7 g, 8 g and 9 g. She makes four rings each with two pearls. The pearls on those rings weigh in order 17 g, 13 g, 7 g and 5 g. How much does the pearl which has not been used weigh?  
 A) 1 g    B) 2 g    C) 3 g    D) 4 g    E) 5 g



23) Each one of the three birds Isaak, Max and Oskar has its own nest. Isaak says: "I am more than twice as far away from Max as I am from Oskar". Max says: "I am more than twice as far away from Oskar as I am from Isaak". Oskar says: "I am more than twice as far away from Max as I am from Isaak". At least two of them speak the truth. Who is lying?

- A) Isaak      B) Max      C) Oskar      D) nobody  
E) It can not be decided from the information given.

24) On the inside of a square with side length 7 cm another square is drawn with side length 3 cm. Then a third square with side length 5 cm is drawn so that it cuts the first two as shown in the picture on the right. How big is the difference between the black area and the grey area?



- A) 0 cm<sup>2</sup>      B) 10 cm<sup>2</sup>      C) 11 cm<sup>2</sup>      D) 15 cm<sup>2</sup>  
E) It can not be decided from the information given.

25) Myshko shoots at a target board. He only hits the numbers 5, 8 and 10. In doing so he hits the numbers 8 and 10 equally often and scores a total of 99 points. For 25% of his shots he missed the target board completely. How often did he shoot at the target board?

- A) 10      B) 12      C) 16      D) 20      E) 24

26) In a convex quadrilateral  $ABCD$  with  $AB = AC$ , the following holds true:  $\angle BAD = 80^\circ$ ,  $\angle ABC = 75^\circ$ ,  $\angle ADC = 65^\circ$ . How big is  $\angle BDC$ ? (Note: In a convex quadrilateral all internal angles are less than  $180^\circ$ .)

- A)  $10^\circ$       B)  $15^\circ$       C)  $20^\circ$       D)  $30^\circ$       E)  $45^\circ$

27) Seven years ago Eva's age was a multiple of 8. In eight years it will be a multiple of 7. Eight years ago Raffi's age was a multiple of 7. In seven years it will be a multiple of 8. Which of the following statements can be true?

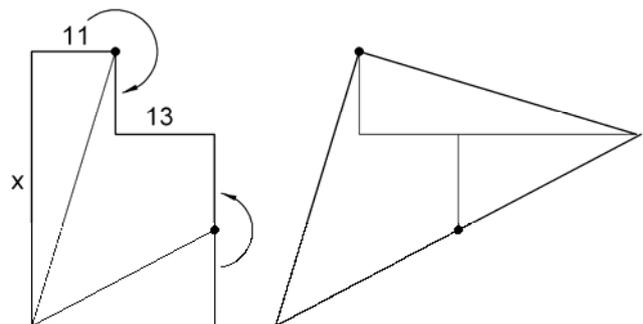
- A) Raffi is two years older than Eva.      B) Raffi is ten years older than Eva.  
C) Raffi and Eva are the same age.      D) Raffi is one year younger than Eva.  
E) Raffi is two years younger than Eva.

28) Which is the smallest possible positive, whole number value of the expression, if different letters stand for different digits not equal to 0 and the same letters stand for the same digits?

$$\frac{K \times A \times N \times G \times A \times R \times O \times O}{G \times A \times M \times E}$$

- A) 1      B) 2      C) 3      D) 5      E) 7

29) The figure on the left consists of two rectangles. Two side lengths are marked: 11 and 13. The figure is cut into three parts along the two lines drawn inside. These can be put together to make the triangle shown on the right. How long is the side marked  $x$ ?



- A) 36      B) 37      C) 38      D) 39      E) 40

30) Mark plays a computer game in a  $4 \times 4$  table. The cells each have a colour which is initially hidden. If he clicks into a cell it changes to red or blue. He knows that there are exactly two blue fields and that they share one side line. Which is the smallest number of clicks with which he can definitely find the blue cells?

- A) 9      B) 10      C) 11      D) 12      E) 13

# MATHEMATICS KANGAROO 2011

## Austria - 17.3.2011

Group: Junior, Grades: 9-10

Name:	
School:	
Class:	

Time allowed: 75 min.

- Each correct answer, questions 1.-10.:                    3 Points
- Each correct answer, questions 11.-20.:                4 Points
- Each correct answer, questions 21.-30.:                5 Points
- Each question with no answer given:                    0 Points
- Each incorrect answer: Lose ¼ of the points for that question.
- You begin with 30 points.



**Please write the letter (A, B, C, D, E) of the correct answer under the question number (1 to 30). Write neatly and carefully!**

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>

<b>11</b>	<b>12</b>	<b>13</b>	<b>14</b>	<b>15</b>	<b>16</b>	<b>17</b>	<b>18</b>	<b>19</b>	<b>20</b>

<b>21</b>	<b>22</b>	<b>23</b>	<b>24</b>	<b>25</b>	<b>26</b>	<b>27</b>	<b>28</b>	<b>29</b>	<b>30</b>

Information über den Känguruwettbewerb: [www.kaenguru.at](http://www.kaenguru.at)  
 Wenn Du mehr in dieser Richtung machen möchtest, gibt es die Österreichische Mathematikolympiade; Infos unter:  
[www.oemo.at](http://www.oemo.at)

Ich melde mich zur Teilnahme zum österreichischen Wettbewerb „Känguru der Mathematik 2011“ an.  
 Ich stimme zu, dass meine personenbezogenen Daten, nämlich Vor- und Zuname, Geschlecht, Klasse, Schulstufe, Schulstandort und Schulart zum Zweck der Organisation und Durchführung des Wettbewerbs, der Auswertung der Wettbewerbsergebnisse (Ermitteln der erreichten Punkte und Prozentzahlen), des Erstellens von landes- sowie österreichweiten Reihungen, der Veröffentlichung der Ergebnisse jener Schülerinnen und Schüler, die in ihrer Kategorie zumindest 50% der zu vergebenden Punkte erreicht haben sowie des Ermöglichens von Vergleichen mit eigenen Leistungen aus vorherigen Wettbewerbsperioden auf [www.kaenguru.at](http://www.kaenguru.at) bzw. <http://kaenguru.diefenbach.at/> verwendet werden.  
 Die Verwendung dieser Daten ist bis 31. Dezember 2013 gestattet. Diese Zustimmung kann ich gemäß § 8 Abs. 1 Z 2 DSGVO 2000 ohne Begründung jederzeit schriftlich bei [webmaster@kaenguru.at](mailto:webmaster@kaenguru.at) widerrufen.  
 Nach dem 31. Dezember 2013 werden Vor- und Zuname, die Klasse und der Schulstandort gelöscht, wobei das zuletzt genannte Datum durch die Angabe des Bundeslandes ersetzt wird. Die Verwendung der auf diese Art pseudonymisierten Daten ist nur mehr für statistische Zwecke auf der Grundlage von § 46 Abs. 1 Z 3 DSGVO 2000 erlaubt.

Unterschrift:

# Mathematics Kangaroo 2011

## Group Junior (Grade 9 and 10)

### Austria - 17.3.2011

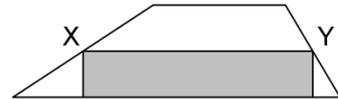


#### - 3 Point Questions -

- 1) A zebra crossing has alternating white and black stripes each 50cm wide. The first stripe is white and the last one is white. The zebra crossing in front of our school has 8 white stripes. How wide is the road?

A) 7 m      B) 7.5 m      C) 8 m      D) 8.5 m      E) 9 m

- 2) The area of the grey rectangle shown on the right is  $13 \text{ cm}^2$ . X and Y are the midpoints of the sides of the trapezium. How big is the area of the trapezium?

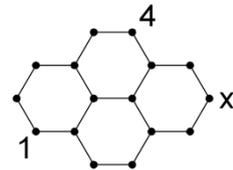


A)  $24 \text{ cm}^2$       B)  $25 \text{ cm}^2$       C)  $26 \text{ cm}^2$       D)  $27 \text{ cm}^2$       E)  $28 \text{ cm}^2$

- 3) Given are the following expressions  $S_1 = 2 \times 3 + 3 \times 4 + 4 \times 5$ ,  $S_2 = 2^2 + 3^2 + 4^2$ ,  $S_3 = 1 \times 2 + 2 \times 3 + 3 \times 4$ . Which one of the following statements is true?

A)  $S_2 < S_1 < S_3$     B)  $S_1 < S_2 = S_3$     C)  $S_1 < S_2 < S_3$     D)  $S_3 < S_2 < S_1$     E)  $S_1 = S_2 < S_3$

- 4) In the picture on the right a number should be written next to each point. The sum of the numbers on the corners of each side of the hexagon should be equal. Two numbers have already been written. Which number should be in the place marked 'x'?



A) 1      B) 3      C) 4      D) 5      E) 24

- 5) If 2011 is divided by a certain positive whole number the remainder is 1011. Which number was it divided by?

A) 100      B) 500      C) 1000      D) another number      E) There is no such number.

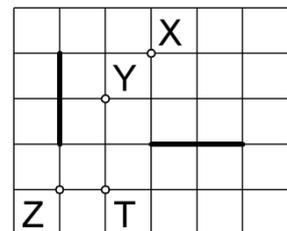
- 6) A rectangle with area  $360 \text{ cm}^2$  is being laid out with square tiles. The rectangle is 24 cm long and 5 tiles wide. How big is the area of one tile in  $\text{cm}^2$ ?

A) 1      B) 4      C) 9      D) 16      E) 25

- 7) All four-digit numbers whose digit sum is 4 are written down in order of size, starting with the biggest. In which position is the number 2011??

A) 6.      B) 7.      C) 8.      D) 9.      E) 10.

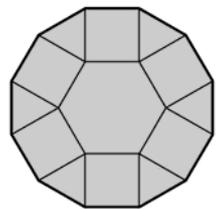
- 8) The two bold lines on the right are rotations of each other. Which of the given points could be the centre of this rotation?



A) only X    B) X and Z    C) X and T    D) only T    E) X, Y, Z and T

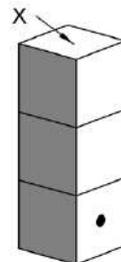
- 9) Given are a regular hexagon with side-length 1, six squares and six equilateral triangles as shown on the right. What is the perimeter of this tessellation?

A)  $6(1 + \sqrt{2})$     B)  $6(1 + \frac{\sqrt{3}}{2})$     C) 12      D)  $6 + 3\sqrt{2}$     E) 9



- 10) In the picture on the left we see three dice on top of each other. The sum of the points on opposite sides of the dice is 7 as usual. The sum of the points of areas that face each other is always 5. How many points are on the area marked X?

A) 2      B) 3      C) 4      D) 5      E) 6



#### - 4 Point Questions -

- 11) In a certain month there were 5 Mondays, 5 Tuesdays and 5 Wednesdays. In the month before there were only 4 Sundays. What will be in next month?

A) exactly 4 Fridays      B) exactly 4 Saturdays      C) 5 Sundays  
D) 5 Wednesdays      E) This situation is impossible.

12) Three racers take part in a Formula-1 Race: Michael, Fernando and Sebastian. From the start Michael is in the lead in front of Fernando who is in front of Sebastian. In the course of the race Michael and Fernando overtake each other 9 times, Fernando and Sebastian 10 times and Michael and Sebastian 11 times. In which order do those three end the race?

- A) Michael, Fernando, Sebastian      B) Fernando, Sebastian, Michael  
 C) Sebastian, Michael, Fernando      D) Sebastian, Fernando, Michael  
 E) Fernando, Michael, Sebastian

13) How big is  $n$ , if  $9^n + 9^n + 9^n = 3^{2011}$  holds true?

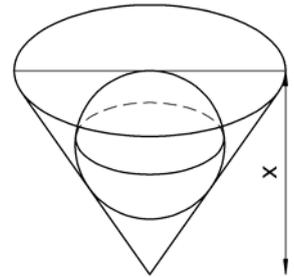
- A) 1005      B) 1006      C) 2010      D) 2011      E) another value

14) I have got two cubes with side lengths  $a$  dm and  $a + 1$  dm. The big cube is full of water and the little one is empty. I pour as much water as possible from the big one into the little one and now 217 ℓ remain in the big die. How many litres of water are now in the little one?

- A) 243 ℓ      B) 512 ℓ      C) 125 ℓ      D) 1331 ℓ      E) 729 ℓ

15) A marble of radius 15 is rolled into a cone-shaped hole. It fits in perfectly. From the side the cone looks like an equilateral triangle. How deep is the hole?

- A)  $30\sqrt{2}$       B)  $25\sqrt{3}$       C) 45      D) 60      E)  $60(\sqrt{3} - 1)$



16) The cells of the 4×4-table on the right should be coloured either in black or white. The numbers determine how many cells in each row/column should be black. How many ways are there to do the colouring in?

- A) 0      B) 1      C) 3      D) 5      E) 9

				2
				0
				1
				1
2	0	1	1	

17) What is the biggest number of consecutive three-digit numbers with at least one odd digit each?

- A) 1      B) 10      C) 110      D) 111      E) 221

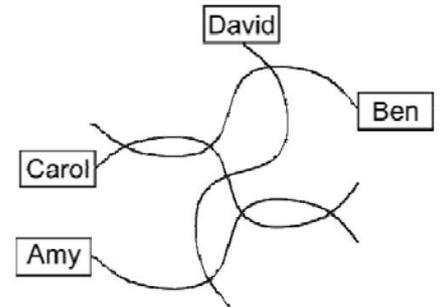
18) Nick wants to write whole numbers into the cells of the 3×3-table on the right so that the sum of the digits in each in each 2×2-sub-table is always 10. Five numbers have already been written. Determine the sum of the remaining four numbers.

- A) 0      B) 10      C) 11      D) 12      E) 13

1		0
	2	
4		3

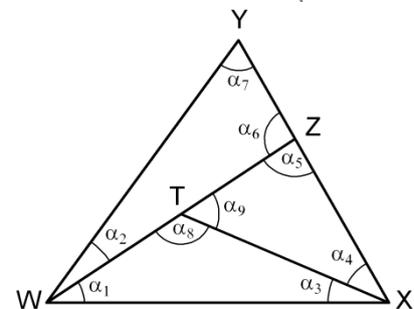
19) Jan cannot draw very accurately but nevertheless he tried to produce a road map of his village. The relative position of the houses and the street crossings are all correct but three of the roads are actually straight and only the Qurwikroad is not. Who lives in the Qurwikroad?

- A) Amy      B) Ben      C) Carol      D) David  
 E) It cannot be determined from the drawing.



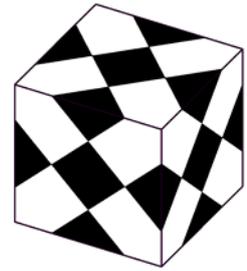
20) In the triangle WXY points Z on XY and T on WZ are, as shown on the right. If one connects T with X, a figure with nine internal angles is created as shown in the figure on the right. From those 9 angles, what is the smallest number that could be a different size to each other

- A) 2      B) 3      C) 4      D) 5      E) 6



**- 5 Point Questions-**

21) Simon has a cube with side length 1 dm made of glass. He sticks several equally big black squares on it, as shown on the right so that all faces look the same. How many  $\text{cm}^2$  were covered over?



- A) 37.5      B) 150      C) 225      D) 300      E) 375

22) The five-digit number  $abcde$  is called *interesting*, if all of its digits are different and  $a = b+c+d+e$  holds true. How many interesting numbers are there?

- A) 72      B) 144      C) 168      D) 216      E) 288

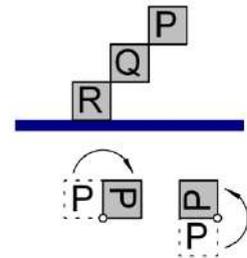
23) The numbers  $x$  and  $y$  are both greater than 1. Which of the following numbers is biggest?

- A)  $\frac{x}{y+1}$       B)  $\frac{x}{y-1}$       C)  $\frac{2x}{2y+1}$       D)  $\frac{2x}{2y-1}$       E)  $\frac{3x}{3y+1}$

24) Given is a regular tetrahedron ABCD whose side ABC is on the plane  $\epsilon$ . The edge BC is on the straight line  $s$ . Another tetrahedron BCDE has one common side with ABCD. Where does the straight line DE intersect the plane  $\epsilon$ ?

- A) Inside of ABC, on the same side of  $s$  as A.  
 B) Outside of ABC, on the same side of  $s$  as A.  
 C) Outside of ABC, not on the same side of  $s$  as A.  
 D) DE is parallel to  $\epsilon$ .  
 E) The answer depends on the side length of the tetrahedrons.

25) Three big boxes P, Q and R are stored in a warehouse. The upper picture on the right shows their placements from above. The boxes are so heavy that they can only be rotated  $90^\circ$  around a vertical edge as indicated in the pictures below. Now the boxes should be rotated to stand against the wall in a certain order. Which arrangement is possible?



- A)      B)      C)      D)

E) All four arrangements are possible.

26) How many ordered pairs of positive whole numbers  $(x, y)$  solve the equation  $\frac{1}{x} + \frac{1}{y} = \frac{1}{3}$ ?

- A) 0      B) 1      C) 2      D) 3      E) 4

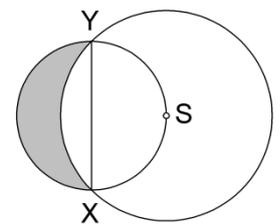
27) For a positive whole number  $n \geq 2$  let  $\langle n \rangle$  indicate the largest prime number less than or equal to  $n$ .

How many positive whole numbers  $k$  fulfill the condition  $\langle k+1 \rangle + \langle k+2 \rangle = \langle 2k+3 \rangle$ ?

- A) 0      B) 1      C) 2      D) 3      E) more than 3

28) The two circles shown on the right intersect each other at X and Y. Thereby XY is the diameter of the small circle. The centre S of the large circle (with radius  $r$ ) is on the small circle. How big is the area of the grey region?

- A)  $\frac{\pi}{6}r^2$       B)  $\frac{\sqrt{3}\pi}{12}r^2$       C)  $\frac{1}{2}r^2$       D)  $\frac{\sqrt{3}}{4}r^2$       E) another number



29) In how many ways can one choose four edges of a cube so that no two of these edges have a common corner?

- A) 6      B) 8      C) 9      D) 12      E) 18

30) Determine all  $n$  ( $1 \leq n \leq 8$ ) for which one can mark several cells of a  $5 \times 5$  table so that there are exactly  $n$  marked cells in every  $3 \times 3$  subtable.

- A) 1      B) 1 and 2      C) 1, 2 and 3      D) 1, 2, 7 and 8  
 E) All numbers from 1 to 8 are possible.

# MATHEMATICS KANGAROO 2011

## Austria - 17.3.2011

Group: Student, Grades: 11 onwards

Name:	
School:	
Class:	

Time allowed: 75 min.

- Each correct answer, questions 1.-10.:                    3 Points
- Each correct answer, questions 11.-20.:                4 Points
- Each correct answer, questions 21.-30.:                5 Points
- Each question with no answer given:                    0 Points
- Each incorrect answer: Lose ¼ of the points for that question.
- You begin with 30 points.



**Please write the letter (A, B, C, D, E) of the correct answer under the question number (1 to 30). Write neatly and carefully!**

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>

<b>11</b>	<b>12</b>	<b>13</b>	<b>14</b>	<b>15</b>	<b>16</b>	<b>17</b>	<b>18</b>	<b>19</b>	<b>20</b>

<b>21</b>	<b>22</b>	<b>23</b>	<b>24</b>	<b>25</b>	<b>26</b>	<b>27</b>	<b>28</b>	<b>29</b>	<b>30</b>

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Unterschrift:

# Mathematics Kangaroo 2011

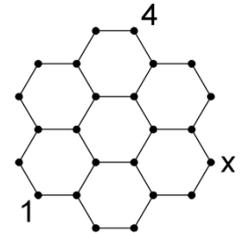
## Group Student (Grade 11 onwards)

### Austria - 17.3.2011



- 3 Point Questions -

1) In the picture on the right a number should be written next to each point. The sum of the numbers on the corners of each side of the hexagon should be equal. Two numbers have already been inserted. Which number should be in the place marked 'x'?



- A) 1      B) 3      C) 4      D) 5      E) 24

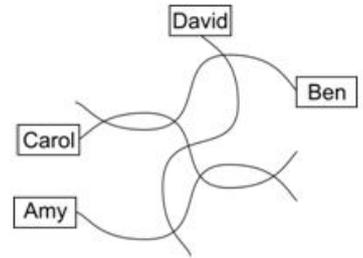
2) Three racers take part in a Formula-1-Race: Michael, Fernando and Sebastian. From the start Michael is in the lead in front of Fernando who is in front of Sebastian. In the course of the race Michael and Fernando overtake each other 9 times, Fernando and Sebastian 10 times and Michael and Sebastian 11 times. In which order do those three end the race?

- A) Michael, Fernando, Sebastian    B) Fernando, Sebastian, Michael    C) Sebastian, Michael, Fernando  
D) Sebastian, Fernando, Michael    E) Fernando, Michael, Sebastian

3) If  $2^x = 15$  and  $15^y = 32$  then  $xy$  equals

- A) 5      B)  $\log_2 15 + \log_{15} 32$     C)  $\log_2 47$       D) 7      E)  $\sqrt{47}$

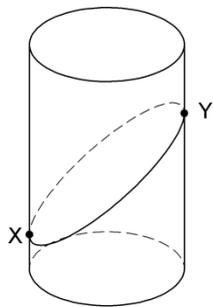
4) Jan cannot draw very accurately but nevertheless he tried to produce a roadmap of his village. The relative position of the houses and the street crossings are all correct but three of the roads are actually straight and only Qurwik street is not. Who lives in Qurwik street?



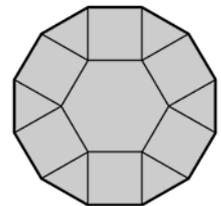
- A) Amy    B) Ben    C) Carol    D) David    E) It cannot be determined from the drawing.

5) All four-digit numbers whose digit sum is 4 are written down in descending order. In which position is the number 2011?

- A) 6.    B) 7.    C) 8.    D) 9.    E) 10.

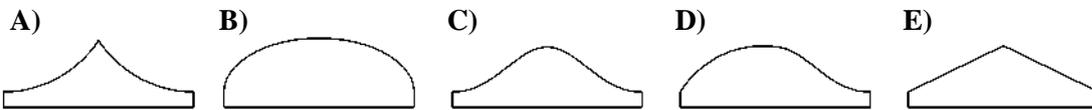


6) Given are a regular hexagon with side-length 1, six squares and six equilateral triangles as shown on the right. How big is the perimeter of this tessellation?



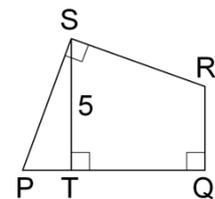
- A)  $6(1 + \sqrt{2})$       B)  $6\left(1 + \frac{\sqrt{3}}{2}\right)$     C) 9    D)  $6 + 3\sqrt{2}$     E) 12

7) A rectangular piece of paper is wrapped around a cylinder. Then an angled straight cut is made through the points X and Y of the cylinder as shown on the left. The lower part of the piece of paper is then unrolled. Which of the following pictures could show the result?



8) Determine the area of the quadrilateral PQRS pictured on the right, where  $PS = RS$ ,  $\angle PSR = \angle PQR = 90^\circ$ ,  $ST \perp PQ$ , and  $ST = 5$ .

- A) 20      B) 22.5      C) 25      D) 27.5      E) 30



9) Andrew wrote down all odd numbers from 1 to 2011 on a board. Bob then deleted all multiples of three. How many numbers remained on the board?

- A) 335      B) 336      C) 671      D) 1005      E) 1006

10) Max and Hugo roll a number of dice in order to decide who has to be the first one to jump into the cold lake. If there is no six, then Max has to jump. If there is one six, then Hugo has to jump and if there are several sixes neither will have to jump in. How many dice do they have to use so that the probability of either of them having to jump in is equal?

- A) 3      B) 5      C) 8      D) 9      E) 17

- 4 Point Questions -

- 11) A rectangle is split into three smaller rectangles. One of which has the measurements 7 by 11. Another one has the measurements 4 by 8. Determine the measurements of the third rectangle so that its area is as large as possible.

A) 1 by 11    B) 3 by 4    C) 3 by 8    D) 7 by 8    E) 7 by 11

	2	
1		3
	4	

- 12) Michael wants to write whole numbers into the empty fields of the 3×3 table on the right so that the sum of the numbers in each 2×2 square equals 10. Four numbers have already been written down. Which of the following values could be the sum of the remaining five numbers?

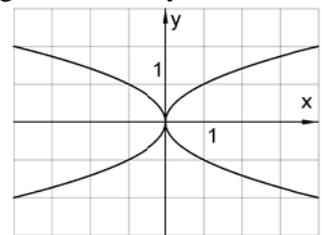
A) 9    B) 10    C) 12    D) 13    E) None of these numbers is possible.

- 13) 48 children are going on a ski trip. Six of which go with exactly one sibling, nine go with exactly two siblings and four with three siblings. The remaining children go without siblings. How many families are going on the trip?

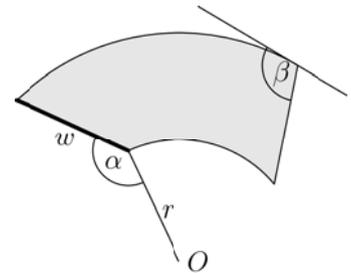
A) 19    B) 25    C) 31    D) 36    E) 48

- 14) How many graphs of the functions  $y = x^2$ ,  $y = -x^2$ ,  $y = +\sqrt{x}$ ,  $y = -\sqrt{x}$ ,  $y = +\sqrt{-x}$ ,  $y = -\sqrt{-x}$ ,  $y = +\sqrt{|x|}$ ,  $y = -\sqrt{|x|}$  are included in the sketch on the right?

A) none    B) 2    C) 4    D) 6    E) all 8



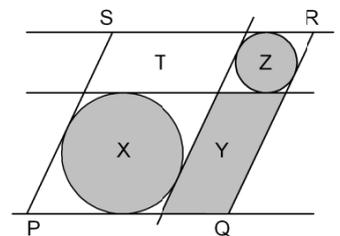
- 15) The rear window wiper of a car is made in a way so that the rod  $r$  and the wiper blade  $w$  are equally long and are connected at an angle  $\alpha$ . The wiper rotates around the centre of rotation  $O$  and wipes over the area shown on the right. Calculate the angle  $\beta$  between the right edge of the cleaned area and the tangent of the curved upper edge.



A)  $\frac{3\pi-\alpha}{2}$     B)  $\pi - \frac{\alpha}{2}$     C)  $\frac{3\pi}{2} - \alpha$     D)  $\frac{\pi}{2} + \alpha$     E)  $\pi + \frac{\alpha}{2}$

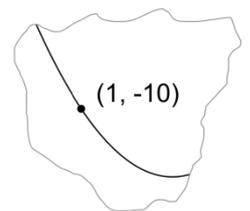
- 16) We have three horizontal lines and three parallel, sloped lines. Both of the circles shown touch four of the lines.  $X$ ,  $Y$  and  $Z$  are the areas of the grey regions.  $D$  is the area of the parallelogram PQRS. At least how many of the areas  $X$ ,  $Y$ ,  $Z$  and  $D$  does one have to know in order to be able to determine the area of the parallelogram  $T$ ?

A) 1    B) 2    C) 3    D) 4  
E)  $T$  cannot be determined from  $X$ ,  $Y$ ,  $Z$  and  $D$ .



- 17) In the  $(x,y)$ -plane the co-ordinate axes are positioned as usual. Point  $A(1, -10)$  which is on the parabola  $y = ax^2 + bx + c$  was marked. Afterwards the co-ordinate axis and the majority of the parabola were deleted. Which of the following statements could be false?

A)  $a > 0$     B)  $b < 0$     C)  $a + b + c < 0$     D)  $b^2 > 4ac$     E)  $c < 0$



- 18) The sides  $AB$ ,  $BC$ ,  $CD$ ,  $DE$ ,  $EF$  and  $FA$  of a hexagon all touch the same circle. The measurements of the sides  $AB$ ,  $BC$ ,  $CD$ ,  $DE$  and  $EF$  are in this order 4, 5, 6, 7 and 8. How long is side  $FA$ ?

A) 9    B) 8    C) 7    D) 6  
E) The length cannot be determined with this information.

- 19) Which is the smallest possible positive, whole number value of the expression

$$\frac{K \cdot A \cdot N \cdot G \cdot A \cdot R \cdot O \cdot O}{G \cdot A \cdot M \cdot E}$$

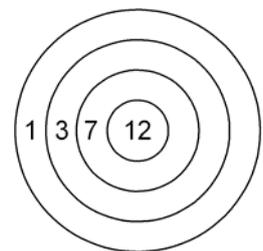
if different letters stand for different digits not equal to 0 and the same letters stand for the same digits?

A) 1    B) 2    C) 3    D) 5    E) 7

- 20) The brothers Gerhard and Günther pass on information about the members of their chess club. Gerhard says: "All members of our club are male with five exceptions." Günther says: "In each group of six members there are at least four female members." How many members does the chess club have?  
 A) 6            B) 7            C) 8            D) 12            E) 18

**- 5 Point Questions -**

- 21) In a drum there are a number of balls. A different positive whole number is written on each ball. On 30 of the balls numbers that are divisible by 6 are written, on 20 balls numbers that are divisible by 7 are written and on 10 balls numbers that are divisible by 42 are written. What is the minimum number of balls in the drum?  
 A) 30            B) 40            C) 53            D) 54            E) 60
- 22) Given are the two arithmetic sequences 5, 20, 35, ... and 35, 61, 87, ... . How many different arithmetic sequences of positive whole numbers do both sequences have as subsequences?  
 A) 1            B) 3            C) 5            D) 26            E) infinite
- 23) The function sequence  $f_1(x), f_2(x), \dots$ , fulfills the conditions  $f_1(x) = x$  and  $f_{n+1}(x) = \frac{1}{1-f_n(x)}$ . Determine the value of  $f_{2011}(2011)$ .  
 A) 2011            B)  $-\frac{1}{2010}$             C)  $\frac{2010}{2011}$             D) 1            E) -2011
- 24) In a box there are red and green balls. If two balls are taken out of the box at random, the probability of them both being the same colour is  $\frac{1}{2}$ . Which of the following could be the total number of balls in the box?  
 A) 81            B) 101            C) 1000            D) 2011            E) 10001
- 25) An airline does not charge for luggage if it is below a certain weight. For each additional kg of weight there is a charge. Mr. and Mrs. Raiss had 60 kg of luggage and paid 3 €. Mr. Wander also had 60 kg of luggage but had to pay 10.50 €. How many kg of luggage per passenger were transported for free?  
 A) 10            B) 18            C) 20            D) 25            E) 39
- 26) Determine the sum of all positive whole numbers  $x$  less than 100 so that  $x^2 - 81$  is a multiple of 100.  
 A) 200            B) 100            C) 90            D) 81            E) 50
- 27) An archer tries his art on the target shown below on the right. With each of his three arrows he always hits the target. How many different scores could he total with three arrows?  
 A) 13            B) 17            C) 19            D) 20            E) 21
- 28) Let  $a, b$  and  $c$  be positive whole numbers for which the following holds true  $a^2 = 2b^3 = 3c^5$ . What is the minimum number of factors of  $abc$  if 1 and  $abc$  are counted as well?  
 A) 30            B) 49            C) 60            D) 77            E) 1596
- 29) Twenty different positive whole numbers are written into a  $4 \times 5$  table. Two numbers in cells that have one common sideline, always have a common factor greater than 1. Determine the smallest possible value of  $n$ , if  $n$  is to be the biggest number in the table.  
 A) 21            B) 24            C) 26            D) 27            E) 40
- 30) A  $3 \times 3 \times 3$  die is assembled out of 27 identical small dice. One plane, perpendicular to one of the space diagonals of the die goes through the midpoint of the die. How many of the smaller dice are cut by this plane?  
 A) 17            B) 18            C) 19            D) 20            E) 21



**2011**

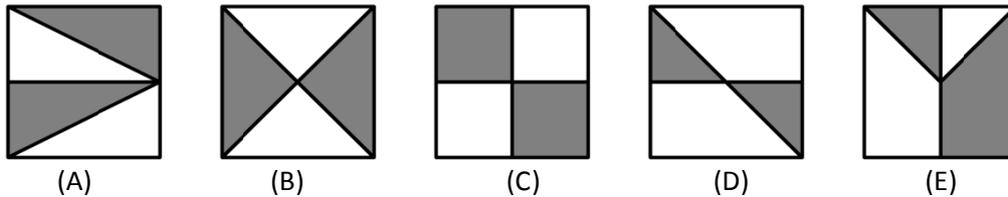
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
<b>Écolier</b>	C	C	B	E	B	A	D	C	B	A	B	E	D	D	C	B	C	C	C	E	D	A	E	D						
<b>Benjamin</b>	C	C	A	E	E	B	A	D	E	B	B	B	C	D	B	B	C	D	E	C	C	D	D	A						
<b>Kadett</b>	D	A	B	A	C	A	E	A	B	C	C	C	B	E	A	D	B	C	B	A	E	D	B	D	D	B	A	B	B	B
<b>Junior</b>	B	C	D	A	E	C	D	C	C	E	B	B	A	B	C	D	D	D	C	B	C	C	B	C	B	D	B	C	C	E
<b>Student</b>	A	B	A	C	D	E	C	C	C	B	D	E	D	D	B	A	E	D	B	B	B	C	A	A	D	A	C	D	C	C

# Mathematics Kangaroo 2012 Group Écolier (Grades 3./4.) Austria - 15.3.2012



## - 3 Point Questions -

1. In which of the five pictures is the white area bigger than the grey area?



2. Barbara wrote the word MATHEMATIC on a piece of paper. She used the same colour for letters which are the same. She used a different colour for letters which are different. How many different colours did she use?

- (A) 7      (B) 8      (C) 9      (D) 10      (E) 13

3. Father hangs towels on the washing as shown in the picture. For three towels he uses 4 clothes pegs. How many clothes pegs would he use for 5 towels?



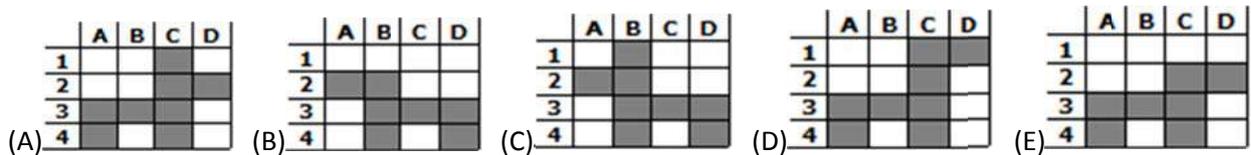
- (A) 4    (B) 5    (C) 6    (D) 8    (E) 10

4. Oli coloured in the following 8 fields in the grid:

A2, B1, B2, B3, B4, C3, D3 and D4.

Which is his grid?

	A	B	C	D
1				
2				
3				
4				

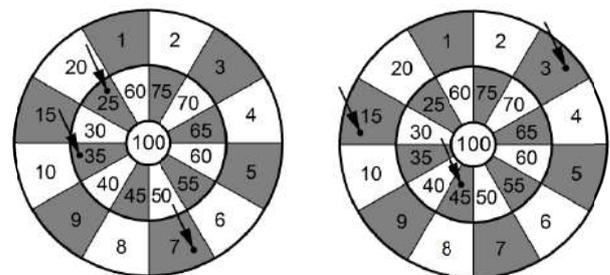


5. 13 children play hide and seek. One of them searches. After a little while 9 children are found. How many are still hiding?

- (A) 3    (B) 4    (C) 5    (D) 9    (E) 22

6. Mike and Jake play darts. Each of them throws three darts. Who won, and by how many points?

- (A) Mike won. He had three points more.  
 (B) Jake won. He had 4 points more.  
 (C) Mike won. He had 2 points more.  
 (D) Jake won. He had 2 points more.  
 (E) Mike won. He had 4 points more.



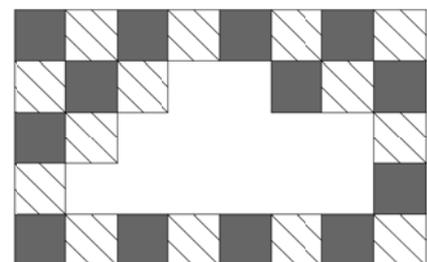
Mike

Jake

7. A Wall was tiled alternately with grey and striped tiles. Some tiles have fallen from the wall.

How many grey tiles have fallen off?

- (A) 9    (B) 8    (C) 7    (D) 6    (E) 5

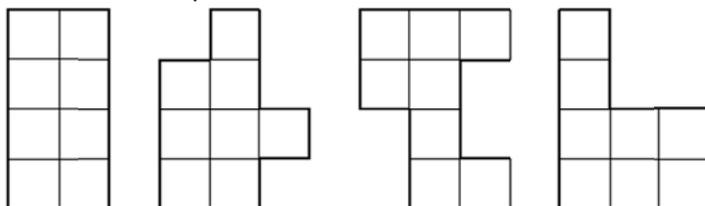
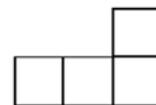


8. On the 24th February 2012 Grandfather's chicks hatched. There are 29 days in February in 2012. How old are the chicks today on 15th March 2012?

- (A) 29 days    (B) 24 days    (C) 22 days    (D) 20 days    (E) 15 days

**- 4 Point Questions -**

9. Anna has made two L shapes out of 8 squares. How many of the following 4 shapes can she make with both L shapes?



- (A) 0    (B) 1    (C) 2    (D) 3    (E) 4

10. 3 balloons cost 12 cents more than 1 balloon. How much does 1 balloon cost?

- (A) 4 Cents    (B) 6 Cents    (C) 8 Cents    (D) 10 Cents    (E) 12 Cents

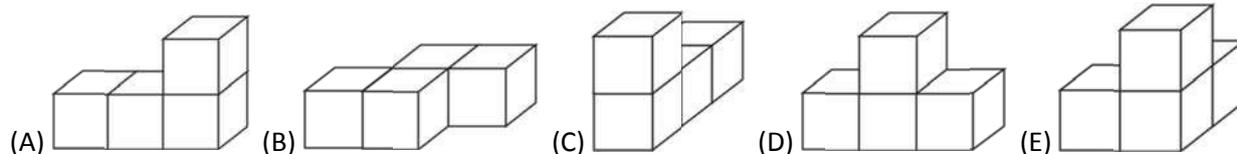
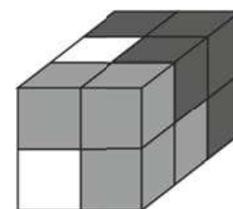
11. Grandmother baked 20 ginger biscuits for her grandchildren. She decorated them with raisins and nuts. First she decorated 15 with raisins, and then 15 with nuts. No biscuit was left over. How many biscuits were decorated with both raisins and nuts?

- (A) 4    (B) 5    (C) 6    (D) 8    (E) 10

12. In the school for animals there are 3 cats, 2 ducks, 2 sheep and some dogs. The teacher counted the legs of all the animals, and got 44. How many dogs go to the school?

- (A) 6    (B) 5    (C) 4    (D) 3    (E) 2

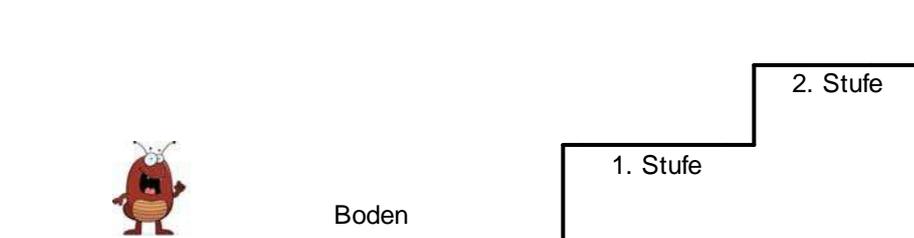
13. You need 3 pieces to build this shape. Each piece is made out of 4, equally sized cubes of the same colour. What is the shape of the white piece?



14. 15 tables were set for a party. 5 plates were laid on 6 tables. 3 plates were laid on the rest of the tables. How many plates were needed in total?

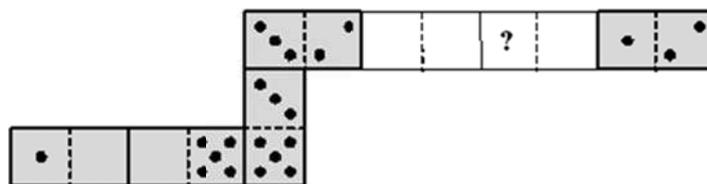
- (A) 45    (B) 50    (C) 57    (D) 60    (E) 75

15. A flea stands on the floor and wants to climb the 10 steps. He can either jump 3 steps upwards or jump 4 steps downwards. What is the smallest number of jumps he must make?



- (A) 4    (B) 5    (C) 6    (D) 7    (E) 8

16. Frank laid out his dominoes as shown in the picture. (Dominoes which touch must always have the same number of points). Before his brother George removed two dominoes there were 33 points altogether. How many points is the questionmark worth?



- (A) 2 (B) 3 (C) 4 (D) 5 (E) 6

**- 5 Point Questions -**

17. In an arithmetic-sudoku, the values 1, 2, 3, 4 appear exactly once in each row and each column. Which value belongs in the grey square?

$1 \times 1$		$1 \times 3$	
$2 \times 2$	$6 - 3$		$6 - 5$
$4 - 1$	$1 + 3$	$8 - 7$	
$9 - 7$	$2 - 1$		

- (A) 1 (B) 2 (C) 3 (D) 4 (E) 1 or 2

18. The classmates of Thomas are twice as many girls as boys. How many children could be in the class?

- (A) 30 (B) 20 (C) 24 (D) 25 (E) 29

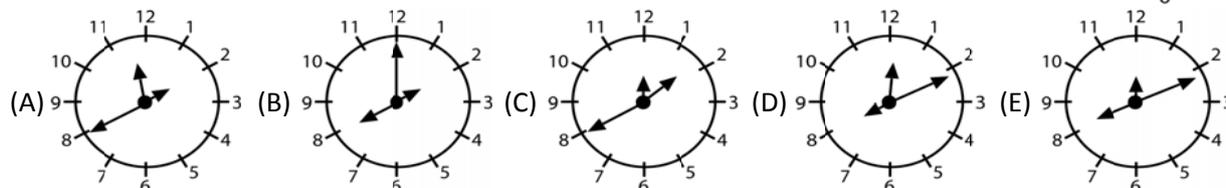
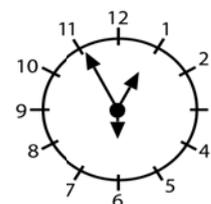
19. Gregory made two 3-digit numbers from the numbers 1, 2, 3, 4, 5, 6. Each number was used only once. Afterwards he added the numbers together. What is the largest answer that he could have got?

- (A) 975 (B) 999 (C) 1083 (D) 1173 (E) 1221

20. Anna, Laura, Lisa and Katharina wanted to take a photo together. Anna and Katharina are best Friends and wanted to stand next to each other. Lisa also wanted to stand next to Anna. In how many different ways can the photo be taken, if their wishes are to be met?

- (A) 3 (B) 4 (C) 5 (D) 6 (E) 7

21. Grandma's watch has an hour, minute and second hand. We don't know which hand does which job, but we know that the watch tells the correct time. At 12:55:30 hours the watch looked as pictured. How will the watch look at 8:11:00 hours?



22. Michael thought of a number. He multiplied this number with itself, added 1, multiplied the result by 10, added 3 and multiplied the total by 4. He arrived at 2012. Which number had Michael thought of to start with?

- (A) 11 (B) 9 (C) 8 (D) 7 (E) 5

23. A rectangular piece of paper is 60 mm long and 36 mm wide. After making a straight cut you have a square and a leftover piece. You do the same with the leftover piece and so on until the leftover piece itself is square. What is the side length of the last square?

- (A) 1 mm (B) 4 mm (C) 6 mm (D) 10 mm (E) 12 mm

24. In football you get 3 points for a win, no points for a loss, and 1 point for a draw. A team has played 36 matches and has 80 points. What is the maximum number of matches the team could have lost?

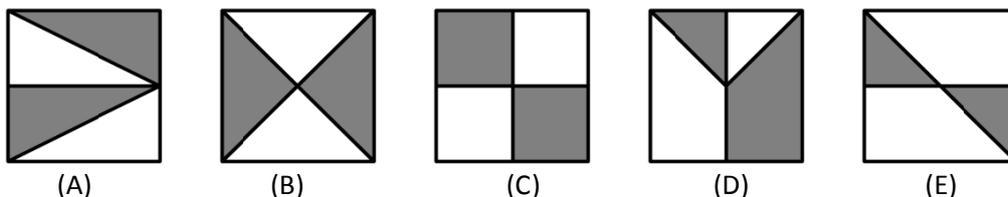
- (A) 12 (B) 11 (C) 10 (D) 9 (E) 8

**Mathematics Kangaroo 2012**  
**Group Benjamin (Grades 5./6.)**  
**Austria - 15.3.2012**



- 3 Point Questions -

1. In which of the five pictures is the white area bigger than the grey area?



2. Barbara wrote "KAENGURUWETTBEWERB" on the blackboard. For some letters she used the same colour, for different letters different colours. How many different colours did she use.

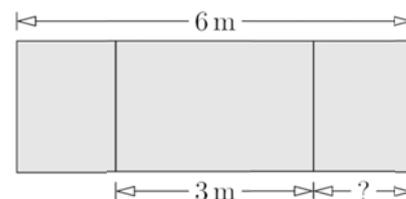
- (A) 7      (B) 8      (C) 9      (D) 10      (E) 11

3. Three bars of chocolate cost 6 €. How much does one bar of chocolate cost?

- (A) 2 €      (B) 4 €      (C) 1 €      (D) 3 €      (E) 5 €

4. A blackboard has a total unfolded length of 6m. The middle section is 3m long. How long is the section labelled with a questionmark?

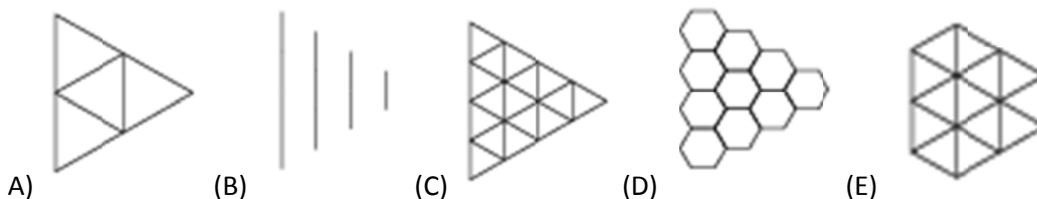
- (A) 1 m    (B) 1.25 m    (C) 1.5 m    (D) 1.75 m    (E) 2 m



5. On the 24th February 2012 Grandfathers chicks hatched. There are 29 days in February in 2012. How old are the chicks today on 15th March 2012?

- (A) 29 days    (B) 24 days    (C) 22 days    (D) 20 days    (E) 15 days

6. Which pattern will you get if you join the centres of each of the neighbouring hexagons.



7. The number three should be added to the number 6. This amount is then doubled and the result increased by 1. Which of the following sums fits this description?

- (A)  $(6 + 3 \times 2) + 1$     (B)  $6 + 3 \times 2 + 1$     (C)  $(6 + 3) \times (2 + 1)$     (D)  $(6 + 3) \times 2 + 1$     (E)  $6 + 3 \times (2 + 1)$

8. In the school for animals there are 3 cats, 2 ducks, 2 sheep and some dogs. The teacher counted the legs of all the animals, and got 44. How many dogs go to the school?

- (A) 6    (B) 5    (C) 4    (D) 3    (E) 2

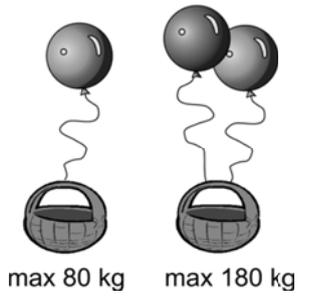
- 4 Point Questions -

9. The last row in an aeroplane is row 25. There is no row 13 and row 15 has only 4 seats. Every other row has 6 seats. How many passenger seats are there on this aeroplane?

- (A) 120    (B) 138    (C) 142    (D) 144    (E) 150

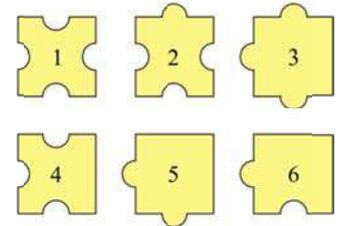
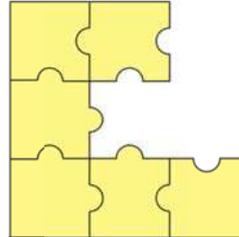
10. In addition to the weight of the basket a single balloon can lift 80 kg. 2 balloons can lift 180 kg in addition to the weight of the basket. How heavy is the basket?

- (A) 60 kg (B) 50 kg (C) 40 kg (D) 30 kg (E) 20 kg



11. Grandmother gave Vivian and Mike some apples and pears. In total they had 25 pieces of fruit. On the way home Vivian ate 1 apple and 3 pears, Mike ate 3 apples and 2 pears. At home they noted that there were exactly the same number of apples and pears in the basket. How many pears had grandmother given them?

- (A) 12 (B) 13 (C) 16 (D) 20 (E) 21

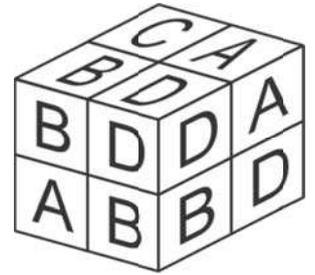


12. Which three puzzle pieces do you need to complete the large puzzle?

- (A) 1, 3, 4 (B) 1, 3, 6 (C) 2, 3, 5 (D) 2, 3, 6 (E) 2, 5, 6

13. Lisa built a large cube out of 8 smaller ones. The small cubes have the same letter on each of their faces (A,B,C or D). Two cubes with a common face always have a different letter on them. Which letter is on the cube that cannot be seen in the picture?

- (A) A (B) B (C) C (D) D (E) The picture is not possible.

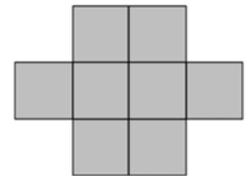


14. The Natural numbers are to be painted. 1 is red, 2 is blue, 3 is green, 4 is red, 5 is blue, 6 is green and so on. Which colour(s), can the sum of a red and a blue number have?

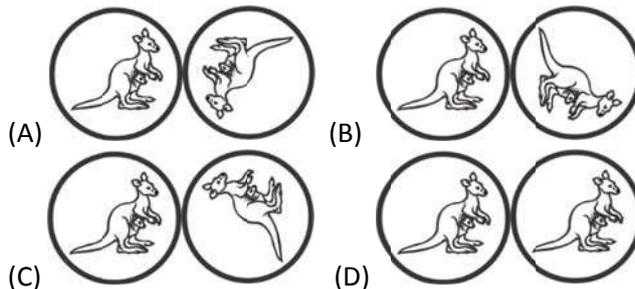
- (A) green only (B) red only (C) blue only (D) red or blue (E) impossible to say.

15. The figure on the right has a perimeter of 42 cm. The figure was made from eight equally sized squares. What is the area of the figure?

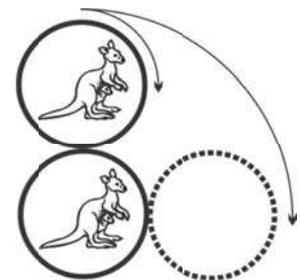
- (A) 8 cm<sup>2</sup> (B) 9 cm<sup>2</sup> (C) 24 cm<sup>2</sup> (D) 72 cm<sup>2</sup> (E) 128 cm<sup>2</sup>



16. The upper coin rolls without sliding around the fixed lower coin. Which position will the two coins have afterwards?



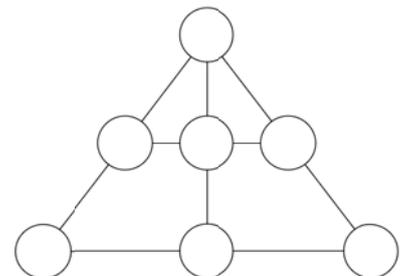
- (E) It depends on the speed.



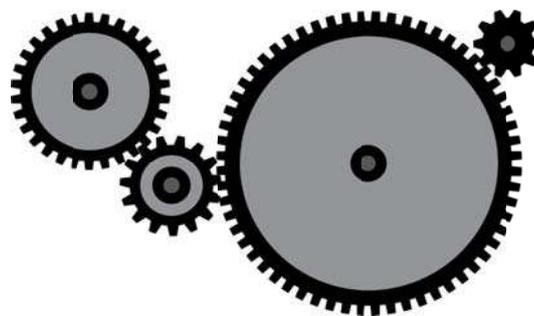
**- 5 Point Questions -**

17. The numbers 1 to 7 should be written in the small circles so that the sum of the numbers along each line is the same. Which number should be written in the uppermost circle on the triangle?

- (A) 1 (B) 3 (C) 4 (D) 5 (E) 6



18. Four cogs are connected to each other as shown in the picture. The first has 30 teeth, the second 15, the third 60 and the fourth 10. How many turns will the last cog make for each full turn of the first cog?

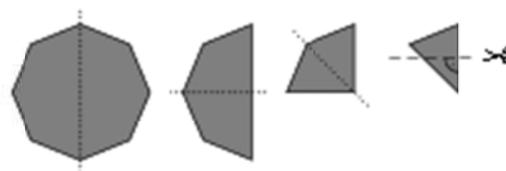


- (A) 3 (B) 4 (C) 6 (D) 8 (E) 9

19. A rectangular piece of paper is 108mm long and 84 mm wide. After making a straight cut you have a square and a leftover piece. You do the same with the leftover piece and so on until the leftover piece itself is square. What is the side length of the last square?

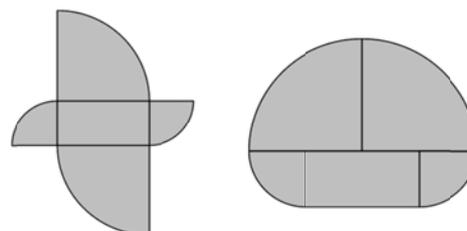
- (A) 1 mm (B) 4 mm (C) 6 mm (D) 10 mm (E) 12 mm

20. A regular octagon is folded three times down the middle as shown, until a triangle is formed. Then the rightmost corner is cut away. Which of the following shapes is formed when the paper is unfolded?



- (A) (B) (C) (D) (E)

21. Both the figures on the right were made out of the same 5 pieces. The rectangle has dimensions 5cm × 10cm. The other pieces are quarter circles with 2 different sized radii. What is the difference between the perimeters of the two figures?



- (A) 2.5 cm (B) 5 cm (C) 10 cm (D) 15 cm (E) 20 cm

22. A few fields of a 4×4 grid were painted red. The numbers in the bottom row and left column give the number of fields coloured red. The red was then rubbed away. Which of the following could be a solution?

- (A) 

				4
				2
				1
				1
0	3	3	2	

 (B) 

				1
				2
				1
				3
2	2	3	1	

 (C) 

				3
				3
				0
				0
1	3	1	1	

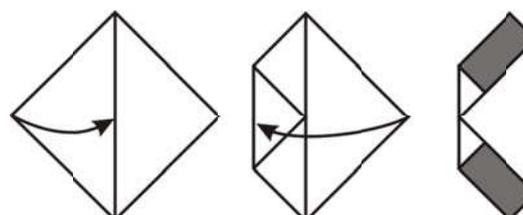
 (D) 

				2
				1
				2
				2
2	1	2	2	

 (E) 

				0
				3
				3
				1
0	3	1	3	

23. A square piece of paper of area  $64 \text{ cm}^2$  is folded twice as show in the picture. What is the area of the two grey sections?



- (A)  $10 \text{ cm}^2$  (B)  $14 \text{ cm}^2$  (C)  $15 \text{ cm}^2$  (D)  $16 \text{ cm}^2$  (E)  $24 \text{ cm}^2$

24. 12 children were at a birthday party. The children were 6, 7, 8, 9, and 10 years old. Four of them were 6 years old. There were more 8 year olds than any other age group. What is the average age of the children?

- (A) 8 (B) 7.5 (C) 7 (D) 6.5 (E) 6

# Mathematics Kangaroo 2012

## Group Kadett (Grades 7./8.)

### Austria - 15.3.2012



#### - 3 Point Questions -

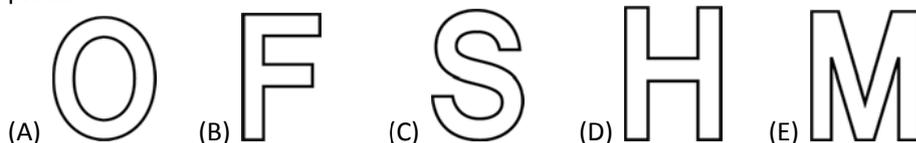
1. Three bars of chocolate cost 6 €. How much is one bar of chocolate?  
 (A) 1 €      (B) 2 €      (C) 3 €      (D) 4 €      (E) 5 €

2.  $11.11 - 1.111 =$   
 (A) 9.009      (B) 9.0909      (C) 9.99      (D) 9.999      (E) 10

3. A wristwatch lies on the table with its face upwards. The minute hand points towards north-east. How many minutes have to pass for the minute hand to point towards north-west for the first time?  
 (A) 45      (B) 40      (C) 30      (D) 20      (E) 15



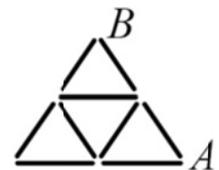
4. Eva has a pair a scissors and five letters made from cardboard. She cuts up each letter with a single straight cut so that as many pieces as possible are obtained. For which letter does she obtain the most pieces?



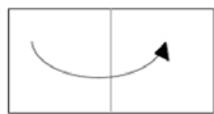
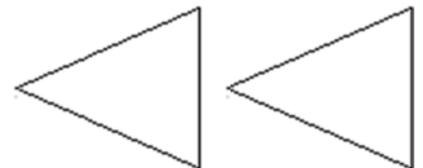
5. The digit sum of a six-digit number is 5. How big is the product of the digits?  
 (A) 0      (B) 5      (C) 6      (D)  $1 \times 2 \times 3 \times 4 \times 5 \times 6$       (E) 4

6. A dragon has 5 heads. Each time someone chops off one head, 5 new heads are grow back. If 6 heads are chopped off one after the other, how many heads does the dragon end up with?  
 (A) 25      (B) 28      (C) 29      (D) 30      (E) 31

7. Each of the nine paths in a park are 100 m long. Anna wants to walk from A to B without using the same path twice. How long the longest path she can choose?  
 (A) 900 m      (B) 800 m      (C) 700 m      (D) 500 m      (E) 400 m



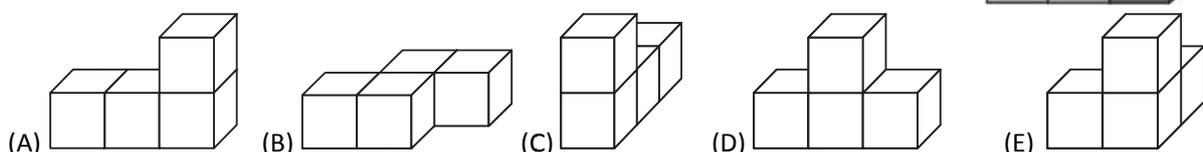
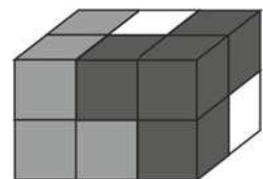
8. One vertex of the triangle on the left is connected to one vertex of the triangle on the right using a straight line so that no connecting line segment dissects either of the two triangles into two parts. In how many ways is this possible?  
 (A) 1      (B) 2      (C) 3      (D) 4      (E) more than 4



9. Werner folds a piece of paper as shown in the diagram. With a pair of scissors he makes two straight cuts into the paper. Then is unfolds it again. Which on the following shapes are not possible for the piece of paper to show afterwards?



10. A cuboid consists of three building blocks. Each building block has a different colour and is made up of 4 cubes. What does the white building block look like?



**- 4 Point Questions -**

11. From the digits 1, 2, 3, 4, 5, 6, 7, 8 we form two four-digit numbers so that every digit is used exactly once and the sum of the two numbers is as small as possible. What is the value of this sum?

- (A) 2468 (B) 3333 (C) 3825 (D) 4734 (E) 6912

12. Ms. Green plants peas (“Erbsen”) and strawberries (“Erdbeeren”) only in her garden. This year she has changed her pea-bed into a square-shaped bed by increasing one side by 3 m. By doing this her strawberry-bed became 15 m<sup>2</sup> smaller. What area did the pea-bed have before?

- (A) 5 m<sup>2</sup> (B) 9 m<sup>2</sup> (C) 10 m<sup>2</sup> (D) 15 m<sup>2</sup> (E) 18 m<sup>2</sup>

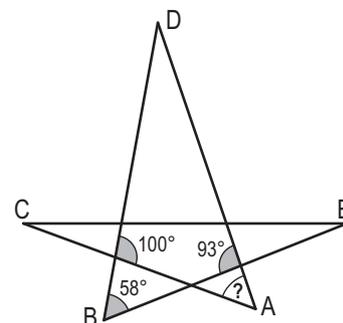
13. Barbara wants to complete the grid shown on the right by inserting three numbers into the empty spaces. The sum of the first three numbers should be 100, the sum of the middle three numbers 200 and the sum of the last three numbers 300. Which is the middle number in this grid?

- (A) 50 (B) 60 (C) 70 (D) 75 (E) 100



14. The diagram shows a five-pointed star. How big is the angle A?

- (A) 35° (B) 42° (C) 51° (D) 65° (E) 109°



15. Take four cards and on each one write one of the numbers 2, 5, 7, 12. On the back of each card write one of the following properties: “divisible by 7”, “prime number”, “odd”, “greater than 100” so that the number on the other side does not have this property. Every number and every property is used exactly once. Which number is on the card with the property “greater than 100”?

- (A) 2 (B) 5 (C) 7 (D) 12 (E) It is impossible to state the number.

16. How many natural numbers n are there for which n – 24 and n + 24 are two-digit numbers?

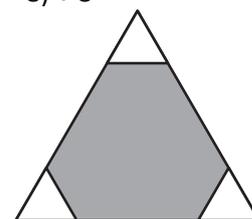
- (A) 42 (B) 48 (C) 51 (D) 52 (E) 66

17. In which of the following expressions can one exchange each number 8 with 8 different sets of equal positive numbers without changing the result?

- (A)  $(8 + 8) \div 8 + 8$  (B)  $8 \times (8 + 8) \div 8$  (C)  $8 + 8 - 8 + 8$  (D)  $(8 + 8 - 8) \times 8$  (E)  $(8 + 8 - 8) \div 8$

18. Three equally sized equilateral triangles are cut from the vertices of a large equilateral triangle of side length 6cm. The three little triangles together have the same perimeter as the remaining grey hexagon. What is the side-length of one side of one small triangle?

- (A) 1 cm (B) 1.2 cm (C) 1.25 cm (D) 1.5 cm (E) 2 cm



19. The lazy tomcat Garfield observes some mice stealing cheese. Each mouse carries away at least one piece of cheese but less than ten pieces. Each mouse steals a different amount of cheese pieces. No mouse steals exactly twice as many pieces as another mouse. What is the maximum number of mice Garfield can have observed?

- (A) 4 (B) 9 (C) 6 (D) 7 (E) 8

20. At an airport there is a “rolling pavement” which is 500 m long and transports people with a speed of 4 km/h. Anna and Peter step onto the rolling pavement at the same time. While Peter is standing still, Anna continues to walk with a speed of 6 km/h. How big is Anna’s head start on Peter when she leaves the rolling pavement after 500 m?

- (A) 100 m (B) 160 m (C) 200 m (D) 250 m (E) 300 m

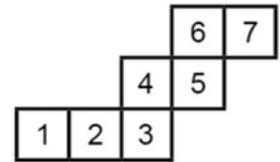
**- 5 Point Questions -**

21. Initially the side length of a talking magic square is 8 cm. Every time it speaks the truth its sides each decrease by 2 cm. If it lies its perimeter doubles. It says four sentences, two of which are true and two are false, in which order is unknown. What is the biggest possible perimeter it can have after those four sentences?

- (A) 28                      (B) 80                      (C) 88                      (D) 112                      (E) 120

22. The diagram shows the 7 positions 1, 2, 3, 4, 5, 6, 7 of the bottom side of a die which is rolled around its edge in this order. Which two of these positions were taken up by the same face of the die?

- (A) 1 and 7              (B) 1 and 6              (C) 1 and 5              (D) 2 and 7              (E) 2 and 6

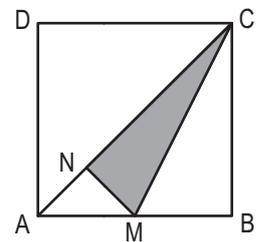


23. Stefan has 5 dice in different sizes. If he places them in order next to each other from smallest to biggest then the height of two neighbouring dice each differ by 2 cm. The biggest die is as big as the tower build by the two smallest dice. How high is a tower made up of all 5 dice?

- (A) 6 cm                      (B) 14 cm                      (C) 22 cm                      (D) 44 cm                      (E) 50 cm

24. In a square ABCD M is the midpoint of AB. MN is perpendicular to AC. Determine the ratio of the area of the grey triangle to the area of the square ABCD.

- (A) 1:6                      (B) 1:5                      (C) 7:36                      (D) 3:16                      (E) 7:40



25. Tango is being danced in pairs, a man with a woman. No more than 50 people attend a dance evening. At a certain moment  $\frac{3}{4}$  of the men were dancing with  $\frac{4}{5}$  of the women. How many people were dancing at this moment?

- (A) 20                      (B) 24                      (C) 30                      (D) 31                      (E) 32

26. David wants to place the twelve numbers from 1 to 12 in a circle so that two adjacent numbers always differ by 2 or 3. Which numbers are therefore adjacent?

- (A) 4 and 6                      (B) 3 and 5                      (C) 7 and 9                      (D) 6 and 8                      (E) 5 and 8

27. Wanted are all three-digit numbers from 100 to 999 that have the following property: If you remove the first digit a square number remains and if you remove the last digit again a square number remains (e.g.  $164 - (1)64 - 16(4)$ ). How big is the sum of all numbers with this special property?

- (A) 1013                      (B) 1177                      (C) 1465                      (D) 1993                      (E) 2016

28. There are 30 chapters in a book. Each chapter has a different length, i.e. 1, 2, 3, ..., 30 pages. Each chapter starts on a new page. The first chapter starts on page 1. At most how many chapters start on a page with an odd page number?

- (A) 15                      (B) 18                      (C) 20                      (D) 21                      (E) 23

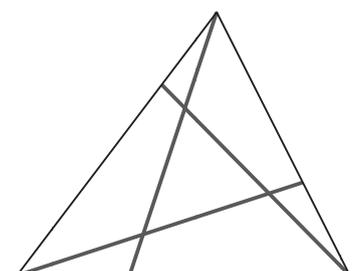
29. A piece of string is folded as shown in the diagram by folding it in the middle, then folding it in the middle again und finally folding it in the middle once more. Then this folded piece of string is cut so that several pieces emerge. Amongst the resulting pieces there are some with length 4 m and some with length 9 m. Which of the following lengths cannot be the total length of the original piece of string?

- (A) 52 m    (B) 68 m    (C) 72 m    (D) 88 m    (E) All answers are possible.



30. Three lines dissect a big triangle into four triangles and three quadrilaterals. The sum of the perimeters of the three quadrilaterals is 25 cm. The sum of the perimeters of the four triangles is 20 cm. The perimeter of the big triangle is 19 cm. How big is the sum of the lengths of the three dissecting lines?

- (A) 11 cm    (B) 12 cm    (C) 13 cm    (D) 15 cm    (E) 16 cm

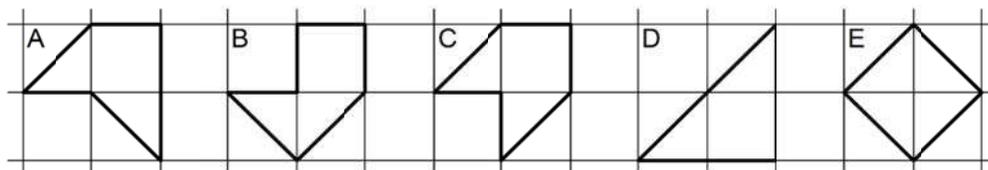


# Mathematics Kangaroo 2012 Group Junior (Grades 9./10.) Austria - 15.3.2012



## - 3 Point Questions -

1. Which of the shapes to the right has the largest area?



- (A) A                      (B) B                      (C) C                      (D) D                      (E) All shapes have the same area.

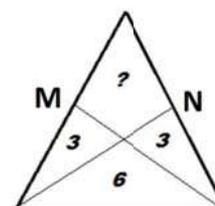
2.  $11.1111 - 1.1111 =$

- (A) 9.0009              (B) 9.0909              (C) 9.9999              (D) 9.999              (E) 10

3. A wristwatch was laid on a table in such a way that the minute hand pointed northeast. How many minutes must pass before the minute hand is pointing northwest for the first time?

- (A) 45                      (B) 40                      (C) 30                      (D) 20                      (E) 15

4. M and N are the midpoints of the equal sides of an isosceles triangle. How big is the area of the quadrilateral (marked ?)?

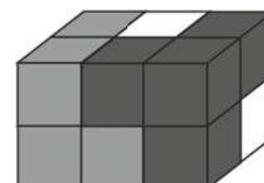
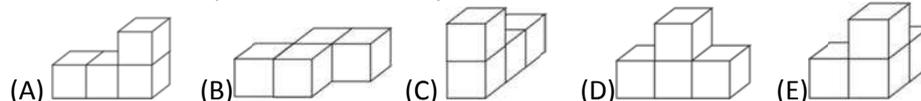


- (A) 3                      (B) 4                      (C) 5                      (D) 6                      (E) 7

5. To the number 6 we add 3. We multiply the result with 2 and add 1. What is the result of this calculation?

- (A) 27                      (B) 7                      (C) 18                      (D) 20                      (E) 19

6. A cuboid is formed from 3 pieces (see picture). Each piece is made from 4 cubes of the same colour. What shape does the white piece have?



7. The digit sum of a seven digit number is 6. What is the product of the digits?

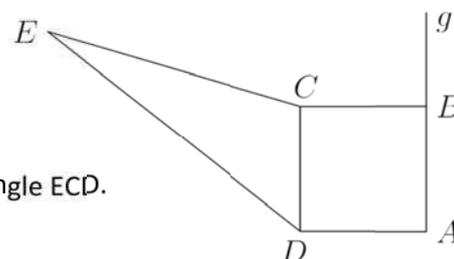
- (A) 0                      (B) 6                      (C) 7                      (D)  $1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7$                       (E) 5

8. ABC is a right-angled triangle with shorter sides 6cm and 8cm. K, L, M are the midpoints of the sides of triangle ABC. What is the perimeter of triangle KLM?

- (A) 10 cm              (B) 12 cm              (C) 15 cm              (D) 20 cm              (E) 24 cm

9. The quadrilateral ABCD with side length 4cm has the same area as triangle ECD. What is the perpendicular distance from point E to the line g?

- (A) 8 cm                      (B)  $(4 + 2\sqrt{3})$  cm                      (C) 12 cm  
(D)  $10 \times \sqrt{2}$  cm                      (E) It depends on the position of E.



10. Alice and Bob send each other secret messages. To put their messages into code they use the following system: First each letter is given a number in order: A = 1, B = 2, C = 3, ... Z = 26. Then the letter number is doubled and 9 is added. Bob received a message which began 19 – 37 – 48 – 19 – ... Which of the following messages had Alice sent to Bob?

- (A) ENDE...              (B) ENTE...              (C) ERNA...              (D) ERDE...              (E) Alice has made a mistake

**- 4 Point Questions -**

**11.** In four of the following calculations you can swap the number 8 with another positive number without changing the answer to the sum. For which calculation does it not work?

- (A)  $(8 + 8 - 8) \div 8$                       (B)  $8 + (8 \div 8) - 8$                       (C)  $8 \div (8 + 8 + 8)$   
 (D)  $8 - (8 \div 8) + 8$                       (E)  $8 \times (8 \div 8) \div 8$

**12.** When Adam stands on a table and Mike on the floor, Adam is 80cm taller than Mike. When Mike stands on the table and Adam on the floor, Mike is one metre taller than Adam. How high is the table?

- (A) 20 cm              (B) 80 cm              (C) 90cm              (D) 100 cm              (E) 120 cm

**13.** When the numbers 144 and 220 are divided by the same positive whole number  $x$ , both have remainder 11. Find  $x$ .

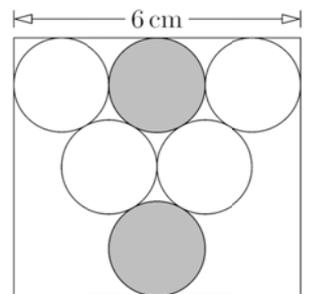
- (A) 7                      (B) 11                      (C) 15                      (D) 19                      (E) 38

**14.** Tom and Mary play a game with a coin. When the coin shows heads, Mary wins and Tom must give her two sweets. When the coin shows tails Tom wins and Mary must give him three sweets. After 30 throws of the coin they each have the same number of sweets as they had at the start of the game. How often has Tom won?

- (A) 6                      (B) 12                      (C) 18                      (D) 24                      (E) 30

**15.** One of the two sides of a rectangle has length 6cm. In the rectangle circles are drawn next to each other in such a way that their centres form an equilateral triangle. What is the shortest distance between the two grey circles ( in cm)?

- (A) 1                      (B)  $\sqrt{2}$                       (C)  $2\sqrt{3} - 2$                       (D)  $\frac{\pi}{2}$                       (E) 2

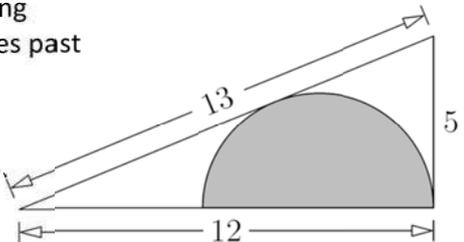


**16.** On each of the four walls in Billy's room hangs a correctly working clock, but each one runs either behind or ahead of the correct time. The first clock is incorrect by 2 minutes, the second by 3 minutes, the third by 4 minutes and the fourth by 5 minutes. Billy wants to know what time it is and sees the following times; 6 minutes to 3, 3 minutes to three, 2 minutes past three and 3 minutes past 3. What is the actual time?

- (A) 3:00              (B) 2:57              (C) 2:58              (D) 2:59              (E) 3:01

**17.** The diagram shows a right-angled triangle with side lengths 5, 12 and 13. What is the length of the radius of the inscribed semi-circle?

- (A)  $7/3$                       (B)  $10/3$                       (C)  $12/3$                       (D)  $13/3$                       (E)  $17/3$



**18.** How many numbers from 1000 to 9999 are there which have 3 as the hundred digit, and for which the sum of the remaining three digits is also 3?

- (A) 2                      (B) 3                      (C) 4                      (D) 5                      (E) 6

**19.** A number from 1 to 9 is to written into each of the 12 fields of the table so that the sum of each column is the same. Also the sum of each row must be the same. A few numbers have already been written in. Which number should be written in the grey square?

- (A) 1                      (B) 4                      (C) 6                      (D) 8                      (E) 9

2	4		2
	3	3	
6		1	

**20.** The runners Kann, Gu and Ru are favourites to win the marathon. Before the race three experts gave their predictions for the outcome of the race.

Expert 1: "Either Kann or Gu will win."

Expert 2: "If Gu is second Ru will win."

Expert 3: "If Gu is third Kan will not win."

Expert 4: "Either Gu or Ru will come second."

After the race all four predictions were proven correct. In which order, did the three runners finish the race?

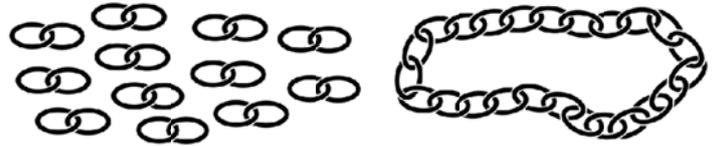
- (A) Kan, Gu, Ru              (B) Kan, Ru, Gu              (C) Ru, Gu, Kan              (D) Gu, Ru, Kan              (E) Gu, Kan, Ru

**- 5 Point Questions -**

**21.** Two sides of a quadrilateral have lengths 1 and 4. One of the diagonals has length 2 and splits the quadrilateral into two isosceles triangles. What is the perimeter of the quadrilateral?

- (A) 8                      (B) 9                      (C) 10                      (D) 11                      (E) 12

**22.** A goldsmith has 12 double-links of chain. Out of these he wants to make a single closed chain with 24 links. What is the minimum number of links that he must open (and close again)?



- (A) 8                      (B) 9                      (C) 10                      (D) 11                      (E) 12

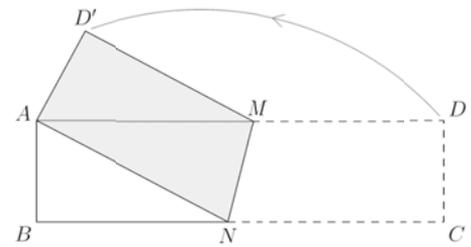
**23.** Peter wrote the number 2012 in the form  $2012 = m^m(m^k - k)$  where  $m$  and  $k$  are natural numbers. Find the value of  $k$ .

- (A) 2                      (B) 3                      (C) 4                      (D) 9                      (E) 11

**24.** What is the last non zero digit of  $K = 2^{59} \times 3^4 \times 5^{53}$  ?

- (A) 1                      (B) 2                      (C) 4                      (D) 6                      (E) 9

**25.** A rectangle ABCD with dimensions 16cm by 4cm was folded along the line MN so that corner C meets corner A. What is the area of the Pentagon ABNMD'?

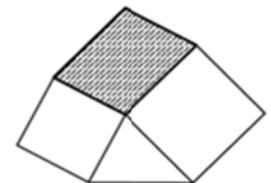


- (A) 17 cm<sup>2</sup>    (B) 27 cm<sup>2</sup>    (C) 37 cm<sup>2</sup>    (D) 47 cm<sup>2</sup>    (E) 57 cm<sup>2</sup>

**26.** It takes 8 seconds for train G to pass by a milestone. Shortly afterwards the train meets train H. It takes 9 seconds for the trains to pass each other. Train H then takes 12 seconds to pass by the milestone. What can be deduced about the length of the trains?

- (A) G is twice as long as H.                      (B) They are the same length.                      (C) H is 50% longer than G  
(D) H is twice as long as G.                      (E) Nothing can be deduced.

**27.** The shape pictured, is made out of two squares with side lengths 4cm and 5cm respectively, a triangle with area 8 cm<sup>2</sup> and the grey parallelogram. What is the area of the parallelogram?



- (A) 15 cm<sup>2</sup>    (B) 16 cm<sup>2</sup>    (C) 18 cm<sup>2</sup>    (D) 20 cm<sup>2</sup>    (E) 21 cm<sup>2</sup>

**28.** Of 5 lamps each one can be set to "ON" or "OFF". Each time when the switch of one lamp is changed, not only does the status of that particular lamp change but also that of one other lamp chosen at random. If the same switch is changed several times not always the same other lamp changes. Initially all lamps are set to "OFF". Then 10 switching operations are carried out. After that one can say that

- (A) definitely not all lamps are switched to "OFF";  
(B) definitely all lamps are switched to "ON";  
(C) definitely not all lamps are switched to "ON";  
(D) definitely all lamps are switched to "OFF";  
(E) none of the statements in (A) to (D) are true.

**29.** The natural numbers from 1 to 120 were written as shown into a table with 15 columns. In which column (counting from left) is the sum of the numbers the largest?

1							...	
2	3						...	
4	5	6					...	
7	8	9	10				...	
11	12	13	14	15			...	
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
106	107	108	109	110	111	112	...	120

- (A) 1    (B) 5    (C) 7    (D) 10    (E) 13

**30.** Positive numbers were written in a 3 × 3 grid in such a way that the product of the numbers in each row and each column is exactly 1. The product of the four numbers in each 2 × 2 grid that can be found inside the 3 × 3 grid is 2. Which number is written in the centre of the 3 × 3 grid?

- (A) 16                      (B) 8                      (C) 4                      (D)  $\frac{1}{4}$                       (E)  $\frac{1}{8}$

# Mathematics Kangaroo 2012

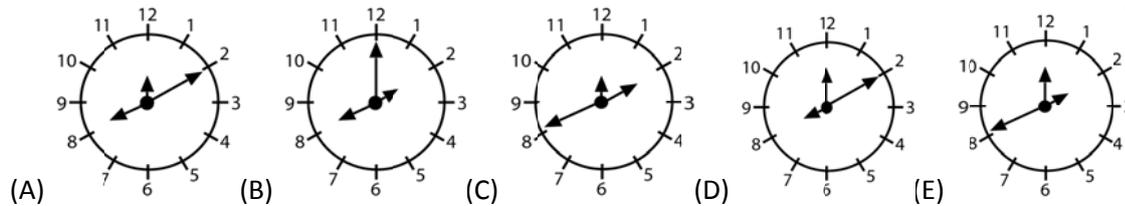
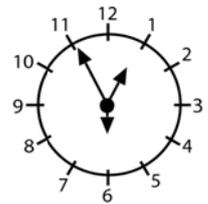
## Group Student (Grade 11 onwards)

### Austria - 15.3.2012

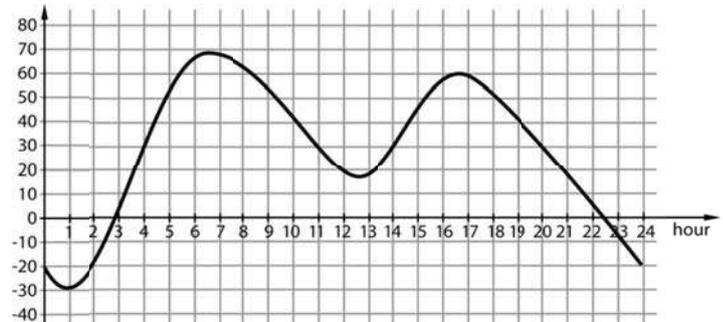


#### - 3 Point Questions -

1. A clock has three hands in different lengths (for seconds, minutes and hours). We don't know the length of each hand but we know that the clock shows the correct time. At 12:55:30 the hands are in the positions shown on the right. What does the clockface look like at 8:10:00?



2. The water level in a port rises and falls on a certain day as shown in the diagram. How many hours on that day was the water level over 30 cm?



(A) 5 (B) 6 (C) 7 (D) 9 (E) 13

3. How many different rectangles with area 60 and whole numbered side lengths are there?

(A) 8 (B) 6 (C) 5 (D) 4 (E) 3

4. The positive whole numbers are being coloured in order, in red, blue and green, i.e. 1 red, 2 blue, 3 green, 4 red, 5 blue, 6 green, and so on. Which colour could the sum of a red number and a blue number be?

(A) any colour (B) red or blue (C) green only (D) red only (E) blue only

5. The number  $\sqrt[3]{2\sqrt{2}}$  is equal to

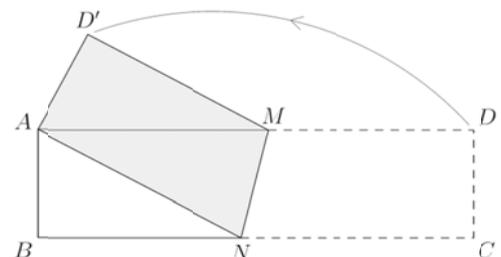
(A) 1 (B)  $\sqrt{2}$  (C)  $\sqrt[6]{4}$  (D)  $\sqrt[3]{4}$  (E) 2

6. In a list of five numbers the first number is 2 and the last one is 12. The product of the first three numbers is 30, of the middle three 90 and of the last three 360. What is the middle number in that list?



(A) 3 (B) 4 (C) 5 (D) 6 (E) 10

7. A rectangular piece of paper ABCD with the measurements 4 cm x 16 cm is folded along the line MN so that point C coincides with point A as shown. How big is the area of the quadrilateral ANMD'?



(A) 28 cm<sup>2</sup> (B) 30 cm<sup>2</sup> (C) 32 cm<sup>2</sup> (D) 48 cm<sup>2</sup> (E) 56 cm<sup>2</sup>

8. The sum of the digits of a nine digit number is 8. How big is the product of the digits of this number?

(A) 0 (B) 1 (C) 8 (D) 9 (E) 9!

9. The biggest possible natural number  $n$ , for which  $n^{200} < 5^{300}$  holds true is

(A) 5 (B) 6 (C) 8 (D) 11 (E) 12

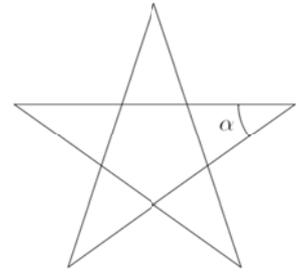
10. The age of Quintus is a two digit power of five and the age of Sekundus is a two digit power of two. If one adds the digits of their ages the total obtained is an odd number. How big is the product of the digits of their ages?

(A) 240 (B) 2012 (C) 60 (D) 50 (E) 300

**- 4 Point Questions -**

11. How big is the angle  $\alpha$  in the regular five-sided star shown?

- (A)  $24^\circ$  (B)  $30^\circ$  (C)  $36^\circ$  (D)  $45^\circ$  (E)  $72^\circ$



12. A real number  $x$  fulfills the condition  $x^3 < 64 < x^2$ . Which of the following statements is definitely true?

- (A)  $0 < x < 64$  (B)  $-8 < x < 4$  (C)  $x > 8$  (D)  $-4 < x < 8$  (E)  $x < -8$

13. A travel agency organises four different trips for a certain group. Each trip has a participation rate of 80%. What is the minimum percentage of the group which has taken part in all four roundtrips?

- (A) 80 % (B) 60 % (C) 40 % (D) 20 % (E) 16 %

14. For a ski race consecutive starting numbers are handed out. One number was accidentally given out twice. The sum of all the numbers handed out is 857. Which number was given out twice?

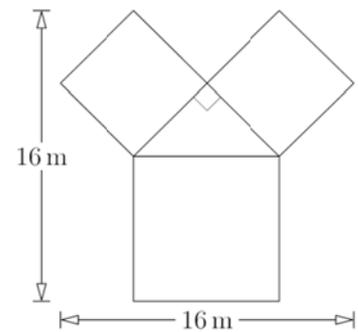
- (A) 4 (B) 16 (C) 25 (D) 37 (E) 42

15. In one class a test did not yield a very successful result because the average mark was exactly 4. The boys have done slightly better with an average mark of 3.6, while the girls have received an average mark of 4.2. Which of the following statements is correct?

- (A) There are twice as many boys as girls.  
 (B) There are 4 times as many boys as girls.  
 (C) There are twice as many girls as boys.  
 (D) There are 4 times as many girls as boys.  
 (E) There are equally many boys and girls.

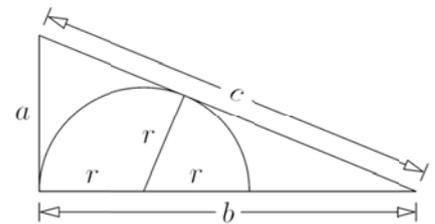
16. In the diagram we see a rose bed. White roses are growing in the squares that are equally big, red ones are in the big square and yellow ones in the right-angled triangle. The bed has width and height 16 m. How big is the area of the bed?

- (A)  $114 \text{ m}^2$  (B)  $130 \text{ m}^2$  (C)  $144 \text{ m}^2$  (D)  $160 \text{ m}^2$  (E)  $186 \text{ m}^2$



17. A right-angled triangle with side lengths  $a = 8$ ,  $b = 15$  and  $c = 17$  is given. How big is the radius  $r$  of the inscribed semicircle shown?

- (A) 2.4 (B) 3 (C) 3.75 (D) 4.8 (E) 6

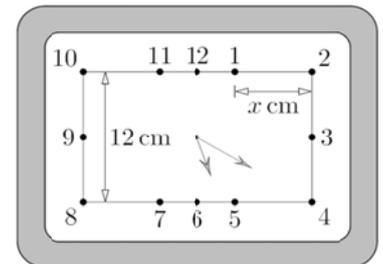


18. A square ABCD has side-length 2. E is the midpoint of AB and F the midpoint of AD. G is a point on the line CF with  $3CG = 2GF$ . How big is the area of the triangle BEG?

- (A)  $\frac{7}{10}$  (B)  $\frac{4}{5}$  (C)  $\frac{8}{5}$  (D)  $\frac{3}{5}$  (E)  $\frac{6}{5}$

19. The clock shown has a rectangular clock face, the hands however move as usual in a constant circular pattern. How big is the distance  $x$  of the digits 1 and 2 (in cm), if the distance between the numbers 8 and 10 is given as 12 cm?

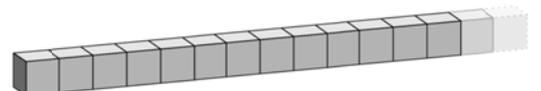
- (A)  $3\sqrt{3}$  (B)  $2\sqrt{3}$  (C)  $4\sqrt{3}$  (D)  $2 + \sqrt{3}$  (E)  $12 - 3\sqrt{3}$



20. Renate wants to glue together a number of ordinary dice (whose number of points on opposite sides always adds up to 7) to form a "dicebar" as shown. Doing this she only wants to glue sides together with an equal number of points. She wants to make sure that the sum of all points on the non-glued sides equals 2012. How many dice does she have to glue together?

- (A) 70 (B) 71 (C) 142 (D) 143

(E) It is impossible to obtain exactly 2012 points on the non-glued together sides.



**- 5 Point Questions -**

21. Which of the following functions fulfills for all  $x \neq 0$  the condition  $f\left(\frac{1}{x}\right) = f(x)$ ?

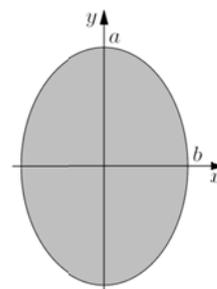
- (A)  $f(x) = \frac{2}{x}$       (B)  $f(x) = \frac{1}{x+1}$       (C)  $f(x) = 1 + \frac{1}{x}$       (D)  $f(x) = \frac{1}{x}$       (E)  $f(x) = x + \frac{1}{x}$

22. The solution set of the inequality  $|x| + |x-3| > 3$  is

- (A)  $]-\infty, 0[ \cup ]3, +\infty[$       (B)  $]-3, 3[$       (C)  $]-\infty, -3[$   
 (D)  $]-3, +\infty[$       (E)  $\mathbf{R}$

23. Let  $a > b$ . If the ellipse shown rotates about the x-axis an ellipsoid  $E_x$  with volume  $\text{Vol}(E_x)$  is obtained. If it rotates about the y-axis an ellipsoid  $E_y$  with volume  $\text{Vol}(E_y)$  is obtained. Which of the following statements is true?

- (A)  $E_x = E_y$  and  $\text{Vol}(E_x) = \text{Vol}(E_y)$       (B)  $E_x = E_y$  but  $\text{Vol}(E_x) \neq \text{Vol}(E_y)$   
 (C)  $E_x \neq E_y$  and  $\text{Vol}(E_x) > \text{Vol}(E_y)$       (D)  $E_x \neq E_y$  and  $\text{Vol}(E_x) < \text{Vol}(E_y)$   
 (E)  $E_x \neq E_y$  but  $\text{Vol}(E_x) = \text{Vol}(E_y)$

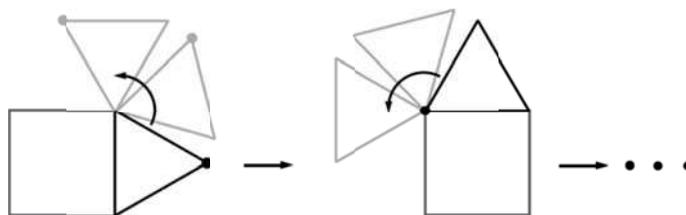


24. In a game with fractions I am allowed to carry out two operations, namely either increase the numerator by 8 or increase the denominator by 7 without simplifying during the game. Starting with the fraction  $\frac{7}{8}$  after  $n$  such operations I again obtain a fraction with equal value. What is the smallest value of  $n$ ?

- (A) 56      (B) 81      (C) 109      (D) 113      (E) This value cannot be obtained.

25. An equilateral triangle is being rolled around a unit square as shown. How long is the path that the point shown covers, if the point and the triangle are both back at the start for the first time?

- (A)  $4\pi$       (B)  $\frac{28}{3}\pi$       (C)  $8\pi$       (D)  $\frac{14}{3}\pi$       (E)  $\frac{21}{2}\pi$



26. How many permutations  $(x_1, x_2, x_3, x_4)$  of the set  $\{1, 2, 3, 4\}$  have property that the number  $x_1 x_2 + x_2 x_3 + x_3 x_4 + x_4 x_1$  is divisible by 3?

- (A) 8      (B) 12      (C) 14      (D) 16      (E) 24

27. After an especially intense lesson the graph of the function  $y = x^2$  was still on the board as well as 2012 straight lines parallel to the straight line with the equation  $y = x$ , which each intersected the parabola in two points. How big is the sum of all x-coordinates of the intersections of the straight lines with the parabola?

- (A) 0      (B) 1      (C) 1006      (D) 2012      (E) The number depends on the choice of the straight lines.

28. Three corners of a die (not all on one face) have the coordinates  $P(3,4,1)$ ,  $Q(5,2,9)$  and  $R(1,6,5)$ . What are the coordinates of the midpoint of the die?

- (A)  $A(4,3,5)$       (B)  $B(2,5,3)$       (C)  $C(3,4,7)$       (D)  $D(3,4,5)$       (E)  $E(2,3,5)$

29. In the sequence  $1, 1, 0, 1, -1, \dots$  the first two terms  $a_1$  and  $a_2$  are each 1. The third term is the difference of the previous two and  $a_3 = a_1 - a_2$  holds true. The fourth one is the sum of the previous two with  $a_4 = a_2 + a_3$ . Then  $a_5 = a_3 - a_4$ ,  $a_6 = a_4 + a_5$ , and so on, alternating difference and sum. How big is the sum of the first 100 terms of this sequence?

- (A) 0      (B) 3      (C) -21      (D) 100      (E) -1

30. Gerhard chooses two numbers  $a$  and  $b$  from the set  $\{1, 2, 3, \dots, 26\}$ . The product  $a \times b$  of these two numbers is equal to the sum of the remaining 24 numbers from this set. How big is  $|a-b|$ ?

- (A) 10      (B) 9      (C) 7      (D) 2      (E) 6

2012

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Écolier	D	A	C	C	A	E	C	D	E	B	E	B	D	C	E	C	C	D	D	B	E	D	E	E						
Benjamin	E	D	A	C	D	C	D	B	C	E	B	D	B	A	D	A	C	A	E	C	E	D	D	B						
Kadett	B	D	A	E	A	C	C	D	D	D	C	C	B	C	C	A	E	D	C	E	D	B	E	D	B	D	D	E	C	C
Junior	E	C	A	D	E	D	A	B	C	E	D	C	D	B	C	D	B	E	B	D	D	A	D	C	D	A	B	C	B	A
Student	A	E	B	C	B	C	C	A	D	A	C	E	D	D	C	C	D	B	C	E	E	A	C	D	B	D	D	A	B	E



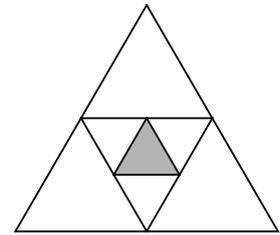


19. Andi, Betti, Clara and Dani were born in the same year. Their birthdays are on the 20th February, 12th April, 12th May and 25th May, but not necessarily in that order. Betti and Andi were born in the same month. Andi and Clara were born on the same day in different months. Who is the oldest?

- (A) Andi      (B) Betti      (C) Clara      (D) Dani  
 (E) There is not enough information to answer the question.

20. If I join the midpoints of the sides of the large triangle in the picture, a small triangle is formed. If I join the midpoints of the sides of this small triangle, a tiny triangle is formed. How many of these tiny triangles can fit into the largest triangle at the same time?

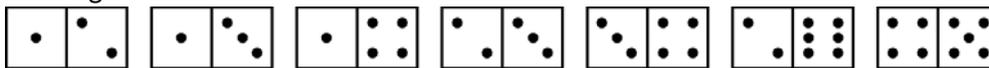
- (A) 5      (B) 8      (C) 10      (D) 16      (E) 32



21. Chrissi wants to sell 10 glass marbles which each have a different weight. Their weights are: 1 dag, 2 dag, 3 dag, 4 dag, 5 dag, 6 dag, 7 dag, 8 dag, 9 dag and 10 dag. They should be packed into bags two at a time, so that each bag has the same weight. Which two marbles will be put into the same bag?

- (A) 3 and 6      (B) 3 and 7      (C) 3 and 8      (D) 3 and 9      (E) 3 and 10

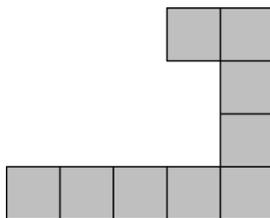
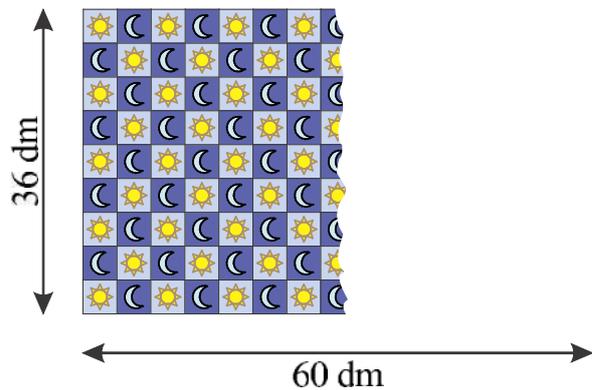
22. Baris has a few dominoes as shown in the picture. He wants to lay them in a line according to the rules of dominoes, that is that two dominoes can only be laid together if the neighbouring squares have the same number of dots in them. What is the biggest number of these dominoes that he can lay in a single line?



- (A) 3      (B) 4      (C) 5      (D) 6      (E) 7

23. Peter has bought a rug that is 36 dm wide and 60 dm long. On the rug you can see squares that contain either a sun or a moon, as shown in the picture. As you can see there are exactly nine squares along the width of the rug. The total length of the rug cannot be seen. How many moons would you see, if you could see the entire rug?

- (A) 68      (B) 67      (C) 65      (D) 63      (E) 60



24. Beatrice has a few grey tiles that all look exactly like the one pictured. At least how many of these tiles does she need in order to make a complete square? (A) 3      (B) 4      (C) 6      (D) 8      (E) 16

# Mathematical Kangaroo 2013

## Group Benjamin (Grade 5/6)

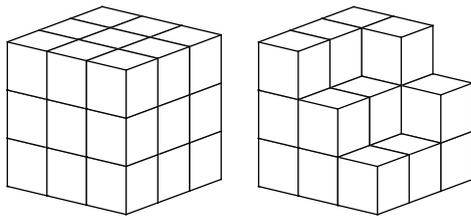
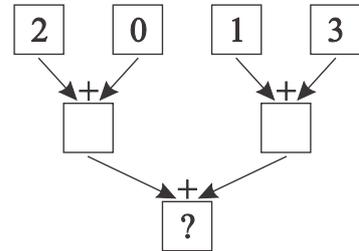
### Austria - 21.3.2013



- 3 Point Questions -

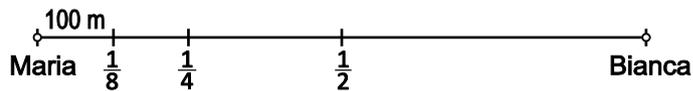
1. Which answer completes the addition tree?

- (A) 2      (B) 3      (C) 4      (D) 5      (E) 6



2. Nathalie wanted to build a large cube out of lots of small cubes. How many cubes are missing from the picture on the right that would be needed to build the large cube on the left? (A) 5      (B) 6      (C) 7      (D) 8      (E) 9

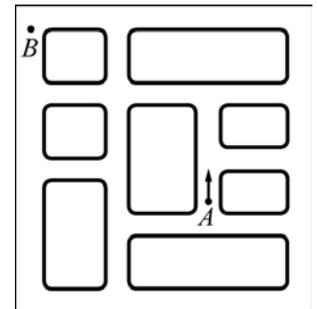
3. How far must Maria walk to reach her friend Bianca?



- (A) 300 m      (B) 400 m      (C) 800 m      (D) 1 km      (E) 700 m

4. Nick can turn right but not left on his bicycle. What is the least number of right turns he must make in order to get from A to B?

- (A) 3      (B) 4      (C) 6      (D) 8      (E) 10



5. Anna, Bob and Chris are altogether 31 years old. How old will all three be altogether in three years time?

- (A) 32      (B) 34      (C) 35      (D) 37      (E) 40

6. In the following sum the same digit is used in each square:  $\square\square \times \square = 176$   
Which digit must be used so that the sum is correct?

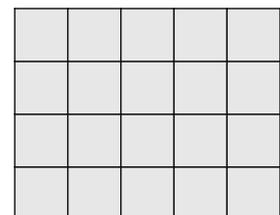
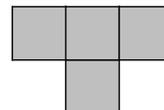
- (A) 6      (B) 4      (C) 7      (D) 9      (E) 8

7. Michael must take a tablet every 15 minutes. He takes the first at 11:05. When does he take the fourth?

- (A) 11:40      (B) 11:50      (C) 11:55      (D) 12:00      (E) 12:05

8. Anne has a few grey tiles like the one in the picture. What is the maximum number of these tiles that she can place on the  $5 \times 4$  rectangle without any overlaps?

- (A) 2      (B) 3      (C) 4      (D) 5      (E) 6

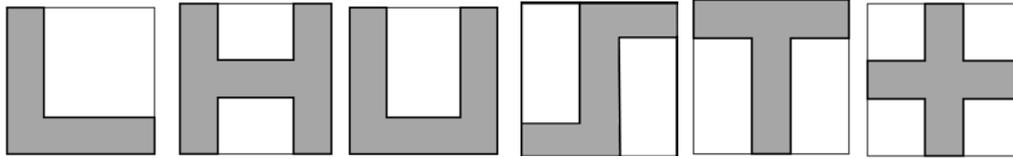


- 4 Point Questions -

9. The number 36 has the following property: 36 can be divided by its units digit without a remainder (36 is divisible by 6). With the number 38 this doesn't work. How many numbers between 20 and 30 have the same property as 36?

- (A) 2      (B) 3      (C) 4      (D) 5      (E) 6

10. Maria drew the following figures on square sheets of paper.



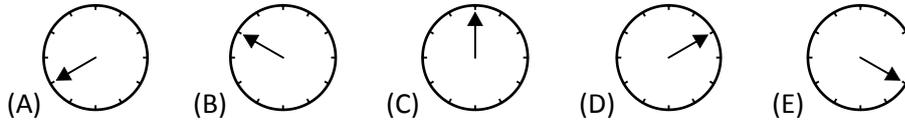
How many of these figures have the same perimeter as the square sheet of paper itself?

- (A) 2 (B) 3 (C) 4 (D) 5 (E) 6

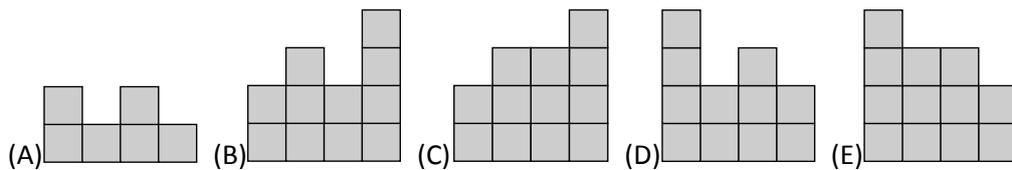
11. Patricia drives one afternoon at a constant speed to her friend. She looks at her watch as she leaves and when she arrives.



In which position will the minute hand be when she has completed one third of her journey?



12. Johann stacks  $1 \times 1$  cubes on the squares of a  $4 \times 4$  grid. The diagram on the right shows how many cubes were piled on top of each other on each square of the grid. What will Johann see if he looks from behind (*hinten*) at the tower?



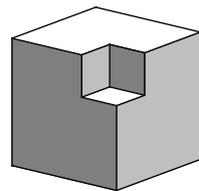
HINTEN			
4	2	3	2
3	3	1	2
2	1	3	1
1	2	1	2
VORNE			

13. 36 children voted for five students from their class. Each child was only allowed to vote once. The winner received 12 votes, and the student placed last just 4 votes. If each student received a different number of votes, how many votes did the second placed student receive?

- (A) 8 (B) 8 or 9 (C) 9 (D) 9 or 10 (E) 10

14. A  $1 \times 1 \times 1$  cube is cut out of each corner of a  $3 \times 3 \times 3$  cube. The picture shows the result after the first cube is cut out. How many faces will the final shape have?

- (A) 16 (B) 20 (C) 24 (D) 30 (E) 36



15. How many different subtraction sums between two digit numbers are there, which have the answer 50?

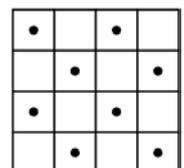
- (A) 40 (B) 30 (C) 50 (D) 60 (E) 10

16. In the last game of the hockey match there were lots of goals. In the first half 6 goals were scored and the visiting team were leading. After the home team scored another three goals in the second half, they won the match. How many goals did the hometeam score in total?

- (A) 3 (B) 4 (C) 5 (D) 6 (E) 7

**- 5 Point Questions -**

17. Which of the figures below will cover the most dots when laid on the square shown on the right.



18. Matthias is catching fish. If he had caught three times as many fish as he has actually caught, he would have 12 more fish. How many fish has he caught?

- (A) 7 (B) 6 (C) 5 (D) 4 (E) 3

19. Numbers are written in the 4x4 grid: any two numbers in neighbouring squares should have a difference of 1, that is squares that share an edge. The number 3 is already given. The number 9 will be used somewhere in the grid. How many different numbers will have been used once the grid is filled in completely?

3			

- (A) 4 (B) 5 (C) 6 (D) 7 (E) 8

20. Two buttons with smiling faces and two buttons with sad faces are in a row as shown in the picture. When you press a button the face changes, and so do the faces of the neighbouring buttons. What is the minimum number of button presses needed so that only smiling faces can be seen?

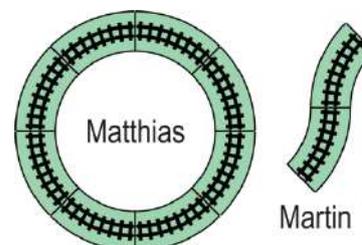


- (A) 2 (B) 3 (C) 4 (D) 5 (E) 6

21. If you start with three numbers, the 'addition machine' produces three new ones by adding together each pair of two. For instance from the numbers {3, 4, 6} the addition machine makes {10, 9, 7}. If you use the addition machine again these numbers become {16, 17, 19}. We feed the three numbers {20, 1, 3} into the addition machine and let the machine calculate 2013 times. What is the biggest possible difference between two of the three resulting numbers?

- (A) 1 (B) 2 (C) 17 (D) 19 (E) 2013

22. From an old model train set there are only identical pieces of track to use. Matthias puts 8 such pieces in a circle (picture on the left). Martin begins his track with 2 pieces as shown in the picture on the right. He also wants to build a closed track and use the smallest number of pieces possible. How many pieces will his track use?



- (A) 11 (B) 12 (C) 14 (D) 15 (E) 16

23. 2013 people live on an island. Some of these people are truth-tellers and the others are liars. The truth-tellers always tell the truth whereas the liars always lie. Each day one of the people says 'when I have left the island the number of truth-tellers will be the same as the number of liars.' Then he leaves the island. After 2013 days there is no longer anybody living on the island. How many liars were living there to begin with?

- (A) 0 (B) 1006 (C) 1007 (D) 2013 (E) It is not possible to answer.

24. 40 boys and 28 girls hold hands in a big circle. Exactly 18 boys give their right hand to a girl. How many boys give their left hand to a girl?

- (A) 18 (B) 9 (C) 28 (D) 14 (E) 20

# Mathematical Kangaroo 2013

## Group Kadett (Grade 7./8.)

### Austria - 21.3.2013



#### 3 Point Questions

1. Triangle ABC is equilateral and has area 9. The dividing lines are parallel to the sides, and divide the sides into three equal lengths. What is the area of the grey shaded part of the triangle?

- (A) 1                      (B) 4                      (C) 5                      (D) 6                      (E) 7

2. We know that  $\frac{1111}{101} = 11$ . How big is the sum  $\frac{3333}{101} + \frac{6666}{303} = ?$

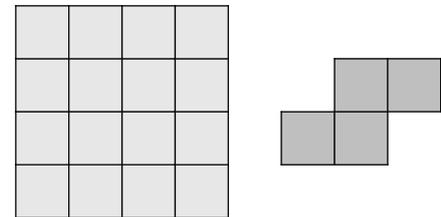
- (A) 5                      (B) 9                      (C) 11                      (D) 55                      (E) 99

3. In sea water the ratio of Salt to fresh water is 7 : 193. How many kilograms of salt will be found in 1000kg of sea water?

- (A) 35                      (B) 186                      (C) 193                      (D) 200                      (E) 350

4. Melanie has a square piece of paper with a 4x4 grid drawn on it. She cuts along the gridlines and cuts several shapes out which all look either the same as the one pictured, or the same as its mirror image. How many squares are left over if she cuts out as many shapes as possible?

- (A) 0                      (B) 2                      (C) 4                      (D) 6                      (E) 8



5. Matthias catches fish. If he had caught three times as many fish as he has actually caught, he would have 12 fish more. How many fish has he caught?

- (A) 7                      (B) 6                      (C) 5                      (D) 4                      (E) 3

6. A sack contains marbles in five different colours: 2 red, 3 blue, 10 white, 4 green, and 3 black marbles. You take marbles out of the bag without looking and without putting them back. What is the smallest number of marbles you must remove from the sack to be sure of having two of the same colour?

- (A) 2                      (B) 12                      (C) 10                      (D) 5                      (E) 6

7. Alex lights a candle every 10 minutes. Each candle burns for 40 minutes before going out. How many candles are burning 55 minutes after he lit the first candle?

- (A) 2                      (B) 3                      (C) 4                      (D) 5                      (E) 6

8. Marie calculates the average number of children in families in her village. Five families live in the village. Which answer could she not get?

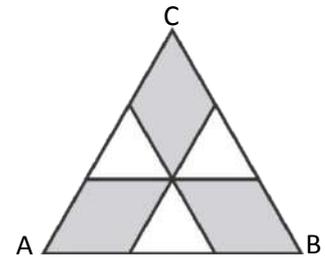
- (A) 1.0                      (B) 1.2                      (C) 1.3                      (D) 1.4                      (E) 2.0

9. Tom and Laura stand directly opposite each other around a circular well. At the same time, they begin to run clockwise around the well. Tom's speed is  $\frac{9}{8}$  of Laura's speed. How many time full laps of the well will Laura run before Tom catches her for the first time?

- (A) 4                      (B) 8                      (C) 9                      (D) 2                      (E) 72

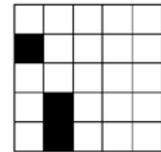
10. For the positive whole numbers  $x, y, z$  the following is true:  $x \times y = 14$ ,  $y \times z = 10$  und  $z \times x = 35$ . What is the value of  $x + y + z$ ?

- (A) 10                      (B) 12                      (C) 14                      (D) 16                      (E) 18



**- 4 Point Questions -**

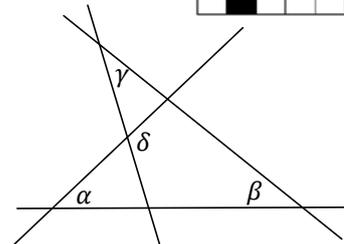
11. Anne plays 'sink the ship' with a friend, on a 5×5 grid. She has already drawn in a 1×1 ship and a 2×2 ship (as shown in the picture). She must also draw a (rectangular) 3×1 ship. Ships may be neither directly nor diagonally adjacent to each other. How many possible positions are there for the 3×1 ship?



- (A) 4                      (B) 5                      (C) 6                      (D) 7                      (E) 8

12. In the diagram pictured,  $\alpha = 55^\circ$ ,  $\beta = 40^\circ$  and  $\gamma = 35^\circ$ . How big is  $\delta$ ?

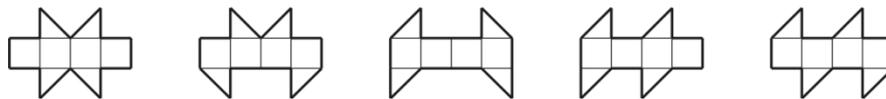
- (A)  $100^\circ$                 (B)  $105^\circ$                 (C)  $120^\circ$                 (D)  $125^\circ$                 (E)  $130^\circ$



13. The perimeter of a trapezium is 5, and the side lengths are whole numbers. How many degrees do the smallest angles measure?

- (A)  $30^\circ$  and  $30^\circ$         (B)  $60^\circ$  and  $60^\circ$         (C)  $45^\circ$  and  $45^\circ$         (D)  $30^\circ$  and  $60^\circ$         (E)  $45^\circ$  and  $90^\circ$

14. The five shapes pictured were cut out of paper. Four of them can be folded to form a cube. For which shape is this not possible.



- (A) Shape 1                (B) Shape 2                (C) Shape 3                (D) Shape 4                (E) Shape 5

15. Willi wrote down a few consecutive whole numbers. A certain percentage of these numbers are odd. Which of the following values cannot be the calculated percentage?

- (A) 40%                      (B) 45%                      (C) 48%                      (D) 50%                      (E) 60%

16. Aron, Ben and Carl always lie. Each of them picks a red or a green stone.

Aron says: "My stone has the same colour as Bens stone."

Ben says: "My stone has the same colour as Carls stone."

Carl says: "Exactly two of us have red stones."

Which of the following is correct?

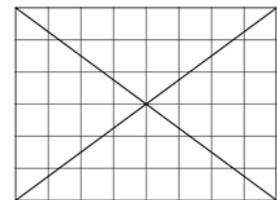
- (A) Arons stone is green.                      (B) Bens stone is green.                      (C) Carls stone is red.  
(D) Arons stone and Carls Stone have different colours.                      (E) None of the possibilities are correct.

17. All four digit positive numbers, which have the same digits as 2013 were written on a blackboard in ascending order. Determine the largest possible difference between two consecutive numbers on the blackboard.

- (A) 702                      (B) 703                      (C) 693                      (D) 793                      (E) 198

18. In the 8×6 grid pictured, there are 24 squares that have not been cut by either of the two diagonals. Now we draw the two diagonals on a 10×6 grid. How many squares in this grid will not be cut by either of the two diagonals?

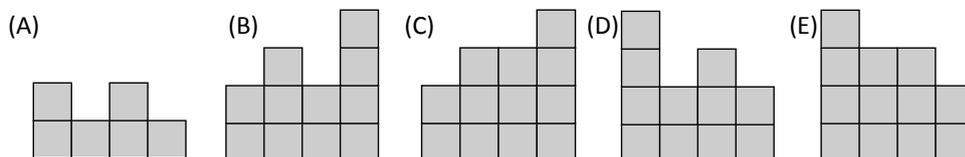
- (A) 28                      (B) 29                      (C) 30                      (D) 31                      (E) 32



19. Andi, Berti, Christa, Doris and Edi were born on the following days; 20.02.2000, 12.03.2000, 20.03.2000, 12.04.2000 and 23.04.2000 respectively. Andi and Edi have their birthday in the same month. Berti and Christa also have their birthday in the same month. Andi and Christa were born on the same day in different months. Doris and Edi were also born on the same day in different months. Which of these children is the youngest?

- (A) Andi                      (B) Berti                      (C) Christa                      (D) Doris                      (E) Edi

20. Johann stacked 1×1 cubes on the squares of a 4×4 grid. The diagram on the right shows the number of cubes that were stacked on top of each other above each square. What will Johann see if he looks from the back (hinten) at the tower?



<b>HINTEN</b>			
4	2	3	2
3	3	1	2
2	1	3	1
1	2	1	2
<b>VORNE</b>			

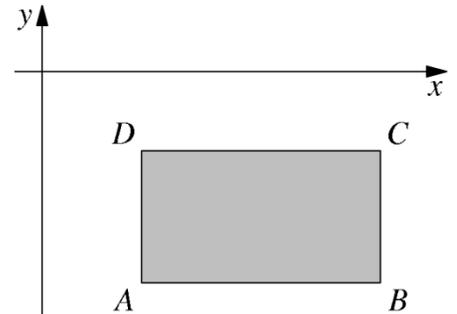
**5 Point Questions**

21. Ralf wants to say a number to Karl, such that the product of its digits is exactly 24. What is the digit sum of the smallest number that Ralf can say?

- (A) 6                      (B) 8                      (C) 9                      (D) 10                      (E) 11

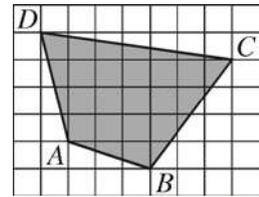
22. The sides of the rectangle ABCD are parallel to the co-ordinate axes. The rectangle is positioned below the x-axis and to the right of the y-axis, as shown in the picture. The co-ordinates of the points A, B, C, D are whole numbers. For each of the points we calculate the value of (y co-ordinate) ÷ (x co-ordinate). Which of the points will give the smallest value?

- (A) A                      (B) B                      (C) C                      (D) D  
(E) It depends on the rectangle.



23. On a sheet of paper a grid is drawn such that each of the squares has sides 2cm long. How big is the area of the grey shaded quadrilateral ABCD?

- (A) 96 cm<sup>2</sup>                      (B) 84 cm<sup>2</sup>                      (C) 76 cm<sup>2</sup>                      (D) 88 cm<sup>2</sup>                      (E) 104 cm<sup>2</sup>



24. Robert chose a five digit positive number. He removed one of the digits so that a four digit number remained. The sum of this four digit and the original five digit number is 52713. What is the digit sum of the original five digit number?

- (A) 26                      (B) 20                      (C) 23                      (D) 19                      (E) 17

25. A gardener wants to plant a row of 20 trees (linden and oak) in a park. There must never be exactly three trees between any two oak trees. What is the maximum number of the 20 trees which could be oak?

- (A) 8                      (B) 10                      (C) 12                      (D) 14                      (E) 16

26. In the finishing order of a cross country race, there are twice as many runners behind Alex as there are before Daniel, and 1.5 as many behind Daniel as before Alex. Alex finished in 21st place. How many runners finished the race?

- (A) 31                      (B) 41                      (C) 51                      (D) 61                      (E) 81

27. A sequence of numbers begins with 1, -1, -1, 1, -1. Each new number is found by taking the product of the two preceding numbers. For instance the sixth number is the product of the fourth and fifth numbers. What is the sum of the first 2013 numbers?

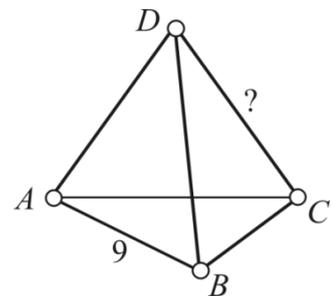
- (A) -1006                      (B) -671                      (C) 0                      (D) 671                      (E) 1007

28. Dad made 6 pancakes, one after the other, and numbered them 1 to 6 in the order that they were made. Sometimes while he did this his children ran into the kitchen and ate the hottest pancakes. In which of the following orders could the pancakes not have been eaten.

- (A) 123456                      (B) 125436                      (C) 325461                      (D) 456231                      (E) 654321

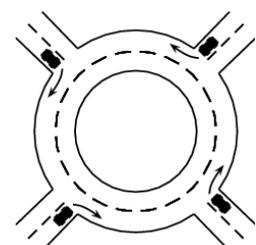
29. Each of the 4 vertices and 6 edges of a tetrahedron is labelled with one of the numbers 1, 2, 3, 4, 5, 6, 7, 8, 9 and 11. (The number 10 is left out). Each number is only used once. The number on each edge is the sum of the numbers on the two vertices which are connected by that edge. The edge AB has the number 9. With which number is the edge CD labelled?

- (A) 4                      (B) 5                      (C) 6                      (D) 8                      (E) 11



30. Four cars drive into a roundabout at the same point in time, each one coming from a different direction (see diagram). No car drives all the way around the roundabout, and no two cars leave at the same exit. In how many different ways can the cars exit the roundabout?

- (A) 9                      (B) 12                      (C) 15                      (D) 24                      (E) 81



# Mathematical Kangaroo 2013

## Group Junior (Grade 9./10.)

### Austria - 21.3.2013

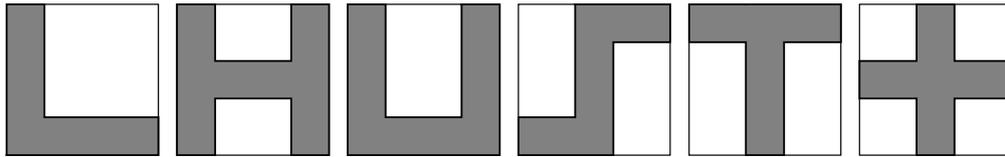


#### - 3 Point Questions -

1) Which of the numbers is not a factor of  $200013 - 2013$ ?

- (A) 2                      (B) 3                      (C) 5                      (D) 7                      (E) 11

2) Maria has six equally big square pieces of plain paper. On each piece of paper she draws one of the figures shown below. How many of these figures have the same perimeter as the plain piece of paper itself?



- (A) 2                      (B) 3                      (C) 4                      (D) 5                      (E) 6

**Special corn-on-the-cob offer!**

1 Cob 20 Cent  
Every 6th cob free!

3) Mrs. Maisl buys four pieces of corn-on-the-cob for each of the four members of her family and get the discount offered. How much does she end up paying?

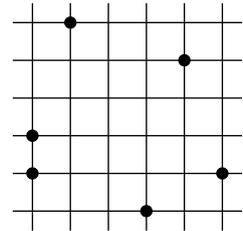
- (A) 0.80 €    (B) 1.20 €    (C) 2.80 €    (D) 3.20 €    (E) 80 €

4) The product of three numbers out of the numbers 2, 4, 16, 25, 50, 125 is 1000. How big is the sum of those three numbers?

- (A) 70                      (B) 77                      (C) 131                      (D) 143                      (E) 177

5) On a square grid made up of unit squares, six points are marked as shown on the right. Three of which form a triangle with the least area. How big is this smallest area?

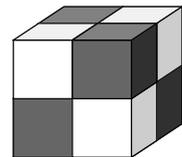
- (A) 1/2                      (B) 1/3                      (C) 1/4                      (D) 1                      (E) 2



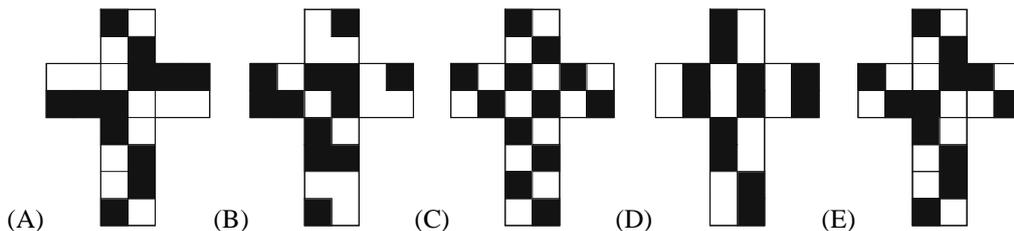
6) If you add  $4^{15}$  and  $8^{10}$ , you obtain a number that is a power of two. Determine that number!

- (A)  $2^{10}$                       (B)  $2^{15}$                       (C)  $2^{20}$                       (D)  $2^{30}$                       (E)  $2^{31}$

7) A cube is coloured on the outside as if it was made up of four white and four black cubes where no cubes of the same colour are next to each other (see picture).



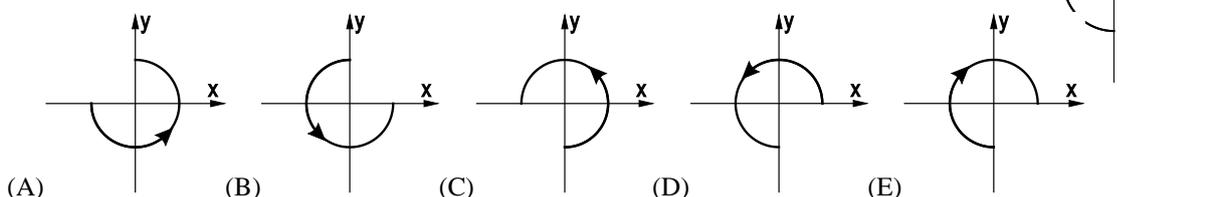
Which of the following figures represents a possible net of the coloured cube?



8) The number  $n$  is the biggest natural number for which  $4n$  is three-digits long and  $m$  is the smallest natural number for which  $4m$  is three-digits long. Which value does  $4n - 4m$  have?

- (A) 900                      (B) 899                      (C) 896                      (D) 225                      (E) 224

9) In a drawing we can see a three quarter circle with centre  $M$  and an indicated orientation arrow. This three-quarter circle is first turned  $90^\circ$  anti-clockwise about  $M$  and then reflected in the  $x$ -axis. Which is the resulting picture?



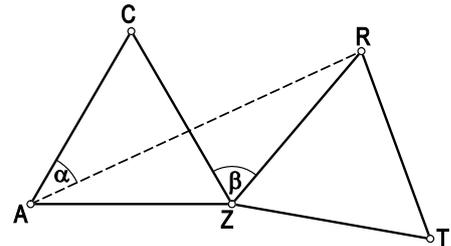
10) Which of the following numbers is biggest?

- (A)  $\sqrt{20} \times \sqrt{13}$  (B)  $\sqrt{20} \times 13$  (C)  $20 \times \sqrt{13}$  (D)  $\sqrt{201} \times 3$  (E)  $\sqrt{2013}$

**- 4 Point Questions -**

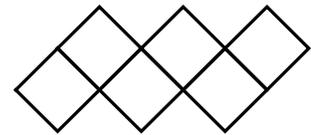
11) Triangle RZT is generated by rotating the equilateral triangle AZC about point Z. Angle  $\beta = \angle CZR = 70^\circ$ . Determine angle  $\alpha = \angle CAR$ .

- (A)  $20^\circ$  (B)  $25^\circ$  (C)  $30^\circ$  (D)  $35^\circ$  (E)  $40^\circ$



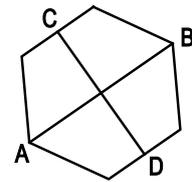
12) The figure on the right is made up of six unit squares. Its perimeter is 14 cm. Squares will be added to this figure in the same way until it is made up of 2013 unit squares (zigzag: alternating bottom right and top right). How big is the perimeter of the newly created figure?

- (A) 2022 (B) 4028 (C) 4032 (D) 6038 (E) 8050



13) A and B are opposite vertices of a regular six-sided shape, the points C and D are the mid-points of two opposite sides. The area of the regular six-sided shape is 60. Determine the product of the lengths of the lines AB and CD!

- (A) 40 (B) 50 (C) 60 (D) 80 (E) 100



14) A class has written a test. If every boy had obtained 3 more points, the points average would be 1.2 points higher than now. Which percentage of the children in this class are girls?

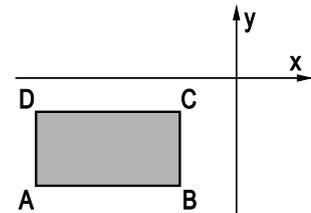
- (A) 20% (B) 30% (C) 40% (D) 60% (E) There is too little information given to determine the answer.

15) The sides of the rectangle ABCD are parallel to the co-ordinate axis. The rectangle lies below the x-axis and to the right of the y-axis, as shown in the diagram.

For each of the points A, B, C, D the quotient (y-coordinate):(x-coordinate) is calculated.

For which point will you obtain the smallest quotient?

- (A) A (B) B (C) C (D) D  
(E) It depends on the position of the rectangle and its side lengths.

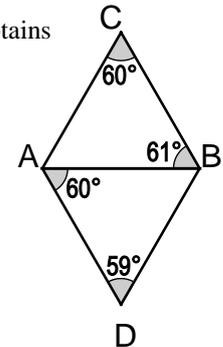


16) Today is Hans' and his son's birthday. Hans multiplies his age with the age of his son and obtains 2013. In which year was Hans born?

- (A) 1952 (B) 1953 (C) 1981 (D) 1982  
(E) More information is needed to be able to answer this question.

17) Tarzan wanted to draw a rhombus made up of two equilateral triangles. He drew the line segments inaccurately. When Jane checked the measurements of the four angles shown, she sees that they are not equally big (see diagram). Which of the five line segments in this diagram is the longest?

- (A) AD (B) AC (C) AB (D) BC (E) BD

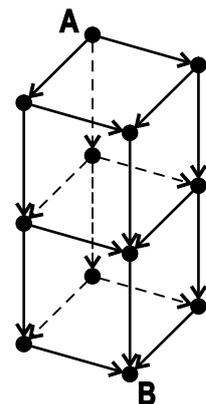


18) Five consecutive positive integers have the following property: The sum of three of the numbers is as big as the sum of the other two. How many sets of 5 such numbers are there?

- (A) 0 (B) 1 (C) 2 (D) 3 (E) more than 3

19) How many different ways are there in the diagram shown, to get from point A to point B if you are only allowed to move in the directions indicated?

- (A) 6 (B) 8 (C) 9 (D) 12 (E) 15



20) Given a six-digit number whose digit sum is even and whose digit product is odd. Which of the following statements are true for this number?

- (A) Two or four of the digits of this number are even.  
(B) There is no such number.  
(C) The number of odd digits of this number is odd.  
(D) The number can be made up of 6 different digits.  
(E) None of the statements (A) – (D) are correct.

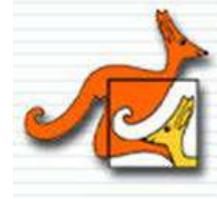
**- 5 Point Questions -**

- 21) How many decimal places are necessary to write the number  $\frac{1}{1024000}$  as a decimal?  
(A) 10            (B) 12            (C) 13            (D) 14            (E) 1024000
- 22) The date 2013 is made up of four consecutive digits 0, 1, 2, 3. How many years before the year 2013 was the date last made up of four consecutive digits?  
(A) 467            (B) 527            (C) 581            (D) 693            (E) 990
- 23) We are looking at rectangles where one side is of length 5.0 cm. Amongst those are some that can be cut into a square and a rectangle one of which has an area of 4,0 cm<sup>2</sup>. How many such rectangles are there?  
(A) 1            (B) 2            (C) 3            (D) 4            (E) 5
- 24) “Sum change” is a procedure where in a set of three numbers, each number is replaced by the sum of the other two. So for instance {3, 4, 6} becomes the set {10, 9, 7} and this again becomes {16, 17, 19}. Let the starting point be the set {1, 2, 3}.  
How many such sum changes are necessary until the number 2013 appears in the set?  
(A) 8            (B) 9            (C) 10            (D) 2013 appears several times.            (E) 2013 never comes up.
- 25) Let Q be the number of square numbers amongst the natural numbers from 1 to 2013<sup>6</sup> and K the number of cubic numbers (powers of three) amongst the natural numbers from 1 to 2013<sup>6</sup>. Which of the following holds true:  
(A)  $Q = 2013 \times K$             (B)  $2Q = 3K$             (C)  $3Q = 2K$             (D)  $Q = K$             (E)  $Q^3 = K^2$
- 26) Using the numbers 1, 2, 3, ..., 22, 11 fractions  $\frac{a}{b}$  are formed where each number is used exactly once. What is the maximum number of fractions with whole number values that can be obtained?  
(A) 11            (B) 10            (C) 9            (D) 8            (E) 7
- 27) Any three vertices of a regular 13-sided-shape are joined up to form a triangle. How many of these triangles contain the circumcentre of the 13-sided-shape?  
(A) 72            (B) 85            (C) 91            (D) 100            (E) another number
- 28) A car starts in point A and drives on a straight road at 50 km/h. Every hour after that another car leaves point A with a speed 1 km/h faster than the one before. The last car leaves A 50 hours after the first car and drives with a speed of 100 km/h. What is the speed of the car that is leading 100 hours after the start of the first car?  
(A) 50 km/h            (B) 66 km/h            (C) 75 km/h            (D) 84 km/h            (E) 100 km/h
- 29) 100 trees (oaks and birches) are standing in a row. The number of trees between any two oaks is not equal to 5. What is the maximum number of trees out of the 100 that can be oak trees?  
(A) 60            (B) 52            (C) 50            (D) 48            (E) This situation is not possible.
30. A positive integer N is smaller than the sum of its three biggest true factors (N itself is not a true factor of N). Which of the following statements is true?  
(A) All such numbers N are divisible by 7.  
(B) All such numbers N are divisible by 6.  
(C) All such numbers N are divisible by 5.  
(D) All such numbers N are divisible by 4.  
(E) Such a number N does not exist.

# Mathematical Kangaroo 2013

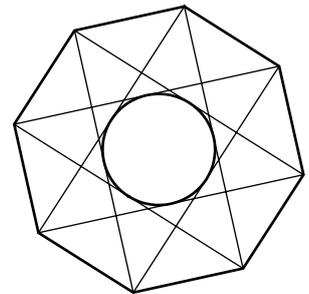
## Group Student (Grade 11. and above)

### Austria - 21.3.2013



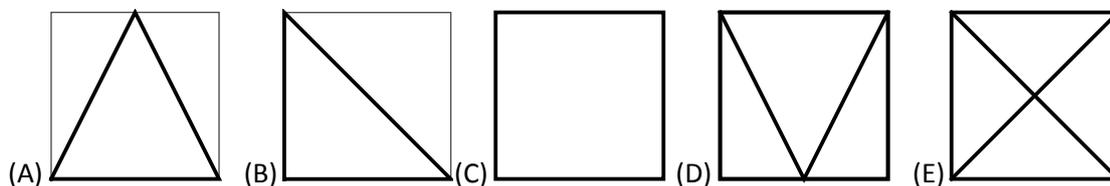
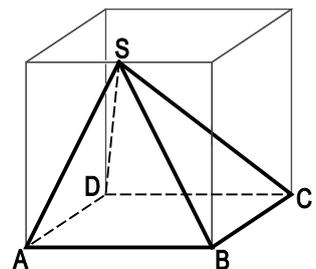
#### - 3 Point Questions -

1. Which of the following numbers is biggest?  
 (A) 2013      (B)  $2^{0+13}$       (C)  $20^{13}$       (D)  $201^3$       (E)  $20 \cdot 13$
2. The regular eight-sided shape on the right has sides of length 10. A circle touches all inscribed diagonals of this eight-sided shape. What is the radius of this circle?  
 (A) 10      (B) 7,5      (C) 5      (D) 2,5      (E) 2
3. The surface of a prism is made of 2013 faces. How many edges does the prism have?  
 (A) 2011      (B) 2013      (C) 4022      (D) 4024      (E) 6033
4. The third root of  $3^{3^3}$  takes which value? (Note:  $a^{b^c} = a^{(b^c)}$ .)  
 (A)  $3^3$       (B)  $3^{3^3-1}$       (C)  $3^{2^3}$       (D)  $3^{3^2}$       (E)  $(\sqrt{3})^3$
5. The date 2013 is made up of four consecutive digits 0, 1, 2, 3. How many years before the year 2013 was the date last made up of four consecutive digits?  
 (A) 467      (B) 527      (C) 581      (D) 693      (E) 990
6. Let  $f$  be a linear function for which  $f(2013) - f(2001) = 100$  gilt. holds true. What is the value of  $f(2031) - f(2013)$ ?  
 (A) 75      (B) 100      (C) 120      (D) 150      (E) 180
7. We know that the relationship  $2 < x < 3$  is valid for a number  $x$ . How many of the following statements are true in this case?  
 (A) 0      (B) 1      (C) 2      (D) 3      (E) 4  
 $4 < x^2 < 9$        $4 < 2x < 9$        $6 < 3x < 9$        $0 < x^2 - 2x < 3$



8. Each of six lone heros has captured wanted people. In total they have captured 20 wanted people: the first hero one wanted person, the second hero two wanted people, the third hero three wanted people. The fourth hero has captured more wanted people than any other hero. Determine the smallest number of wanted people that the fourth hero could have captured, so that this statement could be true.  
 (A) 7      (B) 6      (C) 5      (D) 4      (E) 3

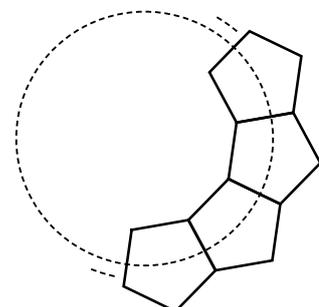
9. Inside the cube lattice pictured on the side one can see a solid, non-seethrough pyramid  $ABCD S$  with square base  $ABCD$ , whose top  $S$  is exactly in the middle of one edge of the cube. If you look at the pyramid from above, from below, from the front, from the back, from the right and from the left – which of the following views cannot be possible?



10. If a certain substance melts the volume increases by  $\frac{1}{12}$ .  
 By how much does the volume decrease if the substance solidifies again?  
 (A)  $\frac{1}{10}$       (B)  $\frac{1}{11}$       (C)  $\frac{1}{12}$       (D)  $\frac{1}{13}$       (E)  $\frac{1}{14}$

#### - 4 Point Questions -

11. Ralf has a number of equally big plastic plates each in the form of a regular five sided



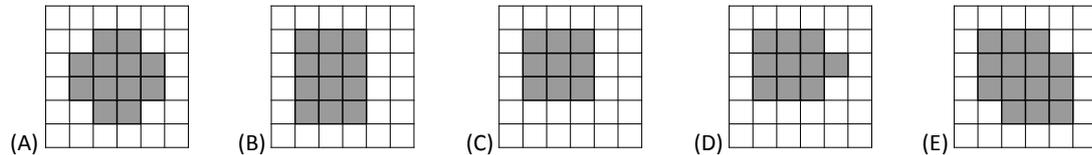
shape. He glues them together along the sides to form a complete ring (see picture). Out of how many of these plates is the ring made up?

- (A) 8 (B) 9 (C) 10 (D) 12 (E) 15

12. How many positive integers  $n$  are there with the property that  $\frac{n}{3}$  as well as  $3n$  are three-digit numbers?

- (A) 12 (B) 33 (C) 34 (D) 100 (E) 300

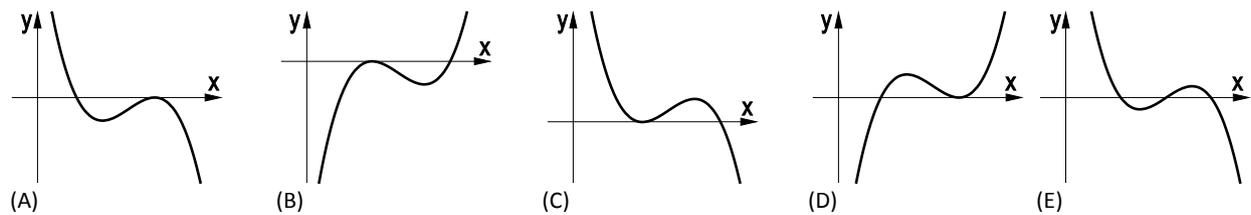
13. A circular carpet is placed on a floor which is covered by equally big, square tiles. All tiles that have at least one point in common with the carpet are coloured in grey. Which of the following cannot be a result of this?



14. We are looking at the following statement about a function defined for all integers  $x$   
 $f: \mathbb{Z} \rightarrow \mathbb{Z}$ : "For each even  $x$   $f(x)$  is even." What would be the negation of this statement?

- (A) For each even  $x$   $f(x)$  is odd.  
 (B) For each odd  $x$   $f(x)$  is even.  
 (C) For each odd  $x$   $f(x)$  is odd.  
 (D) There is a number  $x$ , for which  $f(x)$  is odd.  
 (E) There is an odd number  $x$ , for which  $f(x)$  is odd.

15. Amongst the graphs shown below there is the graph of the function  $f(x) = (a-x)(b-x)^2$  with  $a < b$ . Which is it?

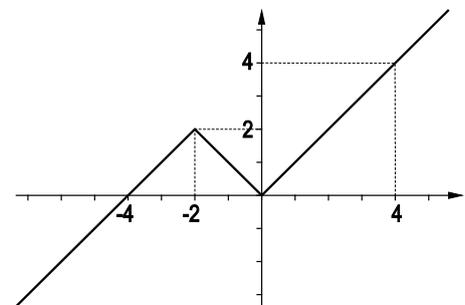


16. We are considering rectangles which have one side of length of 5.0 cm. Amongst these there are some that can be cut to make a square and a rectangle, one of which having an area of 4.0 cm<sup>2</sup>. How many such rectangles are there?

- (A) 1 (B) 2 (C) 3 (D) 4 (E) 5

17. Peter has drawn the graph of a function  $f: \mathbb{R} \rightarrow \mathbb{R}$  which consists of two rays and a line segment as indicated on the right. How many solutions has the equation  $f(f(f(x))) = 0$ ?

- (A) 4 (B) 3 (C) 2 (D) 1 (E) 0



18. How many pairs of positive integers  $(x, y)$  solve the equation  $x^2 \times y^3 = 6^{12}$

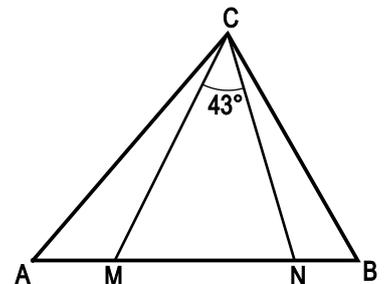
- (A) 6 (B) 8 (C) 10 (D) 12 (E) A different number.

19. In a box there are 900 cards that are numbered from 100 to 999. On any two different cards there are always different numbers. Franz picks a few cards and works out the sum of the digits on each card. What is the minimum number of cards he has to pick to have at least three with the same sum?

- (A) 51 (B) 52 (C) 53 (D) 54 (E) 55

20. In a triangle ABC the points M and N are placed on side AB so that  $AN = AC$  and  $BM = BC$ . Determine  $\angle ACB$  if  $\angle MCN = 43^\circ$ .

- (A)  $86^\circ$  (B)  $89^\circ$  (C)  $90^\circ$  (D)  $92^\circ$  (E)  $94^\circ$



**- 5 Point Questions -**

21. How many pairs of integers  $(x, y)$  with  $x \leq y$  are there such that their product is exactly five times their sum?



**2013**

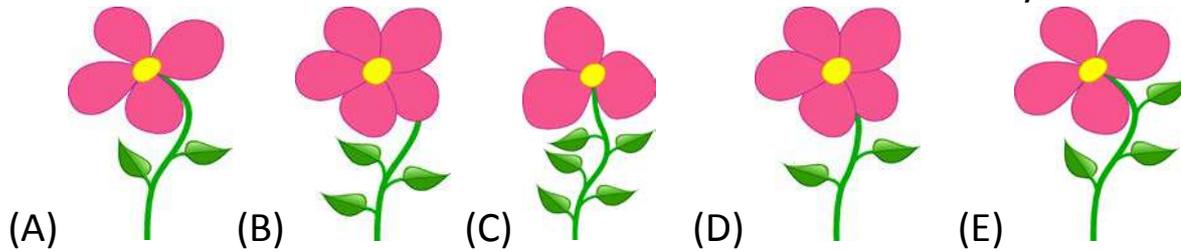
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
<b>Felix</b>	D	B	A	E	C	D	E	D	E	A	E	B	C	C	D															
<b>Écolier</b>	B	D	D	A	E	A	C	B	B	D	D	D	B	C	C	E	B	A	D	D	C	C	B	B						
<b>Benjamin</b>	E	C	C	B	E	B	B	C	C	C	D	C	B	D	A	C	C	B	D	B	D	B	B	A						
<b>Kadett</b>	D	D	A	C	B	E	C	C	A	C	E	E	B	C	B	A	A	E	B	C	E	A	B	C	C	B	B	D	B	A
<b>Junior</b>	D	C	C	C	A	E	E	C	D	C	D	B	D	D	D	A	A	C	D	E	C	C	D	E	A	B	C	C	B	B
<b>Student</b>	C	C	E	D	C	D	E	B	E	D	C	A	E	D	A	D	A	E	C	E	A	D	A	E	D	C	B	D	E	B

**Mathematical Kangaroo 2014**  
**Group Felix (Grade 1 and 2)**  
**Austria – 20.3.2014**



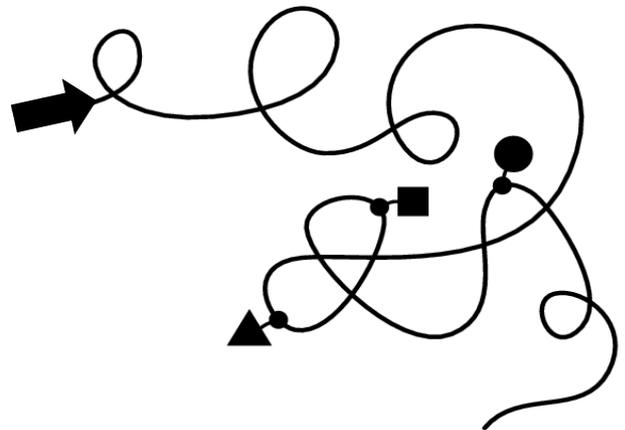
**– 3 Point Questions –**

1. The ladybird  would like to sit on his flower. The flower has five petals and the stem has three leaves. On which flower should the ladybird sit?



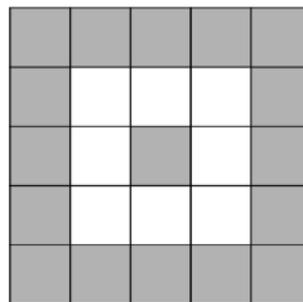
2. Theresa moves a pencil along the line. She starts at the arrow shown. In which order will she go past the shapes?

- (A) ▲, ■, ●    (B) ▲, ●, ■    (C) ●, ▲, ■  
 (D) ■, ▲, ●    (E) ■, ●, ▲



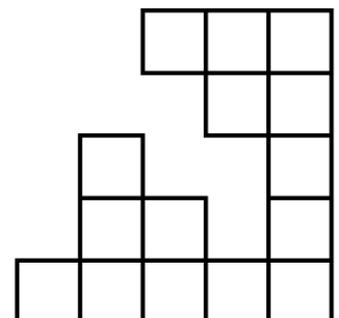
3. There are more grey squares than white. How many more?

- (A) 6            (B) 7            (C) 8  
 (D) 9            (E) 10



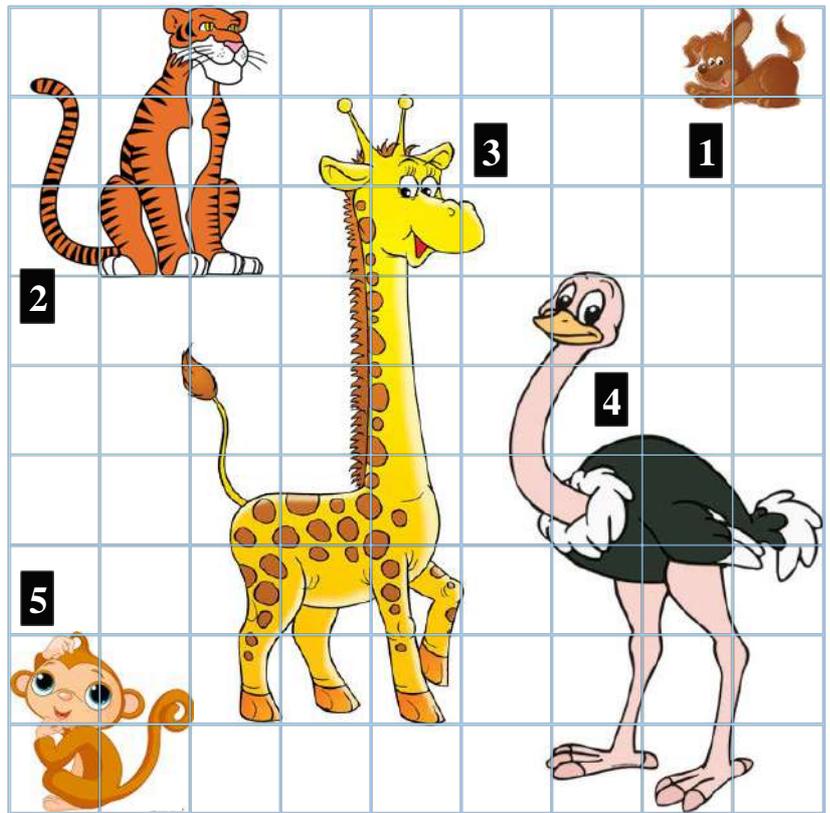
4. A big square is made from 25 small squares put together. A few of the small squares have been lost. How many have been lost?

- (A) 6            (B) 7            (C) 8            (D) 10            (E) 12



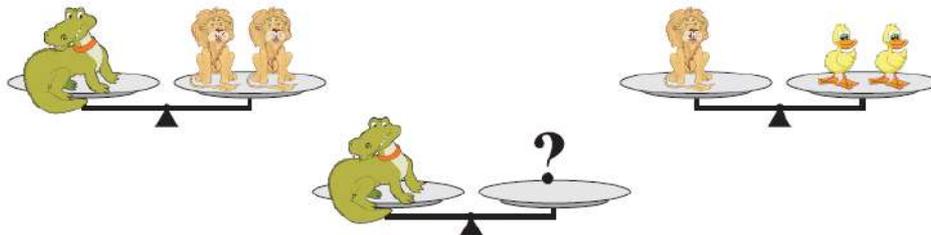
5. Put the animals in order of size. Begin with the smallest. Which animal will be in the middle?

- (A) 1
- (B) 2
- (C) 3
- (D) 4
- (E) 5



– 4 Point Questions –

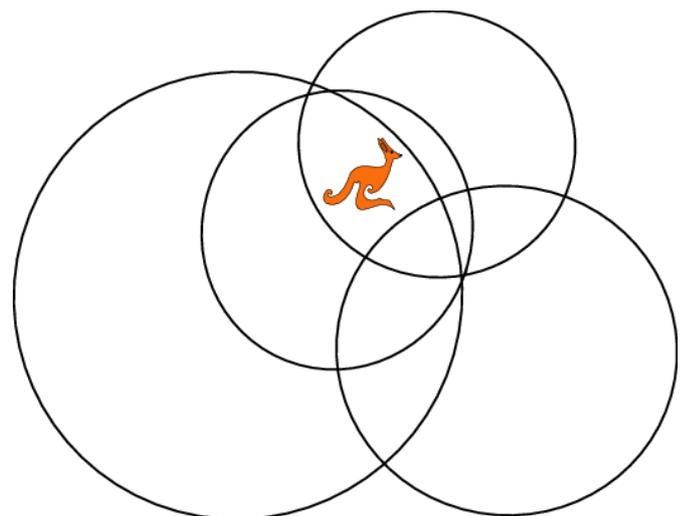
6. How many ducks weigh the same as a crocodile?



- (A)
- (B)
- (C)
- (D)
- (E)

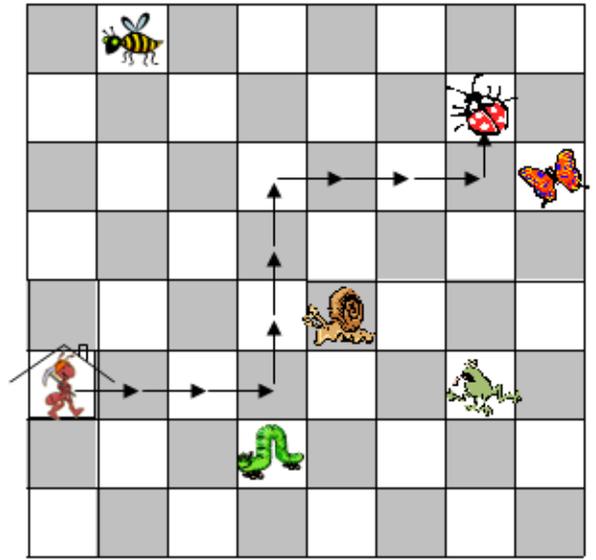
7. The kangaroo is inside how many circles?

- (A) 1
- (B) 2
- (C) 3
- (D) 4
- (E) 5



8. When the ant  walks from home  along the arrows  $\rightarrow 3, \uparrow 3, \rightarrow 3, \uparrow 1$ , he gets to the ladybird .

Which animal does the ant , get to when he walks from home  along the following arrows:  $\rightarrow 2, \downarrow 2, \rightarrow 3, \uparrow 3, \rightarrow 2, \uparrow 2$ ?



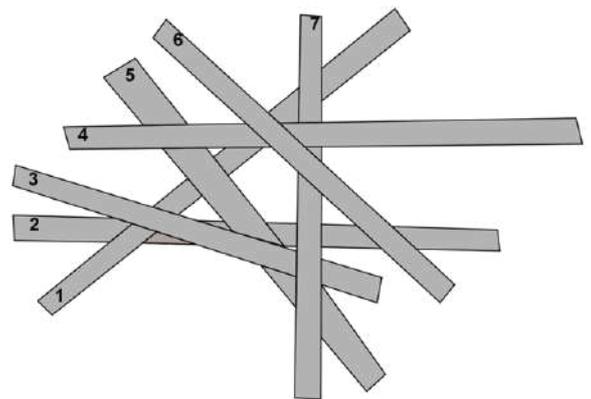
- (A)  (B)  (C)  (D)  (E) 

9. Max has cut a rectangle into two pieces. One piece looks like:  What does the other piece look like?

- (A)  (B)   
 (C)  (D)  (E) 

10. Seven sticks lay on top of each other. Stick 2 lays right at the bottom. Stick 6 lays right on top. Which stick lays exactly in the middle?

- (A) 1 (B) 3 (C) 4  
 (D) 5 (E) 7



**– 5 Point Questions –**

11. How many numbers, which are only allowed to contain the digits 1, 2 or 3 are bigger than 10 and smaller than 32? The digits can be used more than once in the numbers.

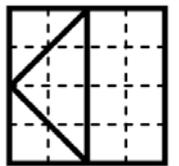
- (A) 2 (B) 4 (C) 6 (D) 7 (E) 8

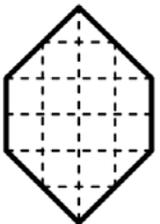
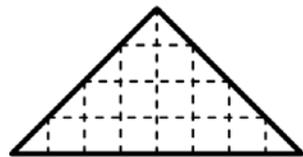
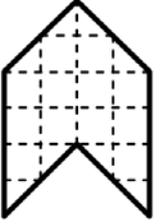
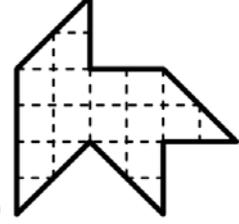
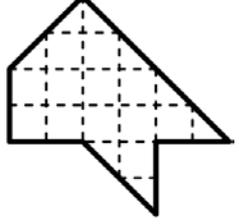
12. The rabbit family Hoppel eat cabbages and carrots. Each day they eat either 10 carrots or 2 cabbages. In the whole of last week they ate 6 cabbages. How many carrots did the rabbit family eat last week?



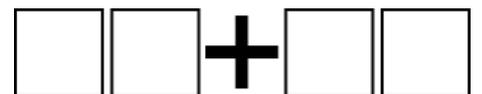
- (A) 20      (B) 30      (C) 34      (D) 40      (E) 50

13. A square is cut into four pieces. Which shape can you not make with these four pieces?



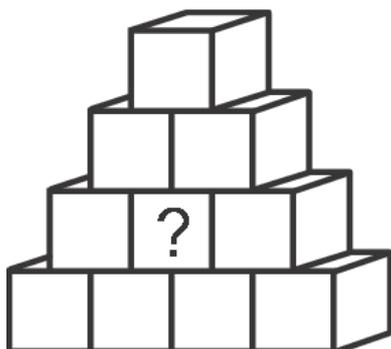
- (A) 
- (B) 
- (C) 
- (D) 
- (E) 

14. Each of the digits 2, 3, 4 and 5 will be placed in a square. Then there will be two numbers, which will be added together. What is the biggest number that they could make?



- (A) 68      (B) 77      (C) 86      (D) 95      (E) 97

15. Ingrid has 4 red, 3 blue, 2 green and 1 yellow cube. She uses them to build the following object:



Cubes with the same colour don't touch each other. Which colour is the cube with the question mark?  
 (A) red      (B) blue      (C) green      (D) Yellow  
 (E) This cannot be worked out for certain.

# Mathematical Kangaroo 2014

## Group Ecolier (Grade 3 and 4 )

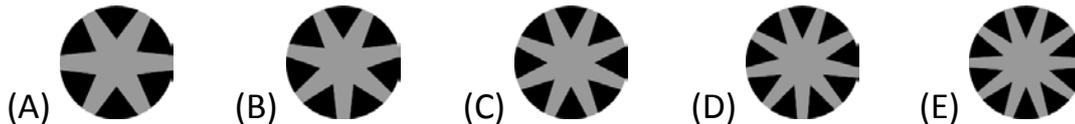
### Austria – 20.3.2014



#### – 3 Point Questions –

1. Luisa draws a star.

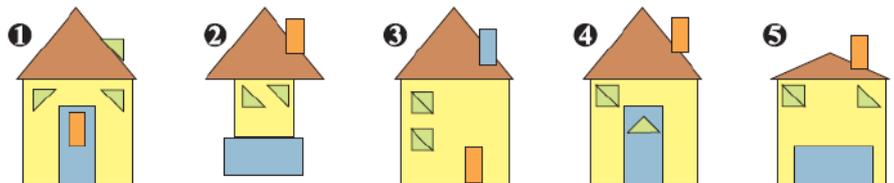
She cuts a piece out of the middle of the drawing. What does this piece look like?



2. Marie wants to insert the digit 3 somewhere into the number 2014. Where must she put the digit 3 so that the new number (with all 5 digits) is as small as possible?

- (A) in front of 2014                      (B) between 2 and 0                      (C) between 0 and 1  
 (D) between 1 and 4                      (E) after 2014

3. For which houses, were exactly the same building blocks used?

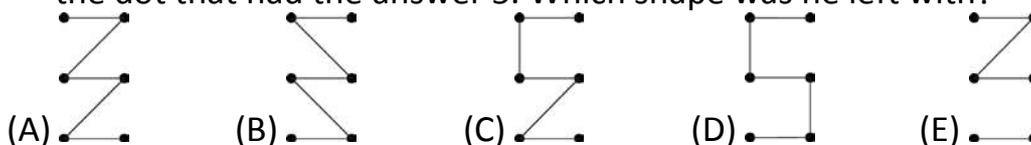
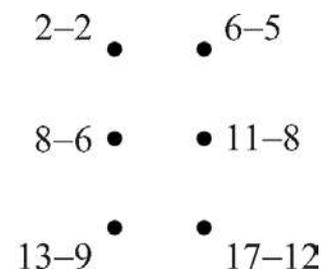


- (A) House 1 and 4  
 (B) House 3 and 4  
 (C) House 1, 4 and 5  
 (D) House 3, 4 and 5                      (E) House 1, 2, 4 and 5

4. Whenever Koko the koala bear is awake, he always eats 50 grams of leaves in one hour. Yesterday Koko slept for 20 hours. How many grams of leaves did he eat yesterday?

- (A) 0 grams                                      (B) 50 grams                                      (C) 100 grams  
 (D) 200 grams                                      (E) 400 grams

5. Christopher solved the sums next to the dots that you can see on the right, and got the answers 0 to 5. He joined the dots in order. He started with the dot that had the answer 0 and finished with the dot that had the answer 5. Which shape was he left with?



6. Anita has built fewer sandcastles than Hans but more than Steffan. Fabian has built more sandcastles than Anita and more than Hans. Bruno has built more sandcastles than Hans but less than Fabian. Who has built the most sandcastles?

- (A) Hans                      (B) Anita                      (C) Stefan                      (D) Bruno                      (E) Fabian

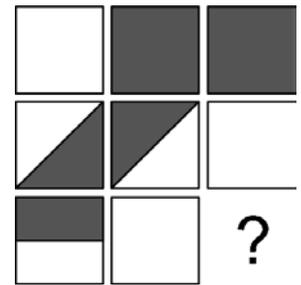
7. Mr Hofer has drawn a picture of flowers on the inside of a display window (large picture). What do these flowers look like when you look at the picture from the outside?



- (A) (B) (C) (D) (E)

8. With which square do you have to swap the question mark, so that the white area and the black area are the same size?

- (A) (B) (C) (D) (E)



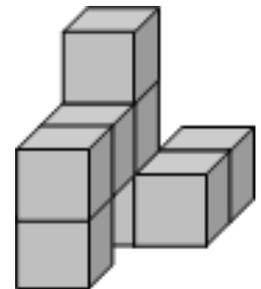
**– 4 Point Questions –**

9. A bowl was full with sweets. Raphael took half of them out. Afterwards Emanuel took out half of the remaining sweets. Now there are only 12 sweets left in the bowl. How many sweets were in the bowl to begin with?

- (A) 12 (B) 18 (C) 20 (D) 24 (E) 48

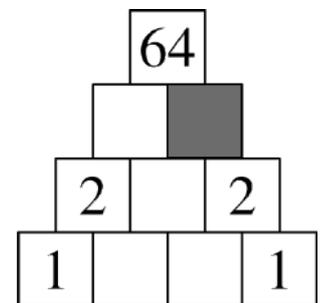
10. The solid in the diagram is made out of 8 identical cubes. What does the solid look like when viewed from above?

- (A) (B) (C) (D) (E)



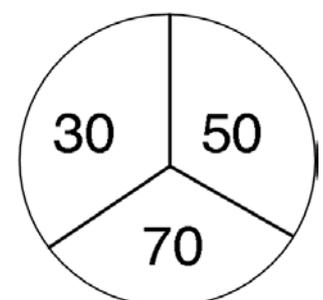
11. Leo writes numbers in the multiplication pyramid. Explanation of the multiplication pyramid: By multiplying the numbers which are next to each other, the number directly above (in the middle) is calculated. Which number must Leo write in the grey field?

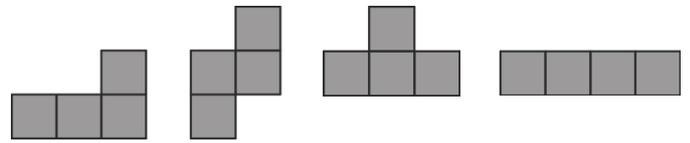
- (A) 0 (B) 1 (C) 2 (D) 4 (E) 8



12. Katja throws darts at the target pictured on the right. If she does not hit the target she gets no points. She throws twice and adds her points. What can her total not be?

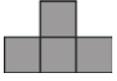
- (A) 60 (B) 70 (C) 80 (D) 90 (E) 100

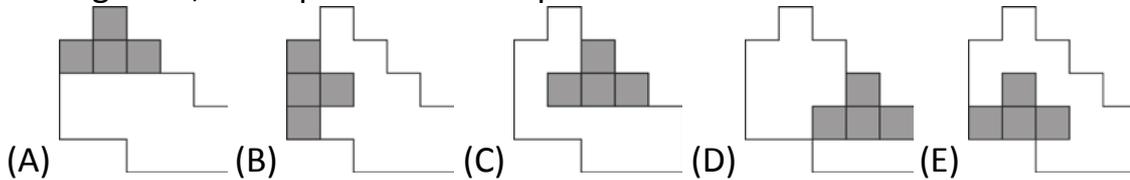




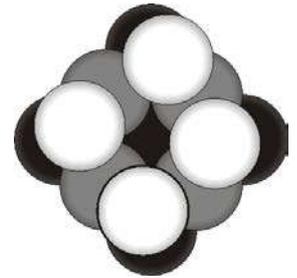
13. Erwin has got the following paper pieces:

With these four pieces he must exactly cover a special shape. In which drawing will he

manage this, if the piece  is placed as shown?



14. Gerhard has the same number of white, grey and black counters. He has thrown some of these circular pieces together onto a pile. All the pieces he has used for this, can be seen in the picture. He has however, got 5 counters left that will not stay on the pile. How many black counters did he have to begin with?



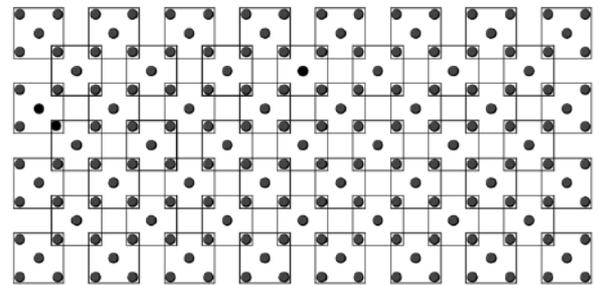
- (A) 5            (B) 6            (C) 7            (D) 15            (E) 18

15. Hubert the rabbit loves cabbages and carrots. In one day he eats either 9 carrots, or 2 cabbages, or one cabbage and 4 carrots. In one week Hubert had eaten 30 carrots. How many cabbages had he in eaten during this week?

- (A) 6            (B) 7            (C) 8            (D) 9            (E) 10

16. How many dots are in the picture?

- (A) 180            (B) 181            (C) 182  
(D) 183            (E) 265

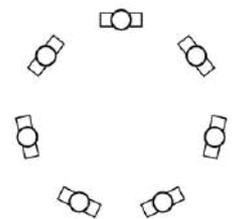


**– 5 point questions –**

17. On the Kangaroo planet each kangoo-year has 20 kangoo-months. Each kangoo-month has 6 kangoo-weeks. How many kangoo-weeks are in a quarter of a kangoo-year?

- (A) 9            (B) 30            (C) 60            (D) 90            (E) 120

18. Seven children stand in a circle. Nowhere are two boys found standing next to each other. Nowhere are three girls found standing next to each other. What is possible for the number of girls? The number of girls can...



- (A) ... only be 3.            (B) ... be 3 or 4.            (C) ... only be 4.  
(D) ... be 4 or 5.            (E) ... only be 5.

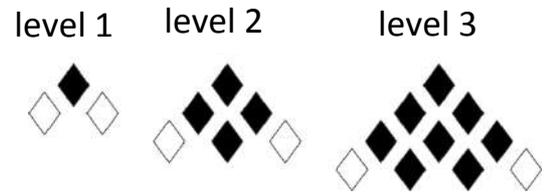
19. Elisabeth sorts the following cards:



With each move she is allowed to swap any two cards with each other. What is the smallest number of moves she needs in order to get the word KANGAROO.

- (A) 2            (B) 3            (C) 4            (D) 5            (E) 6

20. The number of black diamonds  $\blacklozenge$  and white diamonds  $\lozenge$  follow a fixed system. In the picture the first 3 levels are shown. Each level (from the 2<sup>nd</sup> level) has one row more than the level before. For each level the following applies: In the last row both of the outermost diamonds are white, all other diamonds are black. How many black diamonds are there in level 6?



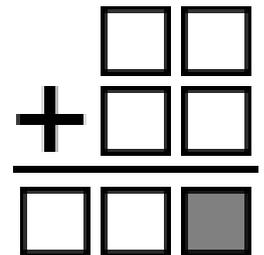
- (A) 19      (B) 21      (C) 26      (D) 28      (E) 34

21. Heinz the kangaroo has bought some toys. For this he gave 150 Kangoo-coins (KC) and received 20 kangoo-coins back. Just before leaving the shop he changed his mind, and exchanged one of the toys he had bought with another one. Therefore he received a further 5 kangoo-coins back from the shopkeeper. Which of the toys in the picture has Heinz taken home with him?



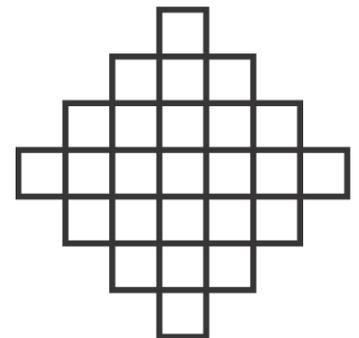
- (A) Carriage and Aeroplane      (B) Carriage and Bus      (C) Carriage and Tram  
(D) Motorbike and Tram      (E) Bus, Motorbike and Tram

22. In each box exactly one of the digits 0, 1, 2, 3, 4, 5 and 6 is to be written. Each digit will only be used once. Which digit has to be written in the grey box so that the sum is correct?



- (A) 2      (B) 3      (C) 4      (D) 5      (E) 6

23. In the figure on the right a few of the small squares will be painted grey. In so doing no square  that is made from four small grey squares must appear. At most how many of the squares in the figure can be painted grey?



- (A) 18      (B) 19      (C) 20      (D) 21      (E) 22

24. Albin has put each of the digits from 1 to 9 in the fields of the table. In the diagram only 4 of these digits are visible. For the field containing the number 5, Albin noticed that the sum of the numbers in the neighbouring fields is 13. (neighbouring fields are fields which share a side). He noticed exactly the same for the field containing the digit 6. Which digit had Albin written in the grey field?

1		2
4		3

- (A) 5      (B) 6      (C) 7      (D) 8      (E) 9

**Mathematical Kangaroo 2014**  
**Group Benjamin (Grade 5 and 6)**  
**Austria - 20.3.2014**



- 3 Point Questions -

1. Arno lays out the word KANGAROO using 8 cards. However, some cards are turned.



By turning it twice the letter K can be corrected, letter A can be corrected by turning it once (see drawing). How often does he have to turn so that the word KANGAROO can be read correctly?

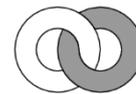


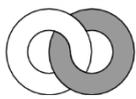
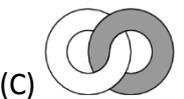
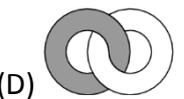
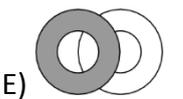
- (A) 4                      (B) 5                      (C) 6                      (D) 7                      (E) 8

2. A cake weighs 900 g. Paul cuts it into 4 pieces. The biggest piece weighs exactly as much as the other three pieces together. How much does the biggest piece weigh?

- (A) 250 g                  (B) 300 g                  (C) 400 g                  (D) 450 g                  (E) 600 g

3. A white and a grey ring are interlinked with one another. Peter sees the two rings from the front as they are seen in the diagram on the right. Paul sees the rings from the back. What does he see?



- (A)       (B)       (C)       (D)       (E) 

4. In the addition sum to the right, three digits have been replaced with stars. How big is the sum of the three missing digits?

- (A) 0                      (B) 1                      (C) 2                      (D) 3                      (E) 10

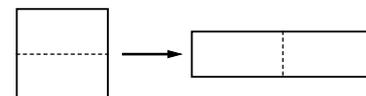
$$\begin{array}{r} 1 * 2 \\ + 1 * 3 \\ + 1 * 4 \\ \hline 3 0 9 \end{array}$$

5. How big is the difference between the smallest five-digit and the biggest four-digit number?

- (A) 1                      (B) 10                      (C) 1111                      (D) 9000                      (E) 9900

6. A square with perimeter 48 cm is cut into two equally big pieces with one cut. They are fitted together to make a rectangle as shown in the diagram. How big is the perimeter of that rectangle?

- (A) 24 cm                  (B) 30 cm                  (C) 48 cm                  (D) 60 cm                  (E) 72 cm



7. Katrin has 38 matches. She uses all the matches and makes a triangle and a square. The triangle and the square do not share any matches. Each side of the triangle consists of 6 matches. One side of the square is made of how many matches?

- (A) 4                      (B) 5                      (C) 6                      (D) 7                      (E) 8

8. Grey and white pearls are threaded on a piece of string.



Monika wants to have 5 grey pearls. However, she can only pull off pearls from the end of the string. Therefore she has to pull off some white pearls as well. What is the minimum number of white pearls she has to pull off, to get 5 grey pearls?

- (A) 2                      (B) 3                      (C) 4                      (D) 5                      (E) 6



- 5 Point Questions -

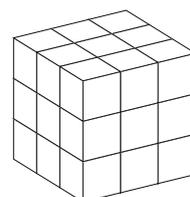
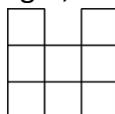
17. Lea plays with her marbles. She places them in small groups on the table. If she places them in groups of three, two marbles are left over. If she places them in groups of five, again two are left over. How many more marbles does Lea need so that she can place them in groups of three as well as groups of five without any marbles being left over?

- (A) 3      (B) 1      (C) 4      (D) 10      (E) 13

18. The faces of a die are labelled with the numbers 1, 2, 3, 4, 5 and 6. The faces 1 and 6 have one common edge. The same is true for the faces 1 and 5, the faces 1 and 2, the faces 6 and 5, the faces 6 and 4 and the faces 6 and 2. Which number labels the face that is opposite to face 4?

- (A) 1      (B) 2      (C) 3      (D) 5      (E) 6

19. The  $3 \times 3 \times 3$  cube consists of 27 small cubes. Some of the small cubes are removed. If you now look at the cube from the right, from above and from the front, you see the following:



How many little cubes were removed?

- (A) 1      (B) 4      (C) 5      (D) 6      (E) 7

20. There are 5 songs on an MP3-player: Song A lasts 3 mins, song B 2 mins 30 s, song C 2 mins, song D 1 min 30 s, and song E 4 mins. These 5 songs are played non-stop one after the other. Song C is playing when Andy left the house. Exactly one hour later he returns. Which song is playing when Andy came back?

- (A) A      (B) B      (C) C      (D) D      (E) E

21. Daniela fills a  $3 \times 3$  table using the digits 1 to 9 so that each field contains only one digit. She has already placed the digits 1, 2, 3 and 4 in the table as shown in the diagram. Two numbers count as "adjacent" if the fields which they fill have one common side. When she has finished filling the table she realised: the sum of the numbers adjacent to 5 is 9. How big is the sum of the numbers adjacent to 6?

1		3
2		4

- (A) 14      (B) 15      (C) 17      (D) 28      (E) 29

22. The king travels with his messengers at a speed of 5 km/h from his castle to his summer residence. Each hour he sends a messenger with a speed of 10 km/h back to the castle. How much difference in time is there between two consecutive messengers arriving at the castle?

- (A) 30 min      (B) 60 min      (C) 75 min      (D) 90 min      (E) 120 min

23. Mia writes three single-digit numbers on the board. Ali adds them and gets 15. Then he deletes one of the three numbers and replaces it with the number 3. Resi multiplies these three numbers and obtains 36. Which numbers could Ali have deleted?

- (A) either 6 or 7      (B) either 7 or 8      (C) only 6      (D) only 7      (E) only 8

24. Grandma gives 180 marbles to her ten grandchildren. No two children get the same amount of marbles. Anna gets the most. What is the minimum number of marbles that Anna could get?

- (A) 19      (B) 20      (C) 21      (D) 22      (E) 23

# Mathematical Kangaroo 2014 Group Kadett (Grade 7 and 8 ) Austria - 20.3.2014



## - 3 Point Questions -

1. The Mathematical Kangaroo takes place each year on the third Thursday of March. What is the latest possible date on which the competition could take place?

- (A) 14 March      (B) 15 March      (C) 20 March      (D) 21 March      (E) 22 March

2. How many quadrilaterals of any size are to be found in the diagram pictured.

- (A) 0      (B) 1      (C) 2      (D) 4      (E) 5

3. What is the answer to  $2014 \times 2014 \div 2014 - 2014$  ?

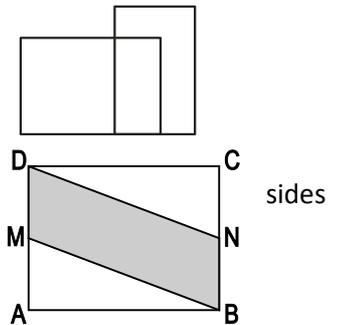
- (A) 0      (B) 1      (C) 2013      (D) 2014      (E) 4028

4. The area of rectangle  $ABCD$  in the diagram is 10.  $M$  and  $N$  are the midpoints of the sides  $AD$  and  $BC$  respectively. How big is the area of the quadrilateral  $MBND$ ?

- (A) 0.5      (B) 5      (C) 2.5      (D) 7.5      (E) 10

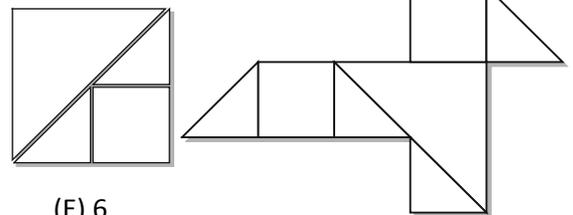
5. The product of two natural numbers is 36, and their sum 37. How big is the (positive) difference between the two numbers?

- (A) 1      (B) 4      (C) 10      (D) 26      (E) 35



6. Wanda has lots of pages of square paper, whereby each page has an area of 4. She cuts each of the pages into right-angled triangles and squares (see the left hand diagram). She takes a few of these pieces and forms the shape in the right hand diagram. How big is the area of this shape?

- (A) 3      (B) 4      (C)  $\frac{9}{2}$       (D) 5      (E) 6

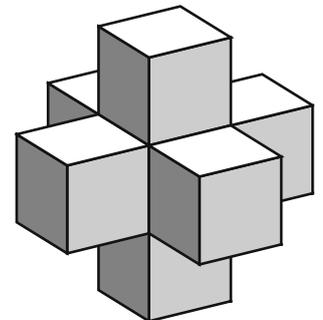


7. A bucket is filled halfway with water. A cleaning liquid fills another 2 litres of liquid into the bucket. Now the bucket is three-quarters full. How many litres of water in total can fit into the bucket?

- (A) 10 Litre      (B) 8 Litre      (C) 6 Litre      (D) 4 Litre      (E) 2 Litre

8. George builds the sculpture shown from seven cubes each of edge length 1. How many more of these cubes must he add to the sculpture so that he builds a large cube of edge length 3?

- (A) 12      (B) 14      (C) 16      (D) 18      (E) 20



9. Which of the following sums gives the biggest answer?

- (A)  $44 \times 777$       (B)  $55 \times 666$       (C)  $77 \times 444$       (D)  $88 \times 333$       (E)  $99 \times 222$

10. Gray and white pearls are threaded onto a string.



Tony pulls pearls from the ends of the chain. After pulling off the fifth gray pearl he stops. At most, how many white pearls could he have pulled off?

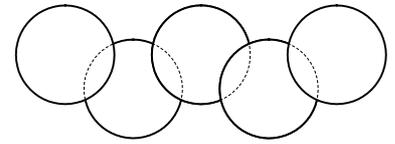
- (A) 4      (B) 5      (C) 6      (D) 7      (E) 8

- 4 Point Questions -

11. Max has a one hour piano lesson twice a week, Hanna only has a one hour lesson every second week. The piano lessons run over a particular number of weeks. How many weeks is this, if during this time Max has 15 more hours of lessons than Hanna?

- (A) 30 Weeks      (B) 25 Weeks      (C) 20 Weeks      (D) 15 Weeks      (E) 10 Weeks

12. Five circles each with an area of  $1 \text{ cm}^2$  overlap each other to form the figure in the diagram. The sections where two circles overlap, each have an area of  $\frac{1}{8} \text{ cm}^2$ . How big is the area, which is completely covered by the figure in the diagram?



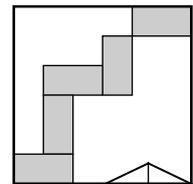
- (A)  $4 \text{ cm}^2$       (B)  $\frac{9}{2} \text{ cm}^2$       (C)  $\frac{35}{8} \text{ cm}^2$       (D)  $\frac{39}{8} \text{ cm}^2$       (E)  $\frac{19}{4} \text{ cm}^2$

13. A grandmother, her daughter and her granddaughter find that the sum of their ages is 100. Also each age is a power of two (that is, several two's multiplied together). How old is the granddaughter?

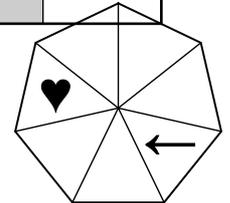
- (A) 1      (B) 2      (C) 4      (D) 8      (E) 16

14. 5 congruent rectangles are positioned in a square with side length 24 as shown in the diagram. How big is the area of one of these rectangles?

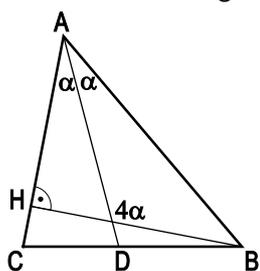
- (A)  $12 \text{ cm}^2$       (B)  $16 \text{ cm}^2$       (C)  $18 \text{ cm}^2$       (D)  $24 \text{ cm}^2$       (E)  $32 \text{ cm}^2$



15. In the following figure, the heart and the arrow are arranged as pictured. At the same moment the heart and the arrow begin to move. The arrow moves around the figure 3 spaces clockwise and the heart 4 spaces anticlockwise and then they stop. This process repeats itself over and over again. After how many repetitions does the arrow find itself for the first time in the same triangle as the heart?



- (A) 7      (B) 8      (C) 9      (D) 10      (E) That will never happen



16. In triangle  $ABC$  (see sketch)  $AD$  is the angle bisector of the angle at  $A$  and  $BH$  is the height from side  $AC$ . The obtuse angle between  $BH$  and  $AD$  is four times the size of angle  $\angle DAB$ . How big is the angle  $\angle CAB$ ?

- (A)  $30^\circ$       (B)  $45^\circ$       (C)  $60^\circ$       (D)  $75^\circ$       (E)  $90^\circ$

17. Six boys live together in an apartment, which has two bathrooms. Each morning from 7:00 they use both of the bathrooms before breakfast whereby they are 8, 10, 12, 17, 21, and 22 minutes respectively, constantly alone in one of the two bathrooms. What is the earliest time that all six boys can have breakfast together?

- (A) 7:45      (B) 7:46      (C) 7:47      (D) 7:48      (E) 7:50

18. The sides of a rectangle are 6cm and 11cm long. You select one of the long sides. Then the angle bisectors of the angles at the ends of this side are drawn. They split the opposite long side into three pieces. How long are these pieces?

- (A) 1 cm, 9 cm, 1 cm      (B) 2 cm, 7 cm, 2 cm      (C) 3 cm, 5 cm, 3 cm      (D) 4 cm, 3 cm, 4 cm      (E) 5 cm, 1 cm, 5 cm

19. Captain Sparrow and his pirates loot some gold coins. They share the coins equally amongst themselves. If they were four pirates less they would each get 10 coins more. If the number of coins was 50 less, they would each get 5 coins less. How many coins did they share between themselves?

- (A) 80      (B) 100      (C) 120      (D) 150      (E) 250

20. The average value of two positive numbers is 30% less than one of the two numbers. By which percentage is the average value bigger than the other number?

- (A) 75%      (B) 70%      (C) 30%      (D) 25%      (E) 20%

**5 Point Questions**

**21.** Andy fills a  $3 \times 3$  table with all the digits from 1 to 9 so that each cell only contains one digit. He has already put the digits 1, 2, 3 and 4 in the table as shown in the diagram. Two numbers are 'neighbouring' when the cells they are in share one side. After he had finished filling in the table he noticed: The sum of the numbers neighbouring 9 equals 15. How big is the sum of the numbers neighbouring 8?

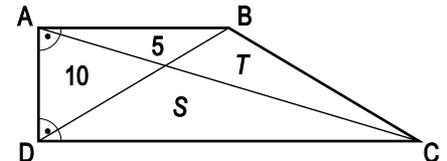
1		3
2		4

- (A) 12                      (B) 18                      (C) 20                      (D) 26                      (E) 27

**22.** A set of scales does not always show the correct mass. If something is less than 1000g they show the exact mass. When something weighs 1000g or more, they show some mass over 1000g. You have 5 balls with the masses A g, Bg, C g, D g and E g each less than 1000g. When you weigh these in pairs the scales show the following:  $B + D = 1200$ ,  $C + E = 2100$ ,  $B + E = 800$ ,  $B + C = 900$ ,  $A + E = 700$ . Which ball is the heaviest?

- (A) A                      (B) B                      (C) C                      (D) D                      (E) E

**23.** The quadrilateral  $ABCD$  has right angles only in corners A and D. The numbers in the diagram give the respective areas of the triangles in which they are located. How big is the area of  $ABCD$ ?



- (A) 60                      (B) 45                      (C) 40                      (D) 35                      (E) 30

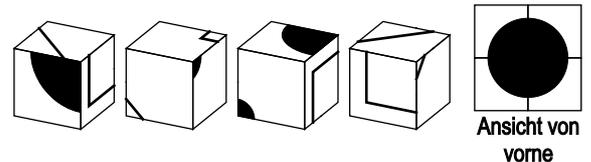
**24.** Jan and Eva undertake a challenge to solve mathematics questions. They each get an identical list of 100 questions. For each correctly solved question, the first to solve it gets 4 points while the slower person gets 1 point. Jan solved 60 questions and Eva also solved 60 questions. Together they score 312 points. How many questions were solved by both Jan and Eva?

- (A) 53                      (B) 54                      (C) 55                      (D) 56                      (E) 57

**25.** David cycles from Edinburgh to his aunty who lives outside of Edinburgh. He wants to arrive at exactly 15:00 hours. After  $\frac{2}{3}$  of his planned travel time he had covered  $\frac{3}{4}$  of the way. Therefore he began to cycle slower and arrived exactly on time at his destination. In which ratio are the average speeds of the two sections of his journey?

- (A) 5 : 4                      (B) 4 : 3                      (C) 3 : 2                      (D) 2 : 1                      (E) 3 : 1

**26.** Four identical cubes (see diagram) were fitted together. If the resulting shape is viewed from the front you see a black circle (picture on the right). What will you see on the back of the shape?



- (A)                      (B)                      (C)                      (D)                      (E)

**27.** A group of 25 people is made up of knights, rascals and shilly-shalliers. The knights always tell the truth, the rascals are always untruthful, and the shilly-shalliers answer alternately truthfully and falsely (or the other way around).

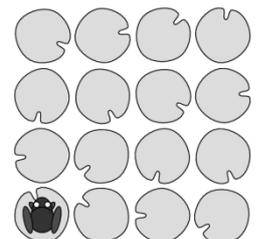
After the first question asked to everybody "are you a knight?" 17 of them answered "yes!"  
 After the second question asked to everybody "are you a shilly-shallier?" 12 of them answered "yes!"  
 After the third question asked to everybody "are you a rascal?" 8 of them answered "yes!"  
 How many knights are in this group of people?

- (A) 4                      (B) 5                      (C) 9                      (D) 13                      (E) 17

**28.** Lots of different positive whole numbers were written on a blackboard. Exactly two of these numbers are divisible by 2 and exactly 13 of these numbers are divisible by 13. The biggest number on the board is  $M$ . What is the smallest value that  $M$  can have?

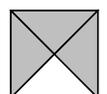
- (A) 169                      (B) 260                      (C) 273                      (D) 299                      (E) 325

**29.** On a pond 16 lilly pads are arranged in a  $4 \times 4$  grid as can be seen in the diagram. A frog sits on a lilly pad in one of the corners of the grid (see picture). The frog jumps from one lilly pad to another horizontally or vertically. In doing so he always jumps over at least one lilly pad. He never lands on the same lilly pad twice. What is the maximum number of lilly pads, including the one he is sitting on, on which he can land?



- (A) 16                      (B) 14                      (C) 8                      (D) 6                      (E) 4

**30.** A  $5 \times 5$  square is covered with  $1 \times 1$  tiles. The design on each tile is made up of three dark triangles and one light triangle (see diagram). The triangles of neighbouring tiles always have the same colour where they join along an edge. The border of the large square is made of dark and light triangles. What is the smallest number of dark triangles that could be amongst them?

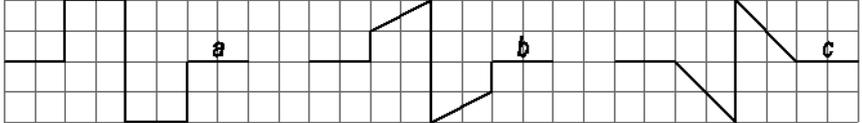
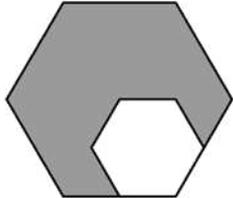


- (A) 4                      (B) 5                      (C) 6                      (D) 7                      (E) 8

# Mathematical Kangaroo 2014 Group Junior (Grades 9. und 10. ) Austria - 20.3.2014



## - 3 Point Questions -

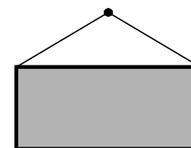
1. The Kangaroo competition takes place each year on the third Thursday of March. Which day is the earliest possible date for the competition?  
(A) 14/3.      (B) 15/3      (C) 20/3      (D) 21/3      (E) 22/3.
  
  2. The container ship MSC Fabiola carries 12500 identically long containers. When put next to each other in a row they make a 75km long container line. Roughly, how long is one container?  
(A) 6 m      (B) 16 m      (C) 60 m      (D) 160 m      (E) 600 m
  
  3.  $a$ ,  $b$  and  $c$  show the lengths of the different pieces of wire pictured. Which of the following inequalities is correct?  
(A)  $a < b < c$       (B)  $a < c < b$       (C)  $b < a < c$       (D)  $b < c < a$       (E)  $c < b < a$
- 
4. Which number is an equal distance from  $\frac{2}{3}$  and  $\frac{4}{5}$  on the number line?  
(A)  $\frac{11}{15}$       (B)  $\frac{7}{8}$       (C)  $\frac{3}{4}$       (D)  $\frac{6}{15}$       (E)  $\frac{5}{8}$
  
  5. In the year number 2014, the last digit is bigger than the sum of the three other digits. How many years ago did this last happen?  
(A) 1      (B) 3      (C) 5      (D) 7      (E) 11
  
  6. The side lengths of the large regular hexagon are twice the length of those of the small regular hexagon. What is the area of the large hexagon if the small hexagon has an area of  $4 \text{ cm}^2$ ?  
(A)  $16 \text{ cm}^2$       (B)  $14 \text{ cm}^2$       (C)  $12 \text{ cm}^2$       (D)  $10 \text{ cm}^2$       (E)  $8 \text{ cm}^2$
- 
7. Which statement is definitely correct if the following statement is false: „Everybody has solved more than 20 problems.“  
(A) Nobody has solved more than 20 problems.      (B) Somebody has solved less than 21 problems.  
(C) Everybody has solved less than 21 problems.      (D) Somebody has solved exactly 20 problems.  
(E) Somebody has solved more than 20 problems.
  
  8. Tom draws a square on the co-ordinate plane. One diagonal sits on the x-axis. Its endpoints are  $(-1,0)$  and  $(5,0)$ . Which of the following points is also a corner point of the square?  
(A)  $(2,0)$       (B)  $(2,3)$       (C)  $(2,-6)$       (D)  $(3,5)$       (E)  $(3,-1)$
  
  9. In Kangaroo city there are  $m$  men,  $f$  women and  $k$  children. It is true that  $m : f = 2 : 3$  and  $f : k = 8 : 1$ . In what ratio is the number of adults (men and women) to the number of children?  
(A)  $5 : 1$       (B)  $10 : 3$       (C)  $13 : 1$       (D)  $12 : 1$       (E)  $40 : 3$
  
  10. The circumference of the large wheel measures  $4.2\text{m}$ , and that of the small wheel  $0.9\text{m}$ . To begin with the valves on both wheels are at the lowest point, and then the bicycle moves to the left. After a few metres both valves are again at the lowest point at the same time. After how many metres does this happen for the first time?  
(A)  $4.2 \text{ m}$       (B)  $6.3 \text{ m}$       (C)  $12.6 \text{ m}$       (D)  $25.2 \text{ m}$       (E)  $37.8 \text{ m}$



- 4 Point Questions -

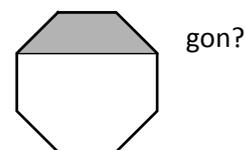
11. A Grandmother, her daughter and her Granddaughter each have their birthday in February. They can say that they are in total 100 years old and that each person's age is a power of 2. In which year was the granddaughter born?  
 (A) 1998      (B) 2006      (C) 2010      (D) 2012      (E) 2013

12. Paul hangs rectangular pictures on a wall. For each picture he hammers a nail into the wall 2.5m above the floor. He ties a 2m long string to the upper corners of each picture (see diagram). Which picture size (width in cm  $\times$  height in cm) has its lower edge nearest to the floor?  
 (A) 60  $\times$  40      (B) 120  $\times$  50      (C) 120  $\times$  90      (D) 160  $\times$  60      (E) 160  $\times$  100



13. In a shared apartment where six girls live there are 2 bathrooms. Each morning from 7:00 the girls use the bathrooms before breakfast whereby they are 9, 11, 13, 18, 22 and 23 minutes respectively, constantly alone in one of the two bathrooms. What is the earliest time that all six girls can have breakfast together?  
 (A) 7:48      (B) 7:49      (C) 7:50      (D) 7:51      (E) 8:03

14. The shaded part of the regular octagon has an area of  $3 \text{ cm}^2$ . How big is the area of the octagon?  
 (A)  $8 + 4\sqrt{2} \text{ cm}^2$       (B)  $9 \text{ cm}^2$       (C)  $8\sqrt{2} \text{ cm}^2$       (D)  $12 \text{ cm}^2$       (E)  $14 \text{ cm}^2$



15. The length of the tail of the biggest crocodile in a zoo is one third of the total length of the crocodile. The head is 93cm long and makes up one quarter of the length of the crocodile without its tail included. How long is the crocodile?  
 (A) 558 cm      (B) 496 cm      (C) 490 cm      (D) 372 cm      (E) 186 cm

16. If you add the numbers on opposite faces of this special die, you will get the same total three times. The numbers on the hidden faces of the die are prime numbers. Which number is on the face opposite to 14?  
 (A) 11      (B) 13      (C) 17      (D) 19      (E) 23



17. Anna walks a distance of 8 km at a speed of 4 km/h. Then she runs for a while at 8 km/h. How many minutes must she run for, so that she has been underway with an overall average speed 5 km/h?  
 18. (A) 15 min      (B) 20 min      (C) 30 min      (D) 35 min      (E) 40 min

19. A chess player plays 40 matches and gains from these 25 points, whereby a win gives 1 point, a draw  $\frac{1}{2}$  point, and a loss 0 points. How many more matches does he win than he loses?  
 (A) 5      (B) 7      (C) 10      (D) 12      (E) 15

20. The triplets Meike, Monika and Zita each want to buy equally expensive hats. However, Meike's savings were  $\frac{1}{3}$ , Monika's  $\frac{1}{4}$  and those from Zita  $\frac{1}{5}$  smaller than the price of a hat. After these hats were reduced by €9.40, the triplets put their savings together and they each bought a hat. Not a single cent was left over. How much had a hat cost originally?  
 (A) 12 €      (B) 16 €      (C) 28 €      (D) 36 €      (E) 112 €

21.  $p$ ,  $q$  and  $r$  are positive whole numbers where  $p + \frac{1}{q + \frac{1}{r}} = \frac{25}{19}$ . The value of the product  $pqr$  is then equal to;  
 (A) 6      (B) 10      (C) 18      (D) 36      (E) 42



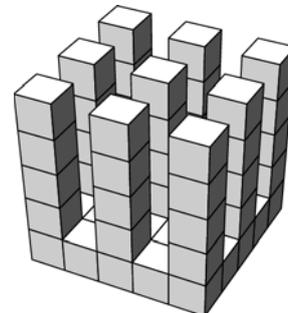
**Mathematical Kangaroo 2014**  
**Group Student (Grade 11 onwards)**  
**Austria - 20.3.2014**



- 3 point questions -

1. If one removes some  $1 \times 1 \times 1$  cubes from a  $5 \times 5 \times 5$  cube, you obtain the solid shown. It consists of several equally high pillars that are built upon a common base. How many little cubes have been removed?

- (A) 56            (B) 60            (C) 64            (D) 68            (E) 80



2. Today is Carmen, Gerda and Sabine's birthday. The sum of their ages is now 44. How big will the sum of their ages be, the next time it is a two-digit number with two equal digits?

- (A) 55            (B) 66            (C) 77            (D) 88            (E) 99

3. How big is the value of  $a^{-3k}$ , if  $a^k = \frac{1}{2}$ ?

- (A)  $\frac{1}{8}$             (B) 8            (C) -8            (D) 6            (E)  $\frac{1}{6}$

4. In three differently sized baskets there are 48 balls in total. Together the smallest and the biggest basket hold twice as many balls as the middle one. The smallest basket holds half as many balls as the middle one. How many balls are there in the biggest basket?

- (A) 16            (B) 20            (C) 24            (D) 30            (E) 32

5.  $\frac{2^{2014} - 2^{2013}}{2^{2013} - 2^{2012}} = ?$

- (A)  $2^{2011}$             (B)  $2^{2012}$             (C)  $2^{2013}$             (D) 1            (E) 2

6. For which of the following expressions is  $b + 1$  not a factor?

- (A)  $2b + 2$             (B)  $b^2 - 1$             (C)  $b^2 + b$             (D)  $-1 - b$             (E)  $b^2 + 1$

7. How many digits has the result of the calculation  $(2^{22})^5 \times (5^{55})^2$ ?

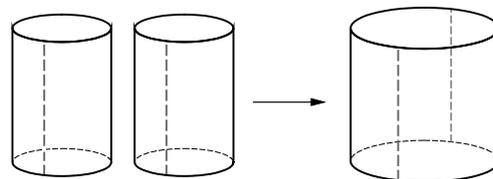
- (A) 22            (B) 55            (C) 77            (D) 110            (E) 111

8. Handsome Fritz has a secret e-mail-address which is only known by four of his friends. Today he received eight e-mails at this address. Which of the following statements is definitely correct?

- (A) Fritz has received two e-mails from each friend.  
 (B) Fritz cannot have received eight e-mails from one friend.  
 (C) Fritz has received at least one e-mail from each friend.  
 (D) Fritz has received at least two e-mails from one of his friends.  
 (E) Fritz has received at least two e-mails from at least two of his friends.

9. The curved surfaces of two identical cylinders are cut open along the vertical dotted line, as shown and then stuck together to create the curved surface of one big cylinder. What can be said about the volume of the resulting cylinder compared to the volume of one of the small cylinders?

- (A) It is 2-times as big.            (B) It is 3-times as big.  
 (C) It is  $\pi$ -times as big.            (D) It is 4-times as big.  
 (E) It is 8-times as big.



10. In the year 2014 all digits are different and the last digit is bigger than the sum of the other three digits. How many years ago was this last the case?

- (A) 5            (B) 215            (C) 305            (D) 395            (E) 485

- 4 Point Questions -

**11.** A cuboid-shaped box has the measurements  $a \times b \times c$  with  $a < b < c$ . If one increases  $a$  or  $b$  or  $c$  by 5 cm, the volume of the box increases as well. When is the increase biggest?

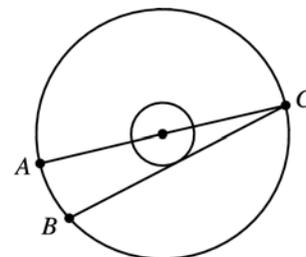
- (A) If one increases  $a$ . (B) If one increases  $b$ .  
 (C) If one increases  $c$ . (D) The answer is depending on the values of  $a$ ,  $b$  and  $c$ .  
 (E) The volume increases in the cases (A), (B) and (C) by an equal amount.

**12.** The winning team of a football match gets 3 points and the losing team 0 points. In the case of a draw both teams get one point each. Four teams A, B, C and D play a tournament. Each team plays each other team exactly once. At the end of the tournament Team A has 7 points, and Teams B and C have 4 points each. How many points has Team D got?

- (A) 0 (B) 1 (C) 2 (D) 3 (E) 4

**13.** The ratio of the radii of two concentric circles is 1 : 3. The line  $AC$  a diameter of the biggest circle. A chord  $BC$  of the big circle touches the small circle (see diagram). The line  $AB$  has length 12. How big is the radius of the big circle?

- (A) 13 (B) 18 (C) 21 (D) 24 (E) 26



**14.** How many whole number triples  $(a,b,c)$  with  $a > b > c > 1$  fulfil the condition  $\frac{1}{a} + \frac{1}{b} + \frac{1}{c} > 1$ ?

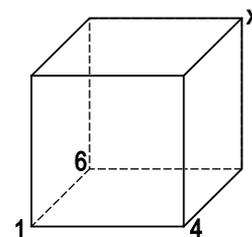
- (A) none (B) 1 (C) 2 (D) 3 (E) infinitely many

**15.** Six weeks are  $n!$  ( $= n \cdot (n-1) \cdot \dots \cdot 2 \cdot 1$ ) seconds.  $n = ?$

- (A) 6 (B) 7 (C) 8 (D) 10 (E) 12

**16.** The vertices of a die are numbered 1 to 8, so that the sum of the four numbers on the vertices of each face are the same. The numbers 1, 4 and 6 are already indicated in the picture. Which number is in position x?

- (A) 2 (B) 3 (C) 5 (D) 7 (E) 8



**17.** On the packaging of a soft cheese it says: total amount of fat 24%. On the same packaging it also says: 64% fat in the dry substance. How much water as a percentage is in the soft cheese?

- (A) 88 % (B) 62.5 % (C) 49 % (D) 42 % (E) 37.5 %

**18.** The function  $f(x) = ax + b$  fulfils the conditions  $f(f(f(1))) = 29$  and  $f(f(f(0))) = 2$ . What is the value of  $a$ ?

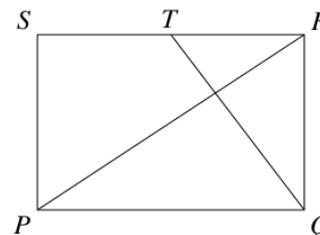
- (A) 1 (B) 2 (C) 3 (D) 4 (E) 5

**19.** Amongst 10 different positive whole numbers there are exactly 5 that are divisible by 5 and exactly 7 that are divisible by 7. Let  $M$  be the biggest amongst these numbers. What is the smallest possible value of  $M$ ?

- (A) 105 (B) 77 (C) 75 (D) 63 (E) another value

**20.**  $PQRS$  is a rectangle.  $T$  is the midpoint of  $RS$ .  $QT$  is normal to the diagonal  $PR$ . What is the ratio of the lengths  $PQ : QR$ ?

- (A) 2 : 1 (B)  $\sqrt{3} : 1$  (C) 3 : 2 (D)  $\sqrt{2} : 1$  (E) 5 : 4



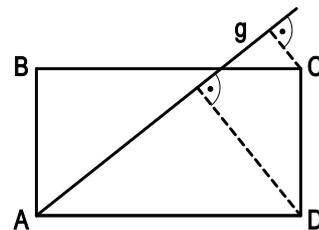
- 5 Point Questions -

**21.** Let  $a, b, c$  be different real numbers not equal to zero and  $n$  be a positive whole number. It is known that the numbers  $(-2)^{2n+3} \times a^{2n+2} \times b^{2n-1} \times c^{3n+2}$  and  $(-3)^{2n+2} \times a^{4n+1} \times b^{2n+5} \times c^{3n-4}$  have the same sign. Which of the following statements is definitely true?

- (A)  $a > 0$       (B)  $b > 0$       (C)  $c > 0$       (D)  $a < 0$       (E)  $b < 0$

**22.** The straight line  $g$  runs through the vertex  $A$  of the rectangle  $ABCD$  shown. The perpendicular distance from  $C$  to  $g$  is 2 and from  $D$  to  $g$  is 6.  $AD$  is twice as long as  $AB$ . Determine the length of  $AD$ .

- (A) 10      (B) 12      (C) 14      (D) 16      (E)  $4\sqrt{3}$

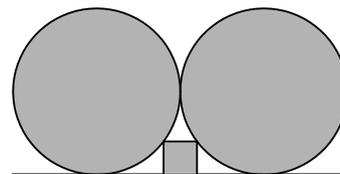


**23.** There are 9 kangaroos that are called the Greatkangs. They are either coloured white or black. If three Greatkangs meet by chance, the probability that none of them is white is exactly two thirds. How many Greatkangs are black?

- (A) 1      (B) 3      (C) 5      (D) 6      (E) 8

**24.** In the diagram on the right the following can be seen: a straight line, which is the common tangent of two touching circles with radius 1, and a square with one edge on the straight line and the other vertices one on each of the two circles. How big is the side length of the square?

- (A)  $\frac{2}{5}$       (B)  $\frac{1}{4}$       (C)  $\frac{1}{\sqrt{2}}$       (D)  $\frac{1}{\sqrt{5}}$       (E)  $\frac{1}{2}$



**25.** Thomas wants to write down pairwise, different positive whole numbers none of which should be bigger than 100. Their product should not be divisible by 54. How many numbers can he write down at the most?

- (A) 8      (B) 17      (C) 68      (D) 69      (E) 90

**26.** Two regular polygons with side length 1, lay on opposite sides of the common edge  $AB$ . One of them is the 15-sided polygon  $ABC_1D_1E_1\dots$  and the other one is the  $n$ -sided polygon  $ABC_2D_2E_2\dots$ . For which value of  $n$  is the distance between  $C_1$  to  $C_2$  exactly 1?

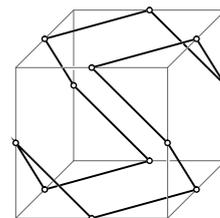
- (A) 10      (B) 12      (C) 15      (D) 16      (E) 18

**27.** The chain of equations  $k = (2014 + m)^{\frac{1}{n}} = 1024^{\frac{1}{n}} + 1$  should be valid for the positive whole numbers  $k, m, n$ . How many different values can  $m$  assume?

- (A) none      (B) 1      (C) 2      (D) 3      (E) infinitely many

**28.** In the diagram a closed polygon can be seen whose vertices are the midpoints of the edges of the die. The interior angles are as usual defined as the angle that two sides of the polygon describe in a common vertex. How big is the sum of all interior angles of the polygon?

- (A)  $720^\circ$       (B)  $1080^\circ$       (C)  $1200^\circ$       (D)  $1440^\circ$       (E)  $1800^\circ$



**29.** The mapping  $f: Z \rightarrow Z$  fulfils the conditions  $f(4) = 6$  and  $xf(x) = (x - 3)f(x + 1)$ . What is the value of the expression  $f(4) \times f(7) \times f(10) \times \dots \times f(2011) \times f(2014)$ ?

- (A) 2013      (B) 2014      (C) 2013·2014      (D) 2013!      (E) 2014!

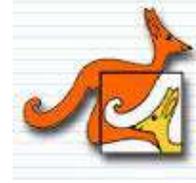
**30.** In the forests of a magical island kingdom there are three kinds of animals: lions, wolves and goats. Wolves can eat goats and lions can eat wolves as well as goats. Since it is a magical island kingdom, the wolf that eats a goat changes into a lion. A lion that eats a goat changes into a wolf and a lion that eats a wolf changes into a goat. To begin with there were 17 goats, 55 wolves and 6 lions on the island. After some time no more eating is possible. How big is the maximum amount of animals that can still be on the island?

- (A) 1      (B) 6      (C) 17      (D) 23      (E) 35

**2014**

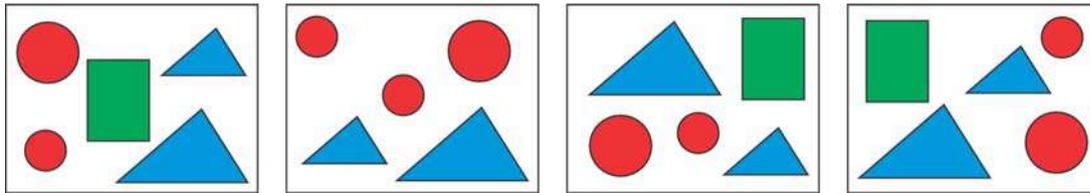
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
<b>Felix</b>	B	A	D	D	B	B	C	A	E	B	D	D	D	D	A															
<b>Écolier</b>	D	D	A	D	A	E	E	B	E	C	E	D	C	B	B	B	B	C	B	C	A	D	D	D						
<b>Benjamin</b>	C	D	D	A	A	D	B	B	B	B	D	B	B	D	A	D	E	A	E	A	E	D	B	E						
<b>Kadett</b>	D	D	A	B	E	E	B	E	B	D	E	B	C	E	E	C	B	E	D	A	E	D	B	D	C	A	B	C	A	B
<b>Junior</b>	B	A	E	A	C	A	B	B	E	C	C	C	B	D	A	E	E	C	D	C	D	D	D	B	C	C	B	E	B	C
<b>Student</b>	C	C	B	C	E	E	E	D	D	C	A	B	B	C	D	A	B	C	E	D	D	A	E	A	D	A	C	B	D	D

Mathematical Kangaroo 2015  
 Group Felix (Grades 1 and 2)  
 Austria – 23. 3. 2015



- 3 point questions -

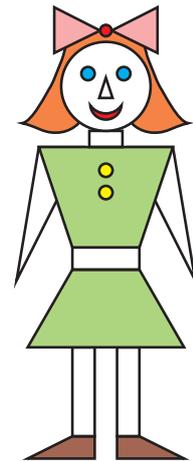
1. Which shape cannot be seen in every picture?



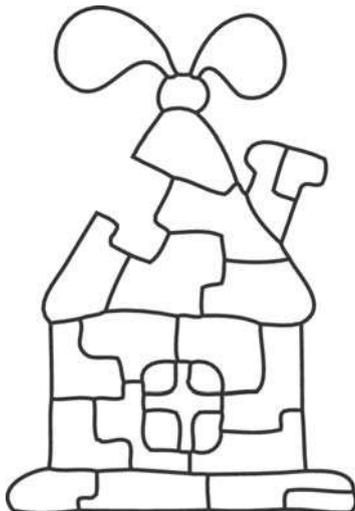
- (A)  (B)  (C)  (D)  (E) 

2. How many triangles can you find in the picture?

- (A) 7 (B) 6 (C) 5 (D) 4 (E) 3



3. Which part of the house is missing?



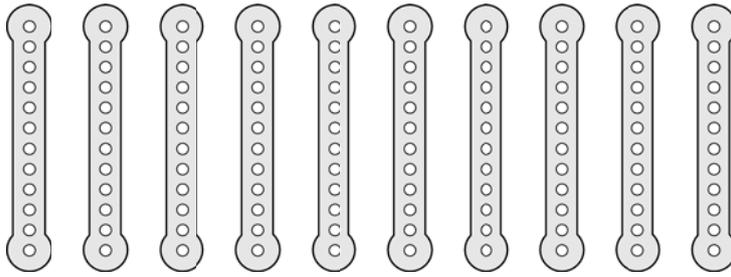
- (A)  (B)  (C)  (D)  (E) 

4. How many dots do all ladybirds have together?

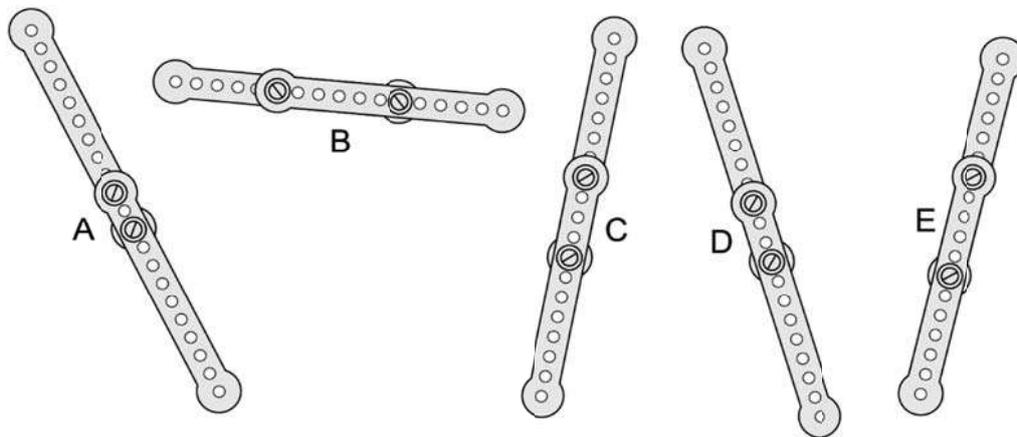
- (A) 17 (B) 18 (C) 19 (D) 20 (E) 21



5. Florian has 10 equally long metal strips with equally many holes.



He bolts the metal strips together in pairs. Now he has five long strips (see the diagram).



Which of the long strips is the shortest?

- (A) A      (B) B      (C) C      (D) D      (E) E

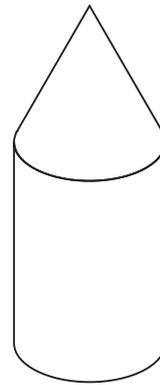
- 4 point questions -

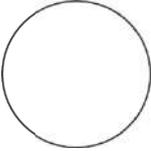
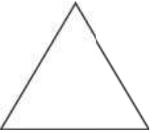
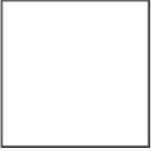
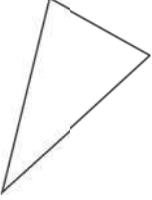
6. Which of the kangaroo cards shown below can be turned around so that it then looks the same as the card shown on the right?



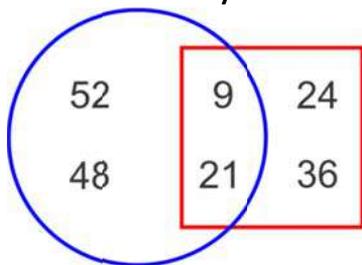
- (A) (B) (C) (D) (E)

7. What do you see if you look at the tower, which is made up of two building blocks, exactly from above?



- (A)  (B)  (C)  (D)  (E) 

8. How many numbers are outside the square?

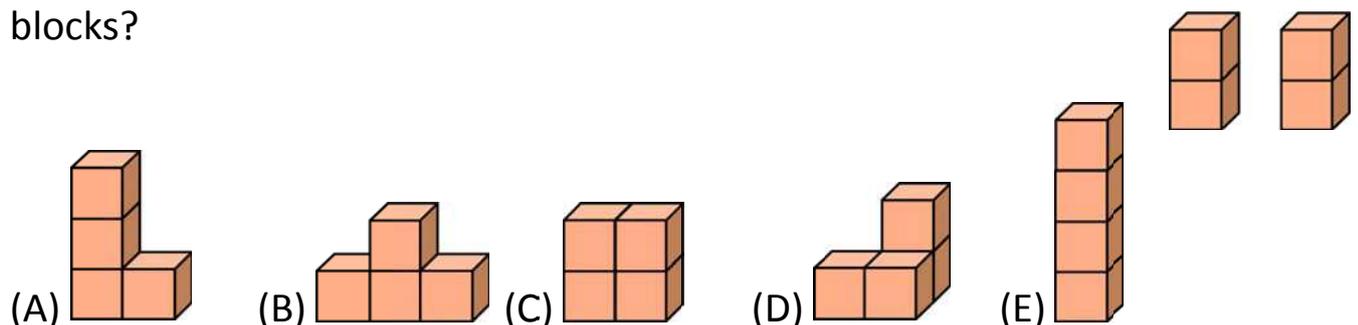


- (A) 6 (B) 5 (C) 4 (D) 3 (E) 2

9. It takes Jennifer half an hour to cover half of her journey home from school. How long does it take her to cover the whole journey home?

- (A) 15 minutes (B) 30 minutes (C) 40 minutes  
(D) 1 hour (E) 2 hours

10. Michael has two building blocks. Each building block is made up of two cubes glued together. Which figure can he not make using the blocks?

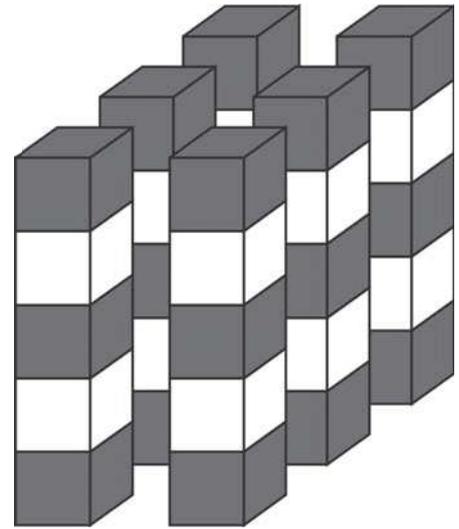


- 5 point questions -

11. Julia has 9 sweets and Katharina has 17 sweets. How many sweets does Katharina have to give to Julia so that they both have the same amount of sweets?

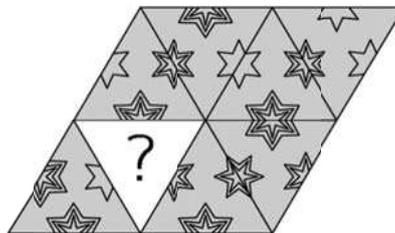
- (A) 2            (B) 3            (C) 4            (D) 5            (E) 6

12. Every one of these six building blocks consists of 5 little cubes. The little cubes are either white or grey. Cubes of equal colour don't touch each other. How many little white cubes are there in total?



- (A) 10    (B) 11    (C) 12    (D) 18    (E) 30

13. Which piece is missing?



- (A) (B) (C) (D) (E)

14. 11 Flags are placed alongside a straight race course. The first flag is at the start, the last one at the finish. The distance between two flags is always 8 meters. How long is the race course?

- (A) 24 meters (B) 48 meters (C) 72 meters (D) 80 meters (E) 88 meters

15. Some pirates are climbing onto a ship one after the other using a rope. Their leader is exactly in the middle. He is the eighth pirate to climb onto the ship. How many pirates board the ship?

- (A) 16            (B) 15            (C) 12            (D) 8            (E) 7

# Mathematical Kangaroo 2015

## Group Ecolier (Grade 3 and 4)

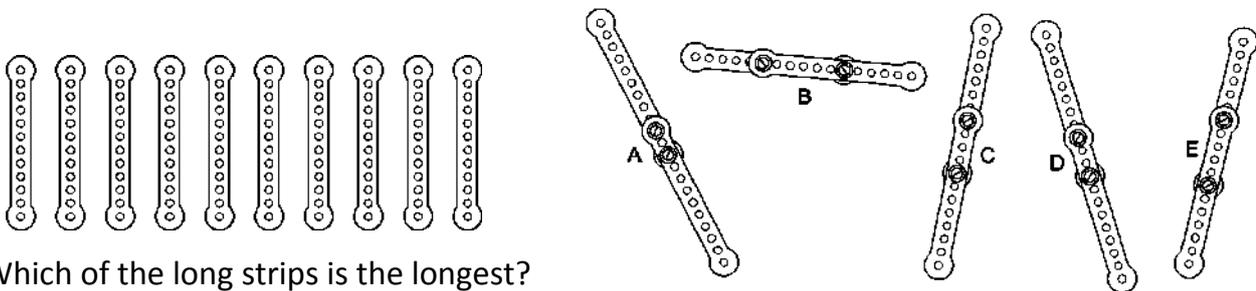
### Austria – 23. 3. 2015



3 point questions

1.  $2 - 0 \rightarrow \quad + 1 \rightarrow \quad \times 5 \rightarrow ?$
- (A) 6      (B) 7      (C) 8      (D) 10      (E) 15

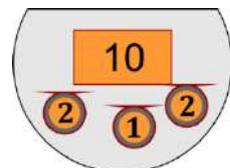
2. Florian has 10 identical metal strips, each with the same amount of holes (picture on the left). He bolts these strips in pairs. That way he gets the 5 long strips in the picture on the right.



Which of the long strips is the longest?

- (A) A      (B) B      (C) C      (D) D      (E) E

3. In kangaroo land you pay with “Kangas”. Lucy has a few Kangas in her purse. She buys a ball and pays 7 Kangas. How many Kangas does she have left over, after she has paid for the ball?



- (A)      (B)      (C)      (D)      (E)

4. If you multiply both digits of the number 35, you get 15. How big is the sum of both digits?
- (A) 2      (B) 4      (C) 6      (D) 7      (E) 8

5. Which number is hidden behind the square?
- (A) 2      (B) 3      (C) 4      (D) 5      (E) 6

$$\color{red}\blacktriangle + 4 = 7$$

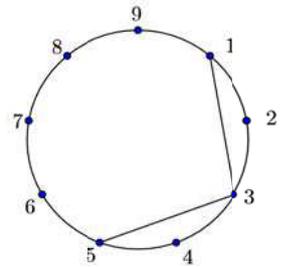
$$\color{blue}\blacksquare + \color{red}\blacktriangle = 9$$

6. The word Kangaroo is written on the top of my umbrella. Which of the 5 pictures shows my umbrella

- (A)      (B)      (C)      (D)      (E)



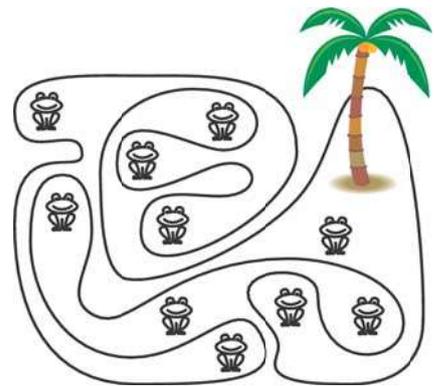
7. 9 points, numbered 1 to 9 are marked on a circle. Point 1 is joined to point 3, 3 to 5. Continue the drawing, always joining to the next but one point along. Which drawing do you get if you keep going until you get back to point 1?



- (A) (B) (C) (D) (E)

8. In the diagram you can see a very ragged island. Some of the frogs are sitting in the water. How many are sitting on the island?

- (A) 5 (B) 6 (C) 7 (D) 8 (E) 9



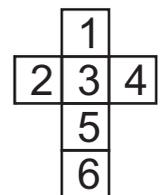
- 4 point questions -

9. Luis has got 7 apples and 2 bananas. He gives 2 apples to his friend Jacob, who gives him bananas in return. Afterwards Luis has got the same amounts of apples as bananas. How many bananas did Luis get from Jacob?

- (A) 2 (B) 3 (C) 4 (D) 5 (E) 7

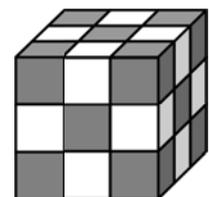
10. Julia folds the paper net pictured on the right, into a cube. Which number is on the face that is opposite to the face with the number 3?

- (A) 1 (B) 2 (C) 4 (D) 5 (E) 6



11. Jack makes a cube from 27 small cubes. The small cubes are either grey or white as shown in the diagram. Two small cubes with the same colour are not allowed to be placed next to each other. How many small, white cubes has Jack used?

- (A) 10 (B) 12 (C) 13 (D) 14 (E) 15



12. 10 runners start in a running race. At the finish, there are 3 more runners behind Thomas than there are in front of him. In which position did Thomas finish?

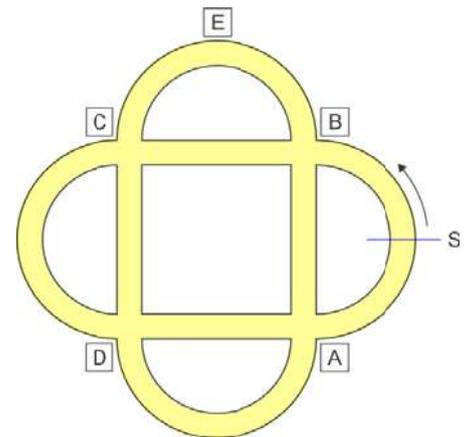
- (A) 1 (B) 3 (C) 4 (D) 6 (E) 7

13. Joseph has got a toy car, a teddy bear, a ball and a ship. He wants to put them in a new order on the shelf. The ship must be next to the car, and the teddy bear should also be next to the car. In how many different orders can he put the toys on the shelf?

- (A) 2      (B) 4      (C) 5      (D) 6      (E) 8

14. Peter rides his bike along a cycle path in a park. He starts at point S and rides in the direction of the arrow. At the first crossing he turns right, then at the next left, and then again to the right and then again to left. Which crossing does he not reach?

- (A) A      (B) B      (C) C      (D) D      (E) E



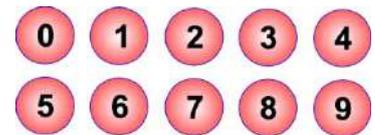
15. Two of the 5 ladybirds in the picture are always friends with each other if the difference between their number of dots is exactly 1. Today every ladybird has sent an SMS to each of their friends. How many SMS messages were sent?

- (A) 2      (B) 4      (C) 6      (D) 8      (E) 9



16. There are 10 balls, numbered 0 to 9 in a basket. John and George play a game. Each person is allowed to take three balls from the basket and calculate the total of the numbers on the balls. What is the biggest possible difference between the John and Georges totals?

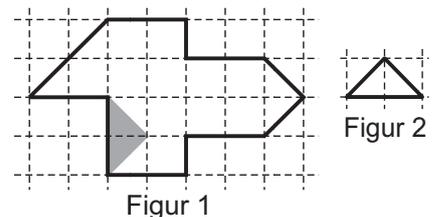
- (A) 1      (B) 12      (C) 18      (D) 19      (E) 21



- 5 point questions -

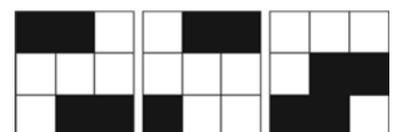
17. Luca wants to cut the shape in figure 1 into equally sized small triangles (like those in figure 2). One of these triangles is already drawn on figure 1. How many of these triangles will he get?

- (A) 8      (B) 12      (C) 14      (D) 15      (E) 16

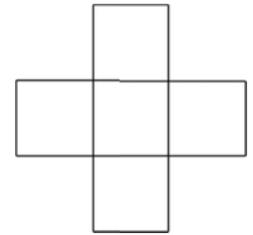


18. Some of the small squares on each of the square transparencies have been coloured black. If you slide the three transparencies on top of each other, without lifting them from the table, a new pattern can be seen. What is the maximum number of black squares which could be seen in the new pattern?

- (A) 5      (B) 6      (C) 7      (D) 8      (E) 9



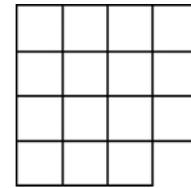
19. The numbers 1, 2, 3, 4 and 9 are written into the squares on the following figure. The sum of the three numbers in the horizontal row, should be the same as the sum of the three numbers in the vertical column. Which number is written in the middle?



- (A) 1      (B) 2      (C) 3      (D) 4      (E) 9

20. The shape in the picture is to be split into three identical pieces.

What does one of these pieces look like?



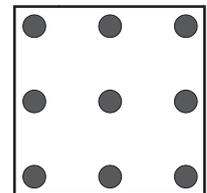
- (A) (B) (C) (D) (E) (E)

21. Which picture shows a single large loop?

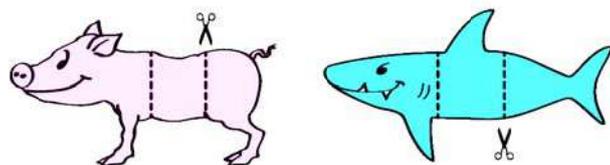
- (A) (B) (C) (D) (E)

22. In this square there are 9 dots. The distance between the points is always the same. You can draw a square by joining 4 points. How many different sizes can such squares have?

- (A) 0      (B) 1      (C) 2      (D) 3      (E) 4



23. Thomas drew a pig and a shark. He cuts each animal into three pieces. Then he takes one of the two heads, one of the two middle sections and one of the two tails and lays them together to make another animal. How many different animals can he make in this way?



- (A) 2      (B) 3      (C) 4      (D) 5      (E) 8

24. Anna, Berta, Charlie, David and Elisa baked biscuits at the weekend. Anna baked 24, Berta 25, Charlie 26, David 27 and Elisa 28 biscuits. By the end of the weekend one of the children had twice as many, one 3 times, one 4 times, one 5 times and one 6 times as many biscuits as on Saturday. Who baked the most biscuits on Saturday?

- (A) Anna      (B) Berta      (C) Charlie      (D) David      (E) Elisa

# Mathematical Kangaroo 2015

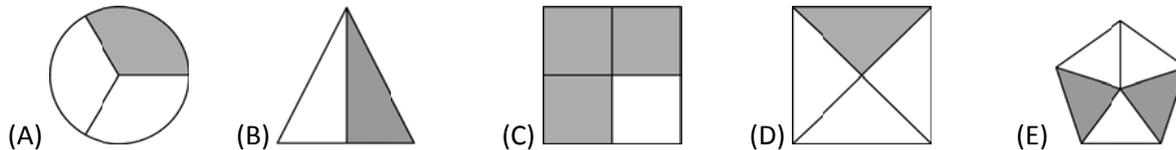
## Group Benjamin (Grade 5 and 6)

### Austria - 23. 3. 2015



- 3 point questions -

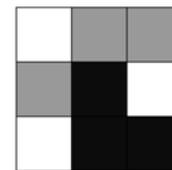
1. In which shape is exactly one half coloured grey?



2. The word KANGAROO is written on the top side of my umbrella. Which of the following pictures does not show my umbrella?



3. Sam paints the 9 small squares in the shape either white, grey or black. What is the minimum number he must paint over so that no two squares sharing a side have the same colour?

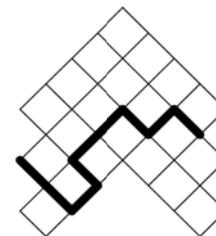


- (A) 2      (B) 3      (C) 4      (D) 5      (E) 6

4. Mr Bauer has 10 ducks. 5 of these ducks lay an egg every day. The other 5 lay an egg every second day. How many eggs will the 10 ducks have laid after 10 days?

- (A) 75      (B) 60      (C) 50      (D) 25      (E) 10

5. Each square in the shape has an area of  $4 \text{ cm}^2$ . How long is the thick line?

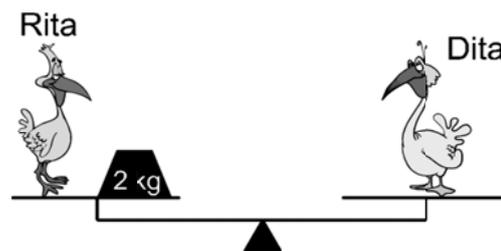
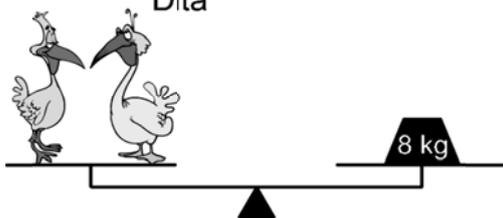


- (A) 16 cm      (B) 18 cm      (C) 20 cm      (D) 21 cm      (E) 23 cm

6. Which of the following fractions is smaller than 2?

- (A)  $\frac{19}{8}$       (B)  $\frac{20}{9}$       (C)  $\frac{21}{10}$       (D)  $\frac{22}{11}$       (E)  $\frac{23}{12}$

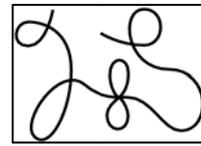
7. Rita      Dita



How much does Dita weigh?

- (A) 2 kg      (B) 3 kg      (C) 4 kg      (D) 5 kg      (E) 6 kg

8. Peter looks at the picture hanging on the wall in more detail through a magnifying glass. Which section can he not see?



- (A) (B) (C) (D) (E)

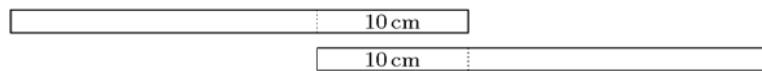
- 4 point questions -

9. Each plant in Johns garden has exactly 5 leaves or exactly 2 leaves and a flower. In total the plants have 6 flowers and 32 leaves. How many plants are growing in the garden?

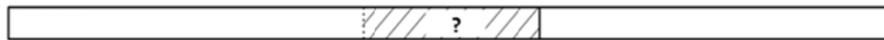


- (A) 10 (B) 12 (C) 13 (D) 15 (E) 16

10. Andrea has 4 equally long strips of paper. When she glues two together with an overlap of 10cm, she gets a strip 50cm long.

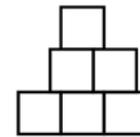


With the other two she wants to make a 56cm long strip. How long must the overlap be?



- (A) 4 cm (B) 6 cm (C) 8 cm (D) 10 cm (E) 12 cm

11. Thomas has made the following shape with 6 squares of side length 1. What is the perimeter of the shape?

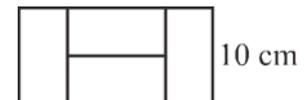


- (A) 9 (B) 10 (C) 11 (D) 12 (E) 13

12. Each day Maria writes down the date and then adds together the individual digits. For instance today on the 23<sup>rd</sup> March she writes 23. 03. and calculates  $2 + 3 + 0 + 3 = 8$ . What is the largest total she make in this way in the course of a year?

- (A) 7 (B) 13 (C) 14 (D) 16 (E) 20

13. A rectangle is formed from 4 equally sized smaller rectangles. The shorter side is 10cm long. How long is the longer side?



- (A) 40 cm (B) 30 cm (C) 20 cm (D) 10 cm (E) 5 cm

14. In Field street there are 9 houses in a row. At least one person lives in each house. Each pair of neighbouring houses have at most 6 inhabitants. What is the maximum number of people living in Field street?

- (A) 23 (B) 25 (C) 27 (D) 29 (E) 31

15. Lucy and her mother were both born in January. Today on 23<sup>rd</sup> March 2015 Lucy adds together her year of birth, that of her mother, her age and that of her mother. Which answer does she get?

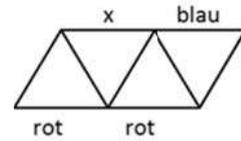
- (A) 4028 (B) 4029 (C) 4030 (D) 4031 (E) 4032

16. A rectangle has area  $12 \text{ cm}^2$ . The lengths of the sides are natural numbers. Which perimeter could the rectangle have?

- (A) 20 cm (B) 26 cm (C) 28 cm (D) 32 cm (E) 48 cm

**- 5 point questions -**

**17.** Each of the 9 sides of the triangles in the picture will be coloured blue, green or red. Three of the sides are already coloured. Which colour can side x have, if the sides of each triangle must be coloured in three different colours?

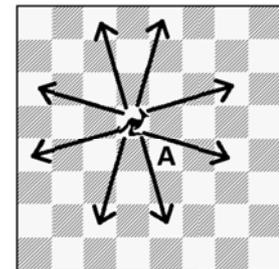


- (A) only blue      (B) only green      (C) only red  
 (D) Each of the three colours is possible.      (E) The colouring described is not possible

**18.** 3 green apples, 5 yellow apples, 7 green pears and 2 yellow pears are in a sack. Without looking, Sebastian takes either an apple or pear out of the sack. How many pieces of fruit must he take out of the sack to be sure of having at least one apple and one pear of the same colour?

- (A) 9      (B) 10      (C) 11      (D) 12      (E) 13

**19.** For the game of Chess a new piece, the Kangaroo, has been invented. With each jump the kangaroo jumps either 3 squares vertically and 1 horizontally, or 3 horizontally and 1 vertically, as pictured. What is the smallest number of jumps the kangaroo must make to move from its current position to position A?

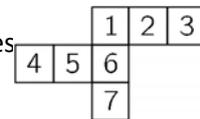


- (A) 2      (B) 3      (C) 4      (D) 5      (E) 6

**20.** Sarah bought three books. For the first book she paid half of her money plus 1 Euro more. For the second book she paid again half of her left-over money plus 2 Euro's more. For the third book she paid again half of her left-over money plus 3 Euro's more. After which she had spent all of her money. How much money did she have to begin with?

- (A) 45 €      (B) 36 €      (C) 34 €      (D) 33 €      (E) 30 €

**21.** Nina wants to make a cube from the paper net. You can see there are 7 squares instead of 6. Which square(s) can she remove from the net, so that the other 6 squares remain connected and from the newly formed net a cube can be made?

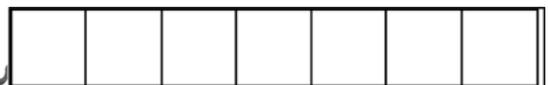


- (A) only 4      (B) only 7      (C) only 3 or 4      (D) only 3 or 7      (E) only 3, 4 or 7

**22.** A train has 12 carriages. In each carriage there is the same number of compartments. Mike is sitting in the 18<sup>th</sup> compartment behind the engine, this is in the 3<sup>rd</sup> carriage. Joanna is sitting in the 50<sup>th</sup> compartment behind the engine, this is in the 7<sup>th</sup> carriage. How many compartments are in one carriage?

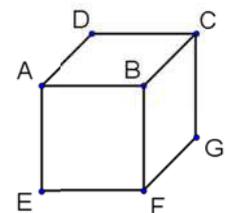
- (A) 7      (B) 8      (C) 9      (D) 10      (E) 12

**23.** In how many ways can the three kangaroos be placed in three different squares so that no kangaroo has an immediate neighbour?



- (A) 7      (B) 8      (C) 9      (D) 10      (E) 11

**24.** Maria writes a number on each face of the cube. Then, for each corner point of the cube, she adds the numbers on the faces which meet at that corner. (For corner B she adds the numbers on faces BCDA, BAEF and BFGC.) In this way she gets a total of 14 for corner C, 16 for corner D, and 24 for corner E. Which total, does she get for corner F?



- (A) 15      (B) 19      (C) 22      (D) 24      (E) 26

# Mathematical Kangaroo 2015

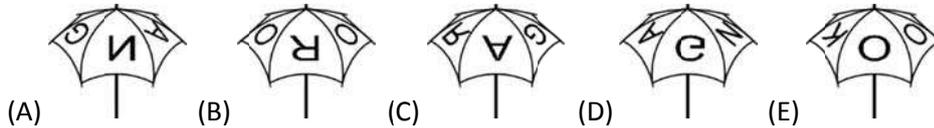
## Group Kadett (Grades 7 and 8)

### Austria - 23. 3. 2015



#### - 3 point questions -

1. The word KANGAROO is written on the top of my umbrella.  
Which of the following pictures shows my umbrella?



2. A rectangle is made of 4 equally sized, small rectangles. The smaller side has side length 10 cm. How long is the longer side?

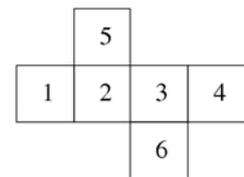


(A) 10 cm (B) 20 cm (C) 30 cm (D) 40 cm (E) 50 cm

3. Which of the following numbers is closest to the product of  $2 \cdot 015 \times 510 \cdot 2$ ?

(A) 0,1 (B) 1 (C) 10 (D) 100 (E) 1000

4. The diagram shows the net of a cube whose faces are numbered. Sascha adds the numbers that are on opposite faces of the cube. Which three results does he get?



(A) 4, 6, 11 (B) 4, 5, 12 (C) 5, 6, 10 (D) 5, 7, 9 (E) 5, 8, 8

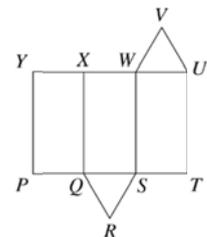
5. Which of the following fractions is not a whole number?

(A)  $\frac{2011}{1}$  (B)  $\frac{2012}{2}$  (C)  $\frac{2013}{3}$  (D)  $\frac{2014}{4}$  (E)  $\frac{2015}{5}$

6. The drive from A-village to B-town via C-house takes 130 minutes. The drive from A-village to C-house takes 35 minutes. How many minutes does a drive from C-house to B-town take?

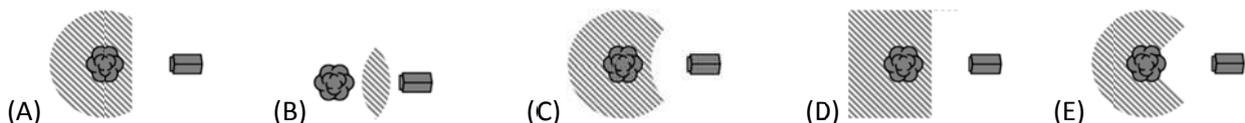
(A) 95 (B) 105 (C) 115 (D) 165 (E) 175

7. The diagram shows the net of a three-sided prism. Which line of the diagram forms an edge of the prism together with line UV when the net is folded up?

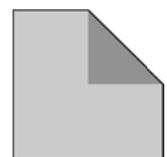


(A) WV (B) XW (C) XY (D) QR (E) RS

8. When Simon the squirrel comes down from his tree onto the floor, he never moves further than 5 m away from the trunk of his tree. Furthermore, he stays at least 5 m away from the dog kennel. Which picture shows most accurately the area in which Simon can be found?



9. One corner of a square piece of paper is folded into the middle of the square. That way an irregular pentagon is created. The numerical values of the areas of the Pentagon and the square are consecutive whole numbers. What is the area of the square?



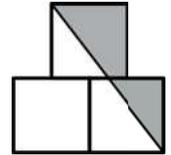
(A) 2 (B) 4 (C) 8 (D) 16 (E) 32

10. The side lengths of a triangle are 6, 10 and 11. An equilateral triangle has the same perimeter as this triangle. How long is one side of the equilateral triangle?

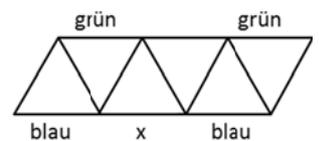
(A) 18 (B) 11 (C) 10 (D) 9 (E) 6

**- 4 point questions -**

11. A cyclist covers a distance of 5 m in one second. The wheels of his bike each have a circumference of 125 cm. How many complete turns does each wheel do in 5 seconds?  
 (A) 4            (B) 5            (C) 10            (D) 20            (E) 25
12. All the boys in a class are born on different days of the week and all the girls are born in different months. If one new girl or boy joins this class, this is definitely no longer true. How many teenagers are in this class?  
 (A) 18            (B) 19            (C) 20            (D) 24            (E) 25
13. The diagram consists of three squares each one of side length 1. The midpoint of the topmost square is exactly above the common side of the two other squares. What is the area of the section coloured grey?  
 (A)  $\frac{3}{4}$             (B)  $\frac{7}{8}$             (C) 1            (D)  $1\frac{1}{4}$             (E)  $1\frac{1}{2}$
14. Each star in the equation  $2 * 0 * 1 * 5 * 2 * 0 * 1 * 5 * 2 * 0 * 1 * 5 = 0$  should be replaced by either "+" or "-" so that the equation is correct. What is the smallest number of stars that can be replaced by "+"?  
 (A) 1            (B) 2            (C) 3            (D) 4            (E) 5
15. During a thunder storm it rained 15 liters per square meter. By how much did the water level of an outdoor swimming pool increase?  
 (A) 150 cm    (B) 0,15 cm    (C) 15 cm            (D) 1,5 cm  
 (E) It depends on the size of the swimming pool.



16. A bush has 10 twigs. Each twig has exactly 5 leaves or exactly 2 leaves and a flower. Which of the following numbers could be the total number of leaves on the bush?  
 (A) 45            (B) 39            (C) 37            (D) 31            (E) None of the numbers from (A) to (D)
17. The 10 participants of a test achieve on average 6 points. Exactly 6 of the participants passed the test. The average of the participants that passed the test was 8 points. What is the average of the participants that did not pass the test?  
 (A) 1            (B) 2            (C) 3            (D) 4            (E) 5



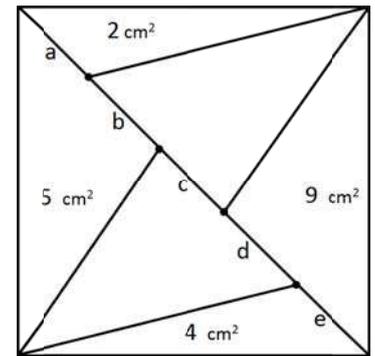
18. Each side of each triangle in the diagram is painted either blue, green or red. Four of the sides are already painted. Which colour can the line marked „x" have, if each triangle must have all sides in different colours?  
 (A) only green    (B) only red    (C) only blue    (D) either red or blue    (E) The question cannot be solved.
19. Eva added the lengths of three sides of a rectangle and obtained 44 cm. Ulli also added the lengths of three sides of the same rectangle and obtained 40 cm. What is the perimeter of the rectangle?  
 (A) 42 cm    (B) 56 cm    (C) 64 cm    (D) 84 cm    (E) 112 cm
20. The teacher asks five of her students, how many of them had studied the previous day. Azra says: "Nobody." Berti says: "Only one." Christa says: "Exactly two." Doris says: "Exactly three." Emina says: "Exactly four." The teacher knows that students always lie if they haven't studied and are always truthful when they have studied. How many of those students had studied the previous day?  
 (A) 0            (B) 1            (C) 2            (D) 3            (E) 4

**- 5 point questions -**

21. In a group of kangaroos the two lightest ones weigh 25 % of the total weight of the whole group. The three heaviest ones weigh 60 % of the total weight. How many kangaroos are in this group?  
 (A) 6            (B) 7            (C) 8            (D) 15            (E) 20

22. Five positive whole numbers, which are not necessarily all different, are written on five cards. Peter calculates the sum of each pair of cards. He obtains only three different results, namely 57, 70 and 83. What is the biggest number that is written on one of the cards?

(A) 35            (B) 42            (C) 48            (D) 53            (E) 82

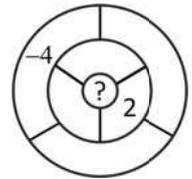


23. A square with area 30 is split into two by its diagonal and then split into triangles as shown in the diagram. Some of the areas of the triangles are given in the diagram. Which of the line segments a, b, c, d, e of the diagonal is the longest?

(A) a            (B) b            (C) c            (D) d            (E) e

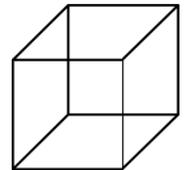
24. Riki wants to write one number in each of the seven sections of the diagram pictured. Two zones are adjacent if they share a part of their outline. The number in each zone should be the sum of all numbers of its adjacent zones. Riki has already placed numbers in two zones. Which number does she need to write in the zone marked „?“.

(A) 1            (B) -2            (C) 6            (D) -4            (E) 0



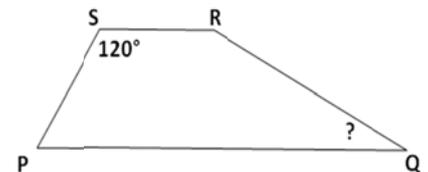
25. Florian has seven pieces of wire of lengths 1 cm, 2 cm, 3 cm, 4 cm, 5 cm, 6 cm and 7 cm. He uses some of those pieces to form a wire model of a cube with side length 1. He does not want any overlapping wire parts. What is the smallest number of wire pieces that he can use?

(A) 1            (B) 2            (C) 3            (D) 4            (E) 5



26. In the trapezium PQRS the sides PQ and SR are parallel. Also  $\angle RSP = 120^\circ$  and  $\overline{RS} = \overline{SP} = \frac{1}{3}\overline{PQ}$ . What is the size of angle  $\angle PQR$ ?

(A)  $15^\circ$             (B)  $22.5^\circ$             (C)  $25^\circ$             (D)  $30^\circ$             (E)  $45^\circ$



27. On a straight line there are five points. Alex measures all the distances between every possible pair of points. He obtains in ascending order 2, 5, 6, 8, 9, k, 15, 17, 20 and 22. What is the value of k?

(A) 10            (B) 11            (C) 12            (D) 13            (E) 14

28. I have noted down six digits of Erich's seven-digit phone number in the correct order. I don't know which digit I have missed out and where I have missed it out. What is the maximum number of tries that I have to make to be sure that I have used the correct phone number? (Note: The first digit could also be 0!)

(A) 55            (B) 60            (C) 64            (D) 70            (E) 80

29. Maria divides 2015 by 1. Then she divides 2015 by 2 and then in order by 3, 4 etc. up to and including 1000. For each division she writes down the remainder. What is the biggest remainder she has noted down?

(A) 15            (B) 215            (C) 671            (D) 1007            (E) another value

30. Each positive whole number is coloured in according to the following three rules:

- (i) Each number is either red or green.
- (ii) The sum of two different red numbers results in a red number.
- (iii) The sum of two different green numbers is a green number.

How many ways are there to do this?

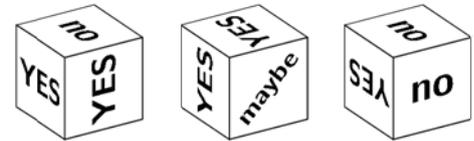
(A) 0            (B) 2            (C) 4            (D) 6            (E) there are more than six ways



10. A pentagon is called convex if all its internal angles are less than  $180^\circ$ . The number of right angles in a convex pentagon is  $n$ . Which of the following lists is a complete listing of all possible values of  $n$ ?  
 (A) 1, 2, 3      (B) 0, 1, 2, 3, 4      (C) 0, 1, 2, 3      (D) 0, 1, 2      (E) 1, 2

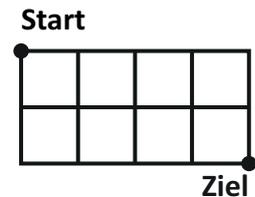
- 4 point questions -

11. In the diagram one can see my decision-die in three different positions. What is the probability I get a „YES“, when rolling this die once.



- (A)  $\frac{1}{3}$       (B)  $\frac{1}{2}$       (C)  $\frac{5}{9}$       (D)  $\frac{2}{3}$       (E)  $\frac{5}{6}$

12. The side lengths of each of the small squares in the diagram are 1. How long is the shortest path from „Start“ to „Ziel“, if you are only allowed to move along the sides and the diagonals of the squares?



- (A)  $2\sqrt{5}$       (B)  $\sqrt{10} + \sqrt{2}$       (C)  $2 + 2\sqrt{2}$       (D)  $4\sqrt{2}$       (E) 6

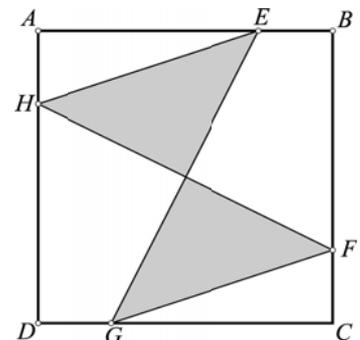
13. Each inhabitant of a distant planet has at least two ears. Three inhabitants called Imi, Dimi and Trimi meet in a trendy crater. Imi says: „I can see 8 ears.“ Dimi then replies: „I can see 7 ears.“ Finally Trimi says: „Strange, I can only see 5 ears.“ None of them can see their own ears. How many ears does Trimi have?

- (A) 2      (B) 4      (C) 5      (D) 6      (E) 7

14. A cuboid shaped container has a square base with side length 10 cm. It is filled up to a height  $h$  with water. Now a metal cube with side length 2 cm is put inside. It sinks to the bottom of the container. The water now reaches to the top corner of the metal cube. Determine  $h$ !

- (A) 1.92 cm      (B) 1.93 cm      (C) 1.90 cm      (D) 1.91 cm      (E) 1.94 cm

15. The square ABCD has area 80. The points E, F, G and H are on the sides of the square and  $AE = BF = CG = DH$ .



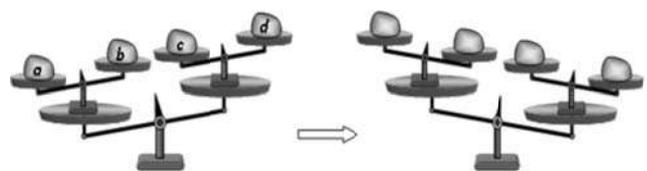
How big is the area of the grey part, if  $AE = 3 \times EB$  ?

- (A) 20      (B) 25      (C) 30      (D) 35      (E) 40

16. If the whole number age of a father is multiplied by the whole number age of his son, one obtains 2015. Both are born in the 20<sup>th</sup> century. How big is the age gap between father and son?

- (A) 26      (B) 29      (C) 31      (D) 34      (E) 36

17. Four objects  $a, b, c, d$  are placed on a double balance as shown. Then two of the objects are exchanged, which results in the change of position of the balance as shown. Which two objects were exchanged?



- (A)  $a$  and  $b$       (B)  $b$  and  $d$       (C)  $b$  and  $c$       (D)  $a$  and  $d$       (E)  $a$  and  $c$

18. It is known that the solutions of the quadratic equation  $x^2 - 85x + c = 0$  are prime numbers. What is the digit sum of  $c$ ?

- (A) 12      (B) 13      (C) 14      (D) 15      (E) 21

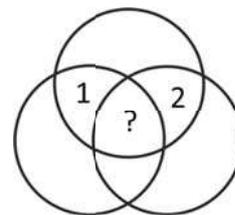
19. How many three-digit positive whole numbers are there, where the digits when placed side by side always differ by 3?

- (A) 12      (B) 14      (C) 16      (D) 20      (E) 27

20. Which value of the variable  $n$  is a counterexample to the statement „If  $n$  is a prime number, then exactly one of the two numbers  $n - 2$  and  $n + 2$  is a prime number.“?
- (A) 11                      (B) 19                      (C) 21                      (D) 29                      (E) 37

**- 5 point questions -**

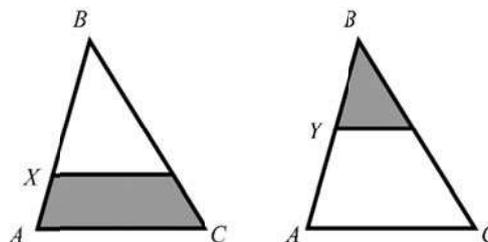
21. In the diagram we can see seven sections which are bordered by three circles. One number is written into each section. It is known that each number is equal to the sum of all the numbers in the adjacent zones. (Two zones are called adjacent if they have more than one corner point in common.) Which number is written into the inner area?
- (A) 0                      (B) -3                      (C) 3                      (D) -6                      (E) 6



22. How many two-digit numbers can be written as sum of exactly six different powers of two? (Hint: Powers of two are  $2^0, 2^1, 2^2, \dots$ )
- (A) 0                      (B) 1                      (C) 2                      (D) 3                      (E) 4

23. Petra has three different dictionaries and two different novels on her bookshelf. In how many different ways can she arrange the books, if all the dictionaries should stay together and likewise the novels as well?
- (A) 12                      (B) 24                      (C) 30                      (D) 60                      (E) 120

24. Lines parallel to the base  $AC$  of triangle  $ABC$  are drawn through  $X$  and  $Y$ . In each case, the areas of the grey parts are equal in size. The ratio  $BX : XA = 4 : 1$  is known. What is the ratio  $BY : YA$ ?
- (A) 1 : 1                      (B) 2 : 1                      (C) 3 : 1                      (D) 3 : 2                      (E) 4 : 3



25. In a right-angled triangle the angle bisector of an acute angle splits the opposite side into segments of length 1 and 2 respectively. How long is this angle bisector?
- (A)  $\sqrt{2}$                       (B)  $\sqrt{3}$                       (C)  $\sqrt{4}$                       (D)  $\sqrt{5}$                       (E)  $\sqrt{6}$

26. A two-digit number with the digits  $x, y$ , can be written in the form  $\overline{xy}$ . Let  $a, b, c$  be different digits. In how many way can the digits  $a, b, c$  be chosen, so that  $\overline{ab} < \overline{bc} < \overline{ca}$ ?
- (A) 84                      (B) 96                      (C) 125                      (D) 201                      (E) 502

27. If one of the numbers  $1, 2, 3, \dots, n - 1, n$ , is crossed out, the average of the remaining numbers is 4.75. Which number was crossed out?
- (A) 5                      (B) 7                      (C) 8                      (D) 9                      (E) The number cannot be determined for certain.

28. The ant Tanti starts an adventure at a vertex of a cube with side length 1. She wants to walk along each edge of the cube at least once and return to the starting point at the end. What is the minimum possible length of her walk?
- (A) 12                      (B) 14                      (C) 15                      (D) 16                      (E) 20

29. Ten different numbers are written down. Each number which is equal to the product of the other nine numbers can then be underlined. What is the maximum amount of numbers that can be underlined?
- (A) 1                      (B) 2                      (C) 3                      (D) 9                      (E) 10

30. Several points are marked on a straight line. Then all possible connecting lines between each two points are drawn. One such point lies within exactly 80 of those connecting lines, and another one lies within exactly 90 of those. How many points were marked on the straight line?
- (A) 20                      (B) 22                      (C) 80                      (D) 90                      (E) Not enough information given to determine an answer.

# Mathematical Kangaroo 2015

## Group Student (Grade 11 and above)

### Austria - 23. 3. 2015



- 3 point questions -

1. Andrea was born sometime in the year 1997 and her sister Charlotte sometime in the year 2001. What is known for certain about the age difference of the two sisters? It is...

- (A) less than 4 years                      (B) at least 4 years                      (C) exactly 4 years  
 (D) more than 4 years                      (E) not less than 3 years

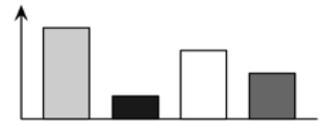
2.  $(a - b)^3 + (b - a)^3 =$

- (A) 0                      (B)  $2(a - b)^3$                       (C)  $2a^3 - 2b^3$                       (D)  $2a^3 + 2b^3$                       (E)  $2a^3 + 6a^2b + 6ab^2 + 2b^3$

3. How many real solutions has the equation  $2^{2x} = 4^{x+1}$  ?

- (A) 0                      (B) infinitely many                      (C) 2                      (D) 1                      (E) 3

4. Diana produces a bar chart which shows the number of four different types of trees which she has counted on a biology trip. Heinz believes that a pie chart would represent the ratio of the different types of trees in a better way. What would the pie chart look like?

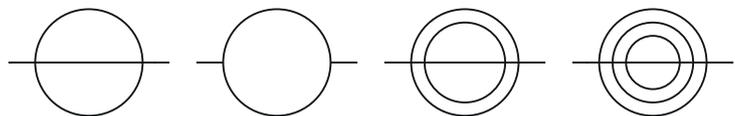


- (A)                      (B)                      (C)                      (D)                      (E)

5. If you add all the whole numbers from 2001 to 2031 and then divide the sum by 31, you get;

- (A) 2012                      (B) 2013                      (C) 2015                      (D) 2016                      (E) 2496

6. How many of the following shapes can be drawn using one continuous line (i.e. without lifting the pencil) and without going over a line twice?



- (A) 0                      (B) 1                      (C) 2                      (D) 3                      (E) 4

7. A quadrilateral is called convex if all its internal angles are less than  $180^\circ$ . The number of right angles in a convex quadrilateral is  $n$ . Which of the following lists is a complete listing of all possible values of  $n$ ?

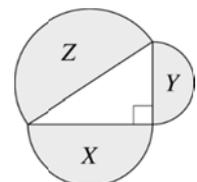
- (A) 0, 1, 2                      (B) 0, 1, 2, 4                      (C) 0, 1, 2, 3, 4                      (D) 0, 1, 3                      (E) 1, 2, 3

8. A drinking glass is made in the shape of a truncated cone. The outside of the glass (without the upper or lower circle) should be covered with coloured paper. How do you need to cut the paper to completely cover the glass without an overlap?



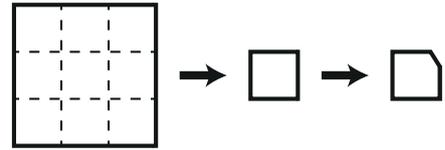
- (A)                      (B)                      (C)                      (D)                      (E)

9. The diameters of three semi-circles form the sides of a right-angled triangle. Their areas are  $X \text{ cm}^2$ ,  $Y \text{ cm}^2$  and  $Z \text{ cm}^2$  as pictured. Which of the following expressions is definitely correct?



- (A)  $X + Y < Z$                       (B)  $\sqrt{X} + \sqrt{Y} = \sqrt{Z}$                       (C)  $X + Y = Z$                       (D)  $X^2 + Y^2 = Z^2$                       (E)  $X^2 + Y^2 = Z$

10. A square bit of paper is folded along the dashed lines in some order and direction. One of the corners of the resulting small square is cut off. The piece of paper is then unfolded. How many holes are on the inner area of the piece of paper?



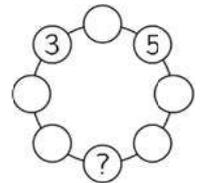
- (A) 0      (B) 1      (C) 2      (D) 4      (E) 9

- 4 point questions -

11.  $\sqrt{(2015 + 2015) + (2015 - 2015) + (2015 \times 2015) + (2015 \div 2015)} =$   
 (A)  $\sqrt{2015}$       (B) 2015      (C) 2016      (D) 2017      (E) 4030

12. The  $x$ -axis and the graphs of  $f(x) = 2 - x^2$  and  $g(x) = x^2 - 1$  split the co-ordinate plane into  
 (A) 7 regions      (B) 8 regions      (C) 9 regions      (D) 10 regions      (E) 11 regions

13 Ella wants to write a number into each circle in the diagram on the right, in such a way that each number is equal to the sum, of its two direct neighbours. Which number does Ella need to write into the circle marked with „?“.



- (A) -5      (B) -16      (C) -8      (D) -3      (E) This question has no solution.

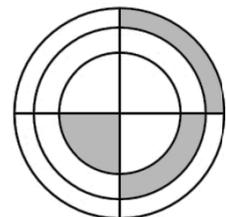
14. We know the following about five positive whole numbers  $a, b, c, d, e$ . All the numbers are different,  $b = c : e$ ,  $d = a + b$  and  $a = e - d$ . Which of the numbers  $a, b, c, d, e$  is the largest?

- (A)  $a$       (B)  $b$       (C)  $c$       (D)  $d$       (E)  $e$

15. The geometric mean of  $n$  numbers is defined as the  $n^{\text{th}}$  root of the product of all  $n$  numbers, that is  $\sqrt[n]{x_1 \cdot x_2 \cdot \dots \cdot x_n}$ . We have six numbers. The geometric mean of three of them is 3, the geometric mean of the other three is 12. How big is the geometric mean of all six numbers?

- (A) 4      (B) 6      (C)  $\frac{15}{2}$       (D)  $\frac{15}{6}$       (E) 36

16. The diagram shows three concentric circles and two perpendicular, common diameters of the three circles. The three grey sections are of equal area, the small circle has radius 1. What is the product of the radii of the three circles?



- (A)  $\sqrt{6}$       (B) 3      (C)  $\frac{3\sqrt{3}}{2}$       (D)  $2\sqrt{2}$       (E) 6

17. In the past 20 years the population of Arnberg has increased by 40%. In the same time span the population of Berghausen has increased by 60%. In total the population of the two villages has increased by 54%. What was the ratio of the populations 20 years ago?

- (A) 10:13      (B) 20:27      (C) 3:7      (D) 7:12      (E) 2:3

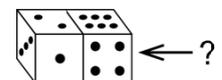
18. Bibi rolls a die which has the numbers 1, 2, 3, 4, 5, 6 on its faces. At the same time Tina rolls a die which has the numbers 2, 2, 2, 5, 5, 5 on its faces. Tina wins if she rolls a number higher than Bibi. What is the probability that Tina wins?

- (A)  $\frac{1}{3}$       (B)  $\frac{7}{18}$       (C)  $\frac{5}{12}$       (D)  $\frac{1}{2}$       (E)  $\frac{11}{18}$

19 There are 2015 marbles in a pipe. They are numbered 1 to 2015. Marbles whose digits add up to the same number, have the same colour and marbles whose digits have a different sum, have a different colour. How many different colours do the marbles in the pipe have?

- (A) 10      (B) 27      (C) 28      (D) 29      (E) 2015

20. On a standard die the sum of the numbers on opposite faces is always 7. Two identical standard dice are shown in the figure. How many dots could there be on the non-visible right-hand face (marked with “?”)?

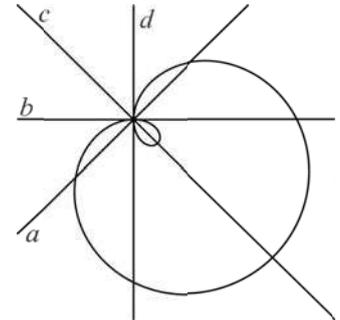


- A) only 5      (B) only 2      (C) either 2 or 5      (D) either 1, 2, 3 or 5      (E) either 2, 3 or 5

**- 5 point questions -**

21. Die Aussagen (A) – (E) werden der Reihe nach auf ihre Wahrheit überprüft. Welche davon ist die erste wahre Aussage?

- (A) (C) is true.                      (B) (A) is true.                      (C) (E) is false.  
 (D) (B) is false.                      (E)  $1 + 1 = 2$



22. The curve in the diagram is defined by the equation

$$(x^2 + y^2 - 2x)^2 = 2(x^2 + y^2)$$

Which of the lines  $a, b, c, d$  is the  $y$ -axis?

- (A)  $a$                       (B)  $b$                       (C)  $c$                       (D)  $d$                       (E) none of them

23. The following table is the multiplication table of the numbers 1 to 10.

What is the sum of all 100 products in the complete table?

- (A) 1000                      (B) 2025                      (C) 2500                      (D) 3025                      (E) 5500

•	1	2	3	...	10
1	1	2	3	...	10
2	2	4	6	...	20
3	3	6	9	...	30
...	...	...	...	...	...
10	10	20	30	...	100

24. How many regular  $n$ -sided shapes are there, whose angles (in degrees) are whole numbers?

- (A) 17                      (B) 18                      (C) 22                      (D) 25                      (E) 60

25. How many three-digit whole numbers can be written as the sum of exactly nine different powers of two? (Hint: Powers of two are  $2^0, 2^1, 2^2, 2^3, \dots$ )

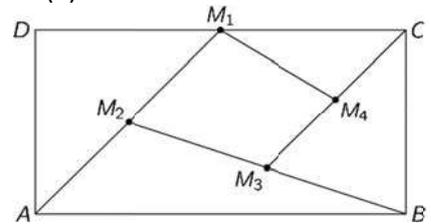
- (A) 1                      (B) 2                      (C) 3                      (D) 4                      (E) 5

26. How many different triangles  $ABC$  whose side lengths are whole numbers are there, if  $\angle ABC = 90^\circ$  and  $AB = 20$ ? (Hint: Two triangles are called different if they are not congruent.)

- (A) 1                      (B) 2                      (C) 3                      (D) 4                      (E) 6

27. In the rectangle  $ABCD$  pictured,  $M_1$  is the midpoint of  $DC$ ,  $M_2$  the midpoint of  $AM_1$ ,  $M_3$  the midpoint of  $BM_2$  and  $M_4$  the midpoint of  $CM_3$ . Determine the ratio of the area of the quadrilateral  $M_1M_2M_3M_4$  to the area of the rectangle  $ABCD$ .

- (A)  $\frac{7}{16}$                       (B)  $\frac{3}{16}$                       (C)  $\frac{7}{32}$                       (D)  $\frac{9}{32}$                       (E)  $\frac{1}{5}$



28. On a board there are blue and red rectangles. Exactly 7 of the rectangles are squares. There are 3 more red rectangles than blue squares. There are also two more red squares than blue rectangles. How many blue rectangles are there on the board?

- (A) 1                      (B) 3                      (C) 5                      (D) 6                      (E) 10

29. The 96 members of a counting club are standing in a circle counting. They start with 1, 2, 3, etc., each person in the circle saying the next number in turn. If a member of the club says an even number, he steps out of the circle. The remaining members continue, starting the second round with 97. They continue in this way until only one member of the club is left. Which number did this person say in round one?

- (A) 1                      (B) 17                      (C) 33                      (D) 65                      (E) 95

30. Independently from each other Bill and Bob substitute the letters in the word KANGAROO with numbers, so that the resulting numbers are multiples of 11. They both substitute different letters with different digits and same letters with the same digits ( $K \neq 0$ ). Bill obtains the biggest possible number and Bob the smallest possible. In both cases one letter is substituted with the same digit. Which digit is that?

- (A) 0                      (B) 3                      (C) 4                      (D) 5                      (E) 6

**2015**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
<b>Felix</b>	D	C	E	C	B	E	A	E	D	B	C	C	A	D	B															
<b>Écolier</b>	E	A	B	E	E	A	E	B	B	E	C	C	B	D	C	E	D	D	E	A	B	D	E	C						
<b>Benjamin</b>	B	C	A	A	B	E	D	E	A	A	D	E	C	D	C	B	C	E	B	C	D	B	D	C						
<b>Kadett</b>	E	B	E	A	D	A	C	C	C	D	D	B	C	B	D	E	C	A	B	B	A	C	D	C	D	D	E	C	C	D
<b>Junior</b>	B	E	B	E	B	C	E	A	D	C	B	C	C	A	B	D	D	B	D	E	A	C	B	D	C	A	B	D	B	B
<b>Student</b>	E	A	A	A	D	D	B	E	C	B	C	D	E	C	B	A	C	C	C	A	D	A	D	C	E	D	C	B	D	D

# Känguru der Mathematik 2016

## Level Felix (Grade 1 and 2)

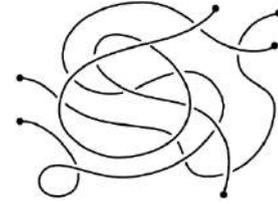
### Österreich – 17. 03. 2016



#### – 3 Points Questions –

1. How many ropes can you see in this picture?

- (A) 2      (B) 3      (C) 4      (D) 5      (E) 6



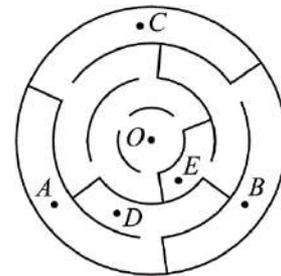
2. In a cave there live a starfish, two seahorses and three turtles. They are visited by three starfish, four turtles and five seahorses.

How many animals are there now in the cave altogether?

- (A) 6      (B) 9      (C) 12      (D) 15      (E) 18

3. Which point in the labyrinth can we get to, starting at point *O*?

- (A) *A*      (B) *B*      (C) *C*      (D) *D*      (E) *E*



4. Ten friends go to Robert's birthday party. Six of which are girls.

How many boys in total are at the party?

- (A) 4      (B) 5      (C) 6      (D) 7      (E) 8

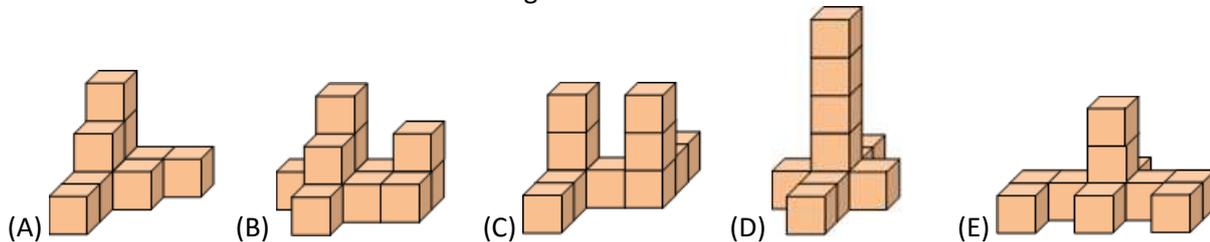
5. Johannes hands out flyers to the houses with the numbers 15 to 47.

How many houses get a flyer?

- (A) 31      (B) 32      (C) 33      (D) 34      (E) 35

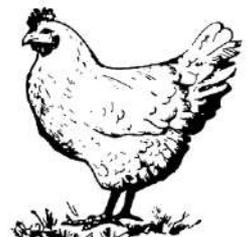
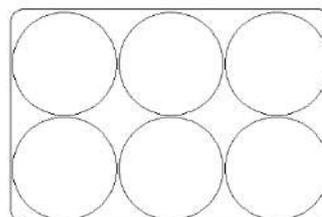
#### – 4 Points Questions –

6. Max has 10 dice. Which one of the following solids can he build with them?



7. A hen lays white and brown eggs.

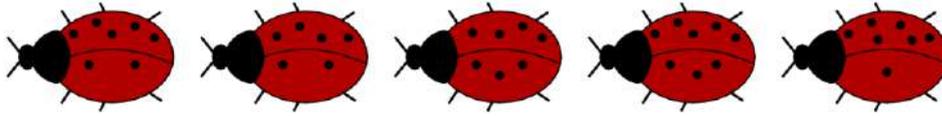
Lisa takes six of them and puts them in a box as shown. The brown eggs are not allowed to touch each other. What is the maximum number of brown eggs Lisa can place in the box?



- (A) 1      (B) 2      (C) 3      (D) 4      (E) 5



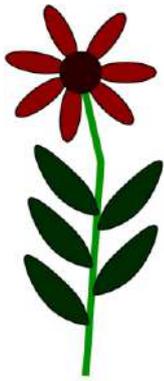
14.



In the picture above five ladybirds can be seen. Each one is sitting on a certain flower. A ladybird is only allowed to sit on a flower if the following conditions are met:

- 1) The difference between the number of points on each wing is equal to the number of leaves on the stem.
- 2) The number of points on the wings of the ladybird is equal to the number of petals on the flower.

Which of the following flowers is without a ladybird?



(A)



(B)



(C)

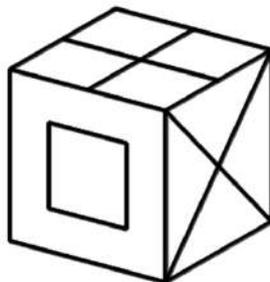
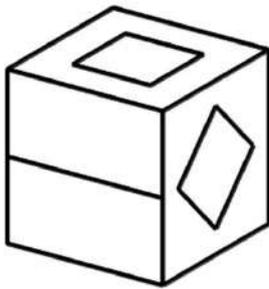


(D)



(E)

15.

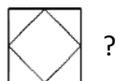


In the picture above we see a cube in two different positions.

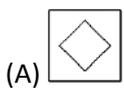
The six sides of the cube look like this:



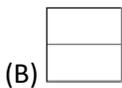
Which side is opposite to



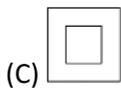
?



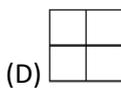
(A)



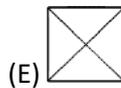
(B)



(C)



(D)



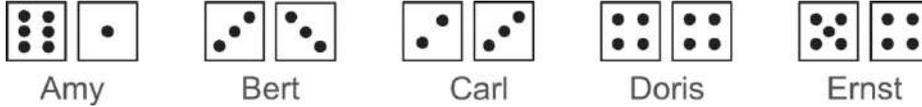
(E)

**Känguru der Mathematik 2016**  
**Level Ecolier (Grade 3 and 4)**  
**Österreich – 17.03.2016**



- 3 Points Questions -

1. Amy, Bert, Carl, Doris and Ernst each throw two dice. Who has got the biggest total altogether?

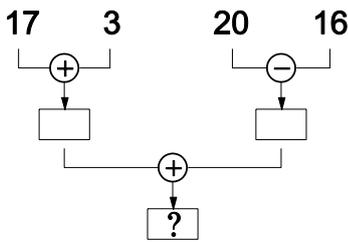


- (A) Amy      (B) Bert      (C) Carl      (D) Doris      (E) Ernst

2. A kangaroo is 7 weeks and 2 days old. In how many days is it 8 weeks old?

- (A) 1      (B) 2      (C) 3      (D) 4      (E) 5

3.



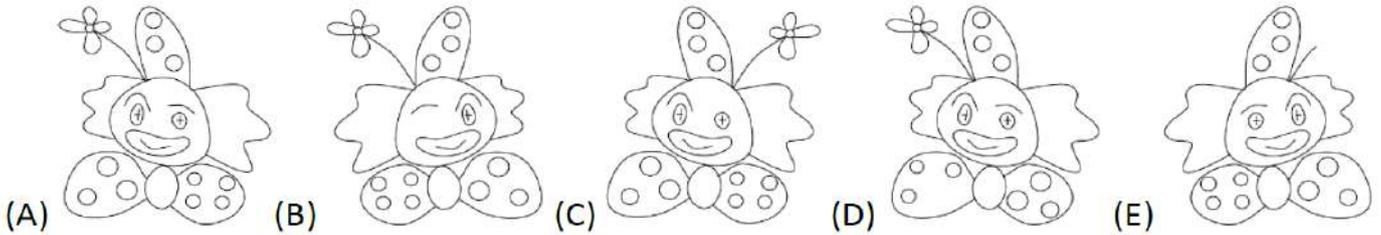
What is the final result?

- (A) 24      (B) 28      (C) 36      (D) 56      (E) 80

4. Clown Pipo looks like this:



He looks at himself in the mirror. Which picture does he see?



5. Georg goes to the circus with his father. They have the seat numbers 71 and 72. Which arrow do they have to follow to get to their seats?

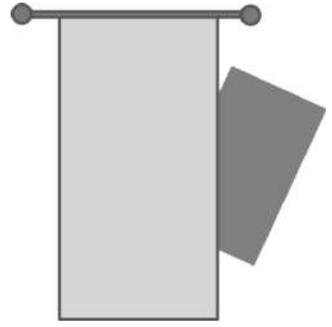
- (A)      (B)      (C)      (D)      (E)

	Seat 1 to 20
	Seat 21 to 40
	Seat 41 to 60
	Seat 61 to 80
	Seat 81 to 100

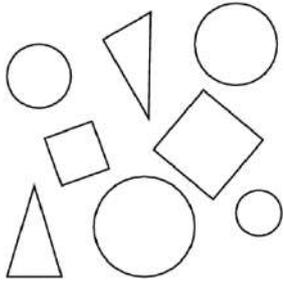
6. Anna has shared her apples fairly between herself and her five girlfriends. Each girl has received half an apple. How many apples did Anna have to start with?

- (A) 2      (B) 3      (C) 4      (D) 5      (E) 6

7. Part of a rectangle is hidden by a curtain. The hidden part is a  
 (A) triangle (B) square (C) hexagon (D) circle (E) rectangle



8. Which of the following sentences fits to the picture?



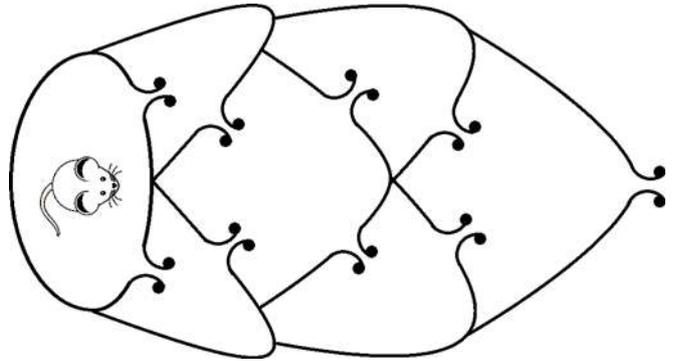
- (A) There are equally many circles as squares.  
 (B) There are fewer circles than triangles.  
 (C) There are twice as many circles as triangles.  
 (D) There are more squares than triangles.  
 (E) There are two more triangles than circles.

- 4 Points Questions -

9. If you add up the digits of the year 2016 ( $2+0+1+6$ ), the result is 9. What is the next year after 2016, for which the sum of the digits is 9 again?

- (A) 2007 (B) 2025 (C) 2034 (D) 2108 (E) 2134

10. A mouse wants to escape a labyrinth. On her way out she is only allowed to go through each opening once at most. How many different ways can the mouse choose to go to get outside?

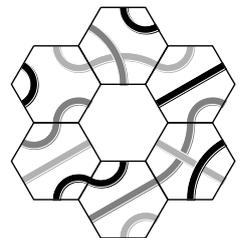


- (A) 2 (B) 4 (C) 5 (D) 6 (E) 7

11. Peter wants to guess Paul's password. He already knows the following: The three last characters are digits. There are at most three capital letters in the password. Which of the following passwords could be Paul's?

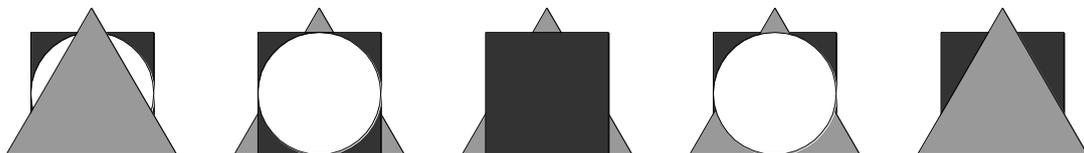
- (A) PAUL123 (B) P0a1u2L3 (C) 1234LLuuaapp4321 (D) Paulin3 (E) 123PAUL

12. In the middle of the big diagram one piece is missing and should be replaced. You are only allowed to do this by connecting light-grey lines with light-grey lines, dark-grey lines with dark-grey lines and black lines with black lines. Which piece fits?



- (A) (B) (C) (D) (E)

13. Five children each have a black square, a grey triangle and a white circle made up of paper. The children place the three shapes on top of each other as seen in the pictures. In how many pictures was the triangles placed after the square?

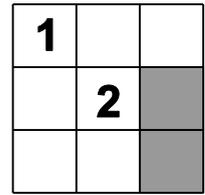


- (A) 0 (B) 1 (C) 2 (D) 3 (E) 4

14. Konrad dries mushrooms. From 4 kg of fresh mushrooms he gets 1 kg of dried mushrooms. How many kilograms of mushrooms does he have to pick in order to receive 4 kg of dried mushrooms?

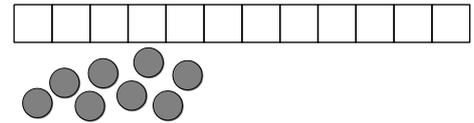
- (A) 12 kg      (B) 16 kg      (C) 20 kg      (D) 25 kg      (E) 50 kg

15. Chantal has placed numbers in two of the nine cells (see diagram). She wants to place the numbers 1, 2, 3 in every row and every column exactly once. How big is the sum of the two numbers in the grey cells?



- (A) 2      (B) 3      (C) 4      (D) 5      (E) 6

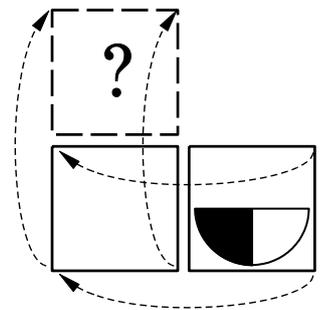
16. Hannes has a game board with 11 spaces. He places one coin each on eight spaces that lie next to each other. He can choose on which space to place his first coin. No matter where Hannes starts some spaces will definitely be filled. How many spaces will definitely be filled?



- (A) 1      (B) 2      (C) 4      (D) 5      (E) 6

- 5 Points Questions -

17. A card has a diagram printed on one side and the other side is plain white. The card is first flipped over to the left and then upwards (see diagram). Which picture do you get this way?



- (A) (B) (C) (D) (E)

18. Tick, Trick and Track are triplets. Their brother Franz is exactly 3 years older. All four children are having their birthdays today. How old can the four brothers be altogether?

- (A) 25      (B) 27      (C) 29      (D) 30      (E) 60

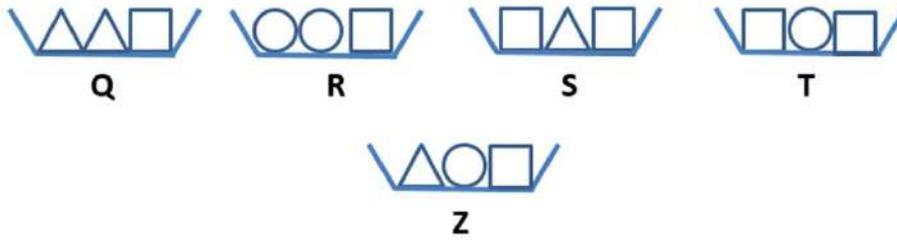
19. In a magic garden there are magic trees. On each tree there are either 6 pears and 3 apples or 8 pears and 4 apples. In total there are 25 apples on the magic trees. How many pears in total are hanging on the magic trees altogether?

- (A) 35      (B) 40      (C) 45      (D) 50      (E) 56

20. Lisa's dogs have 18 more legs than noses. How many dogs does Lisa have?

- (A) 4      (B) 5      (C) 6      (D) 8      (E) 9

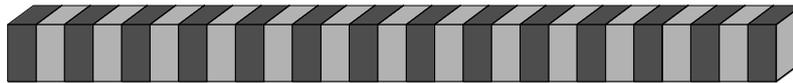
21. Karin wants to place five bowls on a table so that they are ordered according to their weight. She has already placed the bowls Q, R, S and T in order, where Q is lightest and T is heaviest. Where does she have to place bowl Z?



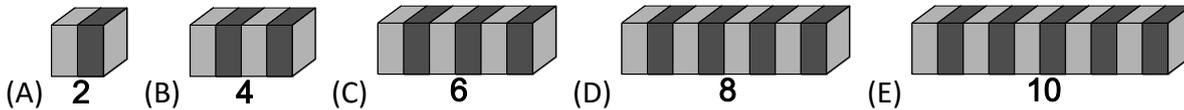
- (A) to the left of bowl Q  
 (B) between bowls Q and R  
 (C) between bowls R and S  
 (D) between bowls S and T  
 (E) to the right of bowl T
22. Eva writes seven numbers on a piece of paper, one of which is 201. She adds up these seven numbers and gets 2016. Now she substitutes the 201 by the number 102 and again adds up the seven numbers. Which result does she get now?

- (A) 1815      (B) 1914      (C) 1917      (D) 2115      (E) 2118

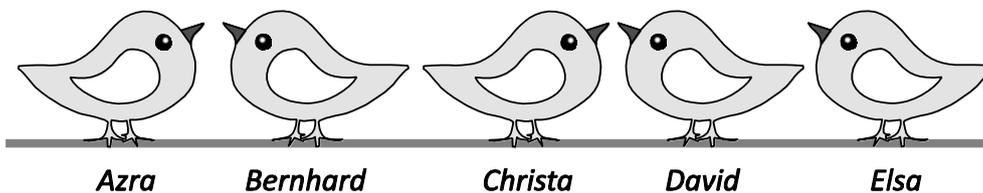
23. Leo has built a stick made up of 27 building blocks.



He splits the stick into two pieces in a way so that one part is twice as long as the other. He keeps repeating this again and again. He takes one of the two pieces and splits it up so that one piece is twice as long as the other. Which of the following pieces can never result in this way?



24. Five sparrows on a rope look in one or the other direction (see diagram). Every sparrow whistles as many times as the number of sparrows he can see in front of him. Azra therefore whistles four times. Then one sparrow turns in the opposite direction and again all sparrows whistle according to the same rule. The second time the sparrows whistle more often in total than the first time. Which sparrow has turned around?



- (A) Azra      (B) Bernhard      (C) Christa      (D) David      (E) Elsa

# Känguru der Mathematik 2016

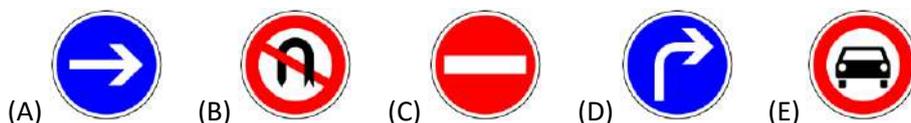
## Level Benjamin (Grade 5 and 6)

### Österreich – 17. 03. 2016



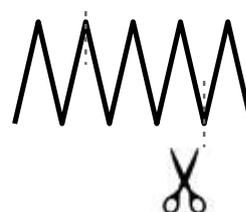
#### - 3 Points Questions -

1. Which of the following road signs has the most axes of symmetry?

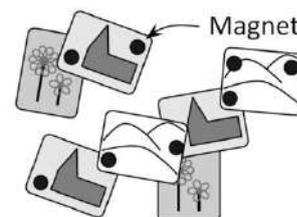


2. Mike cuts a pizza into four equally big pieces. Then he cuts each piece into three equally big pieces. Into how many equally big pieces did Mike cut the pizza?  
 (A) 3 (B) 4 (C) 7 (D) 8 (E) 12

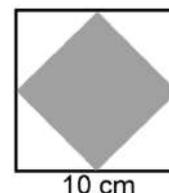
3. A 10 cm long piece of wire is folded so that every part is equally long (see diagram). The wire is then cut through in the two positions marked. How long are the three pieces created in this way?  
 (A) 2 cm, 3 cm, 5 cm (B) 2 cm, 2 cm, 6 cm (C) 1 cm, 4 cm, 5 cm  
 (D) 1 cm, 3 cm, 6 cm (E) 3 cm, 3 cm, 4 cm



4. Lisa has mounted 7 postcards on her fridge door using 8 strong magnets (black dots). What is the maximum amount of magnets she can remove without any postcards falling on the floor?  
 (A) 2 (B) 3 (C) 4 (D) 5 (E) 6



5. Kathi draws a square with side length 10 cm. Then she joins the midpoints of each side to form a smaller square. What is the area of the smaller square?  
 (A)  $10 \text{ cm}^2$  (B)  $20 \text{ cm}^2$  (C)  $25 \text{ cm}^2$  (D)  $40 \text{ cm}^2$  (E)  $50 \text{ cm}^2$

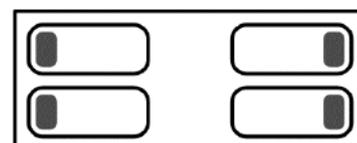


6. Maria wants there to be a knife to the right of every plate and a fork to the left of it. In order to get the right order she always swaps one fork with one knife. What is the minimum number of swaps necessary?  
 (A) 1 (B) 2 (C) 3 (D) 5 (E) 6



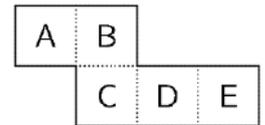
7. A centipede owns 25 pairs of shoes. He needs one shoe for every one of his 100 feet. How many more single shoes does the centipede still need to buy?  
 (A) 15 (B) 20 (C) 35 (D) 50 (E) 75

8. Four girls are sleeping in a room with their heads on the grey pillows. Bea and Pia are sleeping on the left hand side of the room with their faces towards each other; Mary and Karen are on the right hand side with their backs towards each other. How many girls sleep with their right ear on the pillow?  
 (A) 0 (B) 1 (C) 2 (D) 3 (E) 4



**- 4 Points Questions -**

9. The given net is folded along the dotted lines to form an open box. The box is placed on the table so that the opening is on the top. Which side is facing the table?



- (A) A      (B) B      (C) C      (D) D      (E) E

10. Robert has two equally big squares made of paper. He glues them together. Which of the following shapes can he not make?



- (A)      (B)      (C)      (D)      (E)

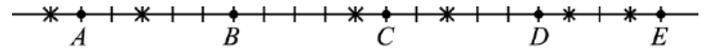
11. Mona, Asma and Nadja work in the same nursery. On each day from Monday to Friday exactly two of them are working. Mona works three times and Asma works four times per week. How many times does Nadja work per week?

- (A) 1      (B) 2      (C) 3      (D) 4      (E) 5

12. Five squirrels A, B, C, D and E are sitting on the points marked. The crosses indicate 6 nuts that they are collecting. The squirrels start to run at the same time with the same speed to the nearest nut in order to pick it up. As soon as a squirrel has picked up the first nut it immediately continues to run in order to get another nut.

Which squirrel gets a second nut?

- (A) A      (B) B      (C) C      (D) D      (E) E



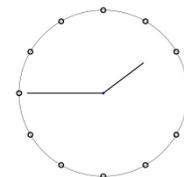
13. There are 30 girls and boys in a class. Always two students share a desk. Every boy shares a desk with a girl. Exactly half the girls share a desk with a boy. How many boys are in the class?

- (A) 25      (B) 20      (C) 15      (D) 10      (E) 5

14. Hansi writes the number 2581953764 on a strip of paper. Twice he cuts through the strip of paper between two digits and obtains three numbers which he adds. How big is the smallest sum he can obtain in this way?

- (A) 2675      (B) 2975      (C) 2978      (D) 4217      (E) 4298

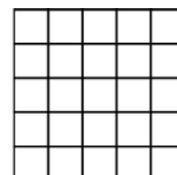
15. Bart sits at the hairdressers. In the mirror he sees a clock as shown in the diagram: What was the mirror image of the clock 10 minutes earlier?



- (A)      (B)      (C)      (D)      (E)

16. What is the maximum number of such pieces that can be cut from a 5 x 5 square?

- (A) 3      (B) 4      (C) 5      (D) 6      (E) 7



- 5 Points Questions -

17. Tim, Tom and Jim are triplets. Their brother Carl is exactly 3 years younger. All four are having their birthdays today.

How old can the four brothers be altogether?

- (A) 53      (B) 54      (C) 56      (D) 59      (E) 60

18. Richard writes down all numbers that have the following properties:

The first digit is 1. Each of the following digits is at least as big as the previous one.

The sum of the digits is 5.

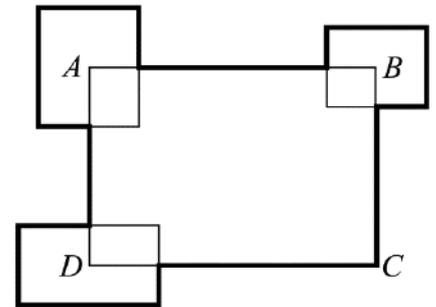
How many such numbers can Richard write down?

- (A) 4      (B) 5      (C) 6      (D) 7      (E) 8

19. The perimeter of the rectangle ABCD is 30 cm. Three more rectangles are added so that their centres are in the corners A, B and D and their sides are parallel to the rectangle (see diagram). The sum of the perimeters of these three rectangles is 20 cm.

What is the length of the boarder of the shape (thick black line)?

- (A) 50 cm      (B) 45 cm      (C) 40 cm      (D) 35 cm      (E) This cannot be calculated.



20. Luigi owns a few square tables and some chairs for his little restaurant. If he sets out his tables individually with 4 chairs each, then he is 6 chairs short. If he always puts two tables together to create a bigger table with 6 chairs, then he has 4 chairs left over.

How many tables does Luigi have?

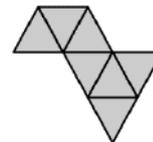
- (A) 8      (B) 10      (C) 12      (D) 14      (E) 16

21. Clara forms one big triangle made up of identical little triangles.

She has already put some triangles together (see diagram).

What is the minimum number of little triangles she has to add?

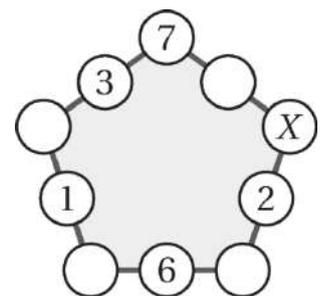
- (A) 5      (B) 9      (C) 12      (D) 15      (E) 19



22. Kirsten has written numbers into 5 of the 10 circles. She wants to write numbers into the remaining circles so that the sum of the three numbers along every side of the pentagon is always the same.

Which number does she have to write into the circle marked X?

- (A) 7      (B) 8      (C) 11      (D) 13      (E) 15



23. The symbols  $\circ$ ,  $\square$  and  $\diamond$  represent three different digits.

If the digits of the number  $\circ\square\circ$  are added, you receive the two-digit number  $\square\diamond$ .

If the digits of the two-digit number  $\square\diamond$  are added, you receive the single-digit number  $\square$ .

Which digit is represented by  $\circ$ ?

- (A) 4      (B) 5      (C) 6      (D) 8      (E) 9

24. Two three-digit numbers are made up of six different digits. The first digit of the second number is twice as big as the last digit of the first number. (Note: 0 is also a digit but cannot be the first digit of a number!)

How big is the smallest possible sum of the two numbers?

- (A) 301      (B) 535      (C) 537      (D) 546      (E) 552

# Känguru der Mathematik 2016

## Level Kadett (Grade 7 and 8)

### Österreich – 17. 03. 2016



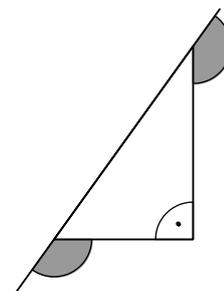
#### – 3 Points Questions –

1. How many natural numbers are there between 3.17 and 20.16?  
 (A) 15      (B) 16      (C) 17      (D) 18      (E) 19

2. Which of the road signs has the most axes of symmetry?

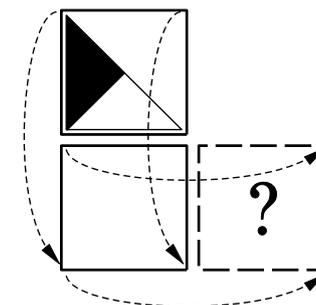
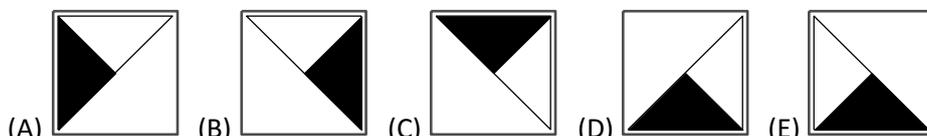


3. What is the sum of the two marked angles?  
 (A)  $150^\circ$       (B)  $180^\circ$       (C)  $270^\circ$       (D)  $320^\circ$       (E)  $360^\circ$



4. Jim should have added 26 to a certain number. Instead he subtracted 26 and obtained  $-14$ .  
 What is the result he would have obtained had he added 26?  
 (A) 28      (B) 32      (C) 36      (D) 38      (E) 42

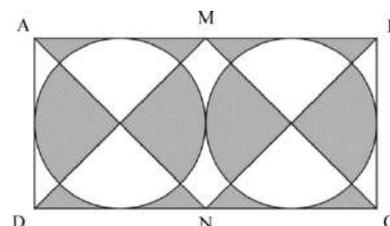
5. A card has a diagram printed on one side and the other side is plain white. The card is first flipped over downwards and then to the right (see diagram).  
 Which picture is obtained?



6. 45 teachers at Anna's school, that's 60% of all teachers, come to school by bike. Only 12% of the teachers come to school by car. How many teachers from Anna's school come to school by car?  
 (A) 4      (B) 6      (C) 9      (D) 10      (E) 12

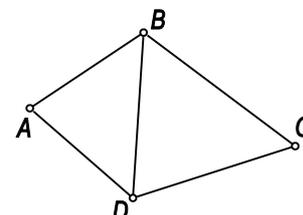
7. Renate puts 555 little piles of 9 stones each together on one big pile. Then she splits this big pile into little groups of 5 stones each. How many such groups does Renate obtain?  
 (A) 999      (B) 900      (C) 555      (D) 111      (E) 45

8. In the rectangle ABCD the side AD is 10 cm long. M and N are the midpoints of the sides AB and CD respectively. How big is the grey area?  
 (A)  $50 \text{ cm}^2$       (B)  $80 \text{ cm}^2$       (C)  $100 \text{ cm}^2$       (D)  $120 \text{ cm}^2$       (E)  $150 \text{ cm}^2$



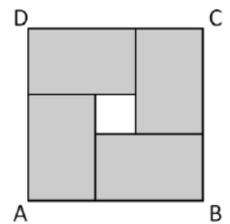
9. Alex has a 1 m long and a 2 m long rope. He cuts up both ropes so that all pieces are of equal length. Which of the following number of pieces can he not obtain in this way?  
 (A) 6      (B) 8      (C) 9      (D) 12      (E) 15

10. During a cycle race starting at D and finishing at B every connecting road (between the towns A, B, C and D) that is shown in the diagram will be ridden along exactly once. How many possible routes are there for the race?  
 (A) 10      (B) 8      (C) 6      (D) 4      (E) 2



– 4 Points Questions –

11. Within the square ABCD there are four identical rectangles (see diagram). The perimeter of each rectangle is 16 cm. What is the perimeter of this square?  
 (A) 16 cm      (B) 20 cm      (C) 24 cm      (D) 28 cm      (E) 32 cm



12. Petra has 49 blue and one red pearl. How many of the blue pearls does Petra have to take away so that 90 % of the pearls are blue?  
 (A) 4      (B) 10      (C) 29      (D) 39      (E) 40

13. Which of the following fractions is closest to  $\frac{1}{2}$ ?  
 (A)  $\frac{25}{79}$       (B)  $\frac{27}{59}$       (C)  $\frac{29}{57}$       (D)  $\frac{52}{79}$       (E)  $\frac{57}{92}$

14. Igor writes down all results of the quarter finals, the semi finals and the final of a tennis tournament. The results are listed in random order.

Bert beats Anton,  
Carl beats Bert,

Carl beats Damien,  
Edon beats Fred,

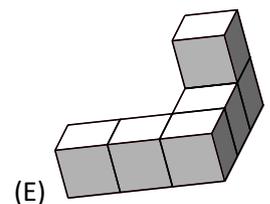
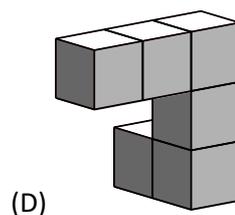
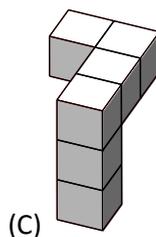
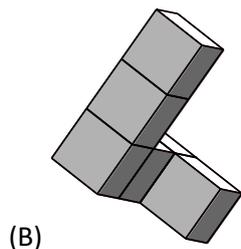
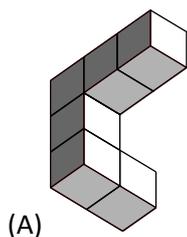
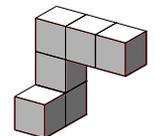
Glen beats Henry,  
Glen beats Edon.

Glen beats Carl,

Who is playing the final?

- (A) Glen and Henry      (B) Glen and Carl      (C) Carl and Bert      (D) Glen and Edon      (E) Carl and Damien

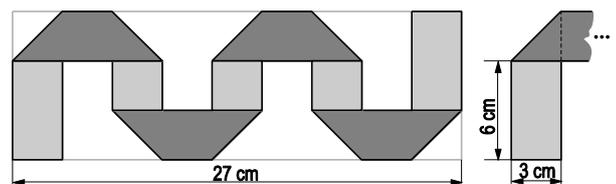
15. Anne has glued together some cubes and has obtained the solid shown on the right. She turns it around to check it out from different sides. Which view can she not obtain?



16. Tim, Tom and Jim are triplets. Their twin brothers John and James are 3 years younger. All five are having their birthdays today. Which of the following numbers could be the sum of the ages of the five brothers?  
 (A) 92      (B) 89      (C) 76      (D) 53      (E) 36

17. A 3 cm wide strip of paper is dark on one side and light on the other. The folded strip of paper lies exactly within a rectangle with length 27 cm and width 9 cm (see diagram). How long is the strip of paper?

- (A) 36 cm      (B) 48 cm      (C) 54 cm      (D) 57 cm      (E) 81 cm

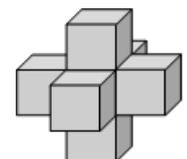


18. The two kangaroos Jump and Hop both jump at the same time from the same starting line in the same direction. Both of them jump exactly once per second. Jump always jumps 6 m . Hop first jumps 1 m, then 2 m, then 3 m etc. After how many jumps does Hop catch up with Jump?

- (A) 10      (B) 11      (C) 12      (D) 13      (E) 14

19. Seven identical dice (each with 1, 2, 3, 4, 5 and 6 points on their faces) are glued together to form the solid shown. Faces that are glued together each have the same number of points. How many points can be seen on the surface of the solid?

- (A) 24      (B) 90      (C) 95      (D) 105      (E) 126



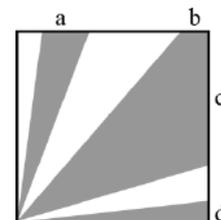
20. There are 20 girls and boys in total in a class. Always two students share a desk so that one third of the boys share a table with a girl and half the girls share a desk with a boy.

How many boys are in this class?

- (A) 9      (B) 12      (C) 15      (D) 16      (E) 18

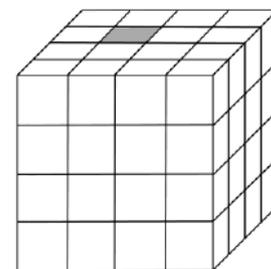
– 5 Points Questions –

21. In a square with area 36 there are grey parts as shown in the diagram. The sum of the areas of all grey parts is 27.



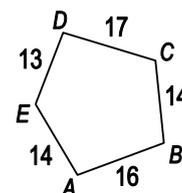
- How long are the distances  $a$ ,  $b$ ,  $c$  and  $d$  together?  
 (A) 4      (B) 6      (C) 8      (D) 9      (E) 10
22. Theos watch runs 10 minutes slow but he thinks it runs 5 minutes fast.  
 Leos watch runs 5 minutes fast but he thinks it runs 10 minutes slow.  
 Both check their own watch at the same time. Theo thinks it is 12:00 o'clock. What time does Leo think it is?  
 (A) 11:30      (B) 11:45      (C) 12:00      (D) 12:30      (E) 12:45
23. Twelve girls met up in a pastry shop. On average they ate 1.5 muffins. None of them ate more than two muffins and two ate nothing. How many girls ate two muffins?  
 (A) 2      (B) 5      (C) 6      (D) 7      (E) 8
24. Little Red Riding Hood is taking waffles to three grandmothers. Initially her basket is completely full. Just before she reaches the houses of each grandmother, the wolf each time eats half of the waffles that are in the basket. When she leaves the house of the third grandmother, the basket is empty. Each grandmother gets the same amount of waffles.  
 The original amount of waffles can definitely be divided by which of the following numbers?  
 (A) 4      (B) 5      (C) 6      (D) 7      (E) 9

25. A big cube is made up of 64 small cubes. Exactly one of these cubes is grey (see diagram). Two cubes are neighbours if they share a common face. On day one the grey cube colours all its neighbouring cubes grey. On day two all grey cubes again colour all their neighbouring cubes grey. How many of the 64 little cubes are grey at the end of the second day?

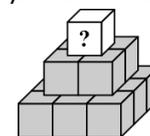


26. Natural numbers are written on a board, of which no two are the same. The product of the two smallest numbers is 16, the product of the two biggest is 225. What is the sum of all numbers written on the board?  
 (A) 38      (B) 42      (C) 44      (D) 58      (E) 243

27. The diagram shows a pentagon and indicates the length of each side. Five circles are drawn with centres A, B, C, D and E. On each side of the pentagon the two circles that are drawn around the ends of that side touch each other.

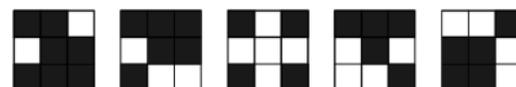


- Which point is the centre of the biggest circle?  
 (A) A      (B) B      (C) C      (D) D      (E) E
28. Susi writes a different positive whole number on each of the 14 cubes of the pyramid (see diagram). The sum of the numbers, which she writes on the nine cubes that lie on the bottom, is 50. The number on every remaining cube is equal to the sum of the numbers of the four cubes that are directly underneath. What is the biggest number that can be written on the topmost cube?  
 (A) 112      (B) 110      (C) 50      (D) 120      (E) 118



29. In every one of the five carriages of a train there is at least one passenger. Two passengers are said to be *neighbouring* if they are either in the same carriage or in two successive carriages. Each passenger has either got exactly 5 or exactly 10 neighbours. How many passengers are on the train?  
 (A) 13      (B) 15      (C) 17      (D) 20      (E) This situation is not possible.

30. A cube of side length 3 consists of 15 black and 12 white unit cubes. In the diagram five of the six faces of the big cube can be seen.



Which of the regions shown below is the 6th face of the big cube?

- (A)      (B)      (C)      (D)      (E)

**Känguru der Mathematik 2016**  
**Level Junior (Grade 9 and 10)**  
**Österreich – 17.03.2016**



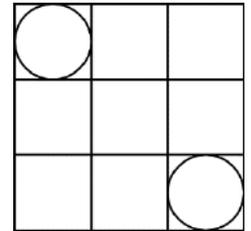
**- 3 Points Questions -**

- The arithmetic mean of four numbers is 9. What is the fourth number if the three other numbers are 5, 9 and 12?  
(A) 6      (B) 8      (C) 9      (D) 10      (E) 36
- Which of the following numbers is closest to the number  $\frac{17 \times 0.3 \times 20.16}{999}$ ?  
(A) 0.01      (B) 0.1      (C) 1      (D) 10      (E) 100
- Ruth takes part in the kangaroo competition where 30 questions have to be answered. She answers every question and each answer is either right or wrong. She has 50% more right than wrong answers. How many of her answers are right?  
(A) 10      (B) 12      (C) 15      (D) 18      (E) 20
- Five points are given in a Cartesian coordinate system: P(-1, 3), Q(0, -4), R(-2, -1), S(1, 1), T(3, -2). Four of these five points are vertices of a square. Which point does not belong there?  
(A) P      (B) Q      (C) R      (D) S      (E) T
- If a positive whole number  $x$  is divided by 6, the remainder is 3. What is the remainder if  $3 \times x$  is divided by 6?  
(A) 4      (B) 3      (C) 2      (D) 1      (E) 0
- 2016 hours are how many weeks?  
(A) 6      (B) 8      (C) 10      (D) 12      (E) 16
- Lukas invents his own notation for negative numbers. When counting backwards he writes:  
... 3, 2, 1, 0, 00, 000, 0000, ... What is the result of the calculation  $000 + 0000$  in his notation?  
(A) 1      (B) 00000      (C) 000000      (D) 0000000      (E) 00000000
- I have some unusual dice. On their faces are the digits 1 to 6 as usual, however the odd numbers are negative (so -1, -3, -5 instead of 1, 3, 5). I throw two such dice at the same time. Which of the following sums can I definitely not achieve with one such throw?  
(A) 3      (B) 4      (C) 5      (D) 7      (E) 8
- Step by step the word VELO is changed into the word LOVE. In every step two adjacent letters are allowed to be swapped around. What is the minimum amount of steps needed?  
(A) 3      (B) 4      (C) 5      (D) 6      (E) 7
- Sven writes five different single-digit positive whole numbers on a board. He realises that no sum of two of these numbers is equal to 10. Which of the following numbers has Sven definitely written on the board?  
(A) 1      (B) 2      (C) 3      (D) 4      (E) 5

**- 4 Points Questions -**

- For the real numbers  $a, b, c, d$  the following holds true:  $a + 5 = b^2 - 1 = c^2 + 3 = d - 4$ . Which of the numbers  $a, b, c, d$  is biggest?  
(A)  $a$       (B)  $b$       (C)  $c$       (D)  $d$       (E) It cannot be uniquely determined using this information.

12. A  $3 \times 3$  field is made up of 9 unit squares. In two of these squares, circles are inscribed as shown in the diagram.

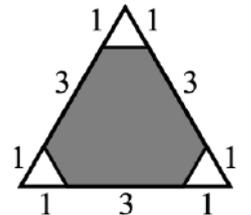


How big is the shortest distance between these circles?

- (A)  $2\sqrt{2} - 1$  (B)  $\sqrt{2+1}$  (C)  $2\sqrt{2}$  (D) 2 (E) 3
13. A knock-out tennis tournament is taking place. There are seven matches (4 quarter finals, 2 semi finals and one final). The results for six of the seven matches are known (but not necessarily in this order):

Bella beats Ann, Celine beats Donna, Gina beats Holly,  
 Gina beats Celine, Celine beats Bella, Emma beats Farah.

- Which result is missing?  
 (A) Gina beats Bella (B) Celine beats Ann (C) Emma beats Celine  
 (D) Bella beats Holly (E) Gina beats Emma



14. What percentage of the area of the triangle is coloured in grey in the adjacent diagram?

- (A) 80% (B) 85% (C) 88% (D) 90% (E) It cannot be calculated.

15. Jilly makes up a multiplication magic square using the numbers 1, 2, 4, 5, 10, 20, 25, 50 and 100. The products of the numbers in each row, column and diagonal should be equal.

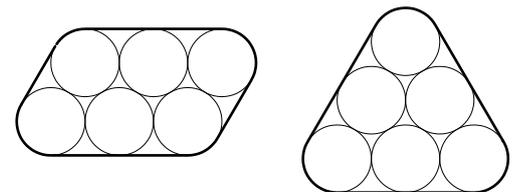
In the diagram it can be seen how she has started.

Which number goes into the cell with the question mark?

20	1	
		?

- (A) 2 (B) 4 (C) 5 (D) 10 (E) 25

16. Jack wants to keep six tubes each of diameter 2 cm together using a rubber band. He chooses between the two possible variations shown.



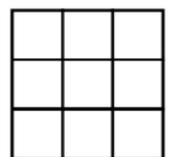
How are the lengths of the rubber bands related to each other?

- (A) In the left picture the band is  $\pi$  cm shorter.  
 (B) In the left picture the band is 4 cm shorter. (C) In the right picture the band is  $\pi$  cm shorter.  
 (D) In the right picture the band is 4 cm shorter. (E) Both bands are equally long.

17. Peter wants to colour in the cells of a  $3 \times 3$  square so that every row, every column and both diagonals each have three cells with three different colours.

What is the smallest number of colours with which Peter can achieve this?

- (A) 3 (B) 4 (C) 5 (D) 6 (E) 7



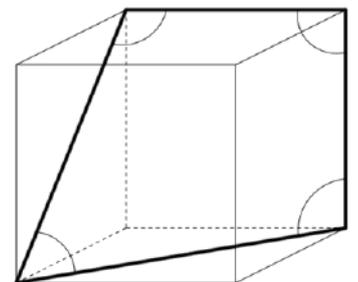
18. Eight cards with the numbers 1, 2, 4, 8, 16, 32, 64, 128 are each in an unmarked envelope. Eva randomly chooses some of these eight envelopes. Ali takes the remaining ones. Both add their numbers together. They find out that Eva's sum is 31 bigger than Ali's sum. How many envelopes has Eva chosen?

- (A) 2 (B) 3 (C) 4 (D) 5 (E) 6

19. In the diagram we see a cube and four marked angles.

How big is the sum of those angles?

- (A)  $315^\circ$  (B)  $330^\circ$  (C)  $345^\circ$  (D)  $360^\circ$  (E)  $375^\circ$



20. In an enclosure there are 2016 kangaroos. Each of them is either red or grey, and there is at least one red and at least one grey kangaroo amongst them.

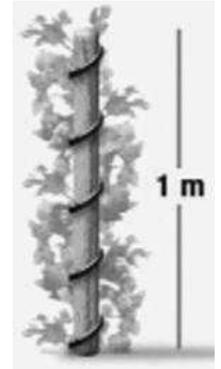
For each kangaroo K we calculate the fraction obtained, if you take the number of kangaroos of the other colour divided by the kangaroos of the own colour (including K itself).

Determine the sum of these 2016 fractions.

- (A) 2016 (B) 1344 (C) 1008 (D) 672 (E) More information is necessary.

- 5 Points Questions -

21. A creeping plant twists exactly 5 times around a post with circumference 15 cm (as shown in the diagram) and thus reaches a height of 1 m. While the plant grows the height of the plant also grows with constant speed. How long is the creeping plant?

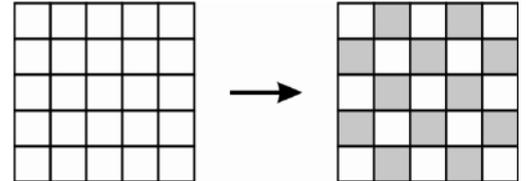


- (A) 0.75 m    (B) 1.0 m    (C) 1.25 m    (D) 1.5 m    (E) 1.75 m

22. What is the biggest remainder one can obtain by dividing a two-digit number by the sum of its digits?

- (A) 13    (B) 14    (C) 15    (D) 16    (E) 17

23. We consider a  $5 \times 5$  square that is split up into 25 fields. Initially all fields are white. In each move it is allowed to change the colour of two fields that are horizontally or vertically adjacent (i.e. white fields turn black and black ones turn white). What is the smallest number of moves needed to obtain the chessboard colouring shown in the diagram?



- (A) 11    (B) 12    (C) 13    (D) 14    (E) 15

24. A motorboat drives in the middle of a stream. Downstream it needs four hours to get from X to Y. In order to drive back from Y to X it needs six hours. Tree trunks are also floating on the stream. How many hours does it take for a tree trunk to float in the middle of the stream from X to Y?

- (A) 5    (B) 10    (C) 12    (D) 20    (E) 24

25. In the Kangaroo Republic, every month has 40 days, which are numbered through from 1 to 40. Every day with a number that is divisible by 6 is a public holiday, and likewise every day with a prime number. How often per month does it occur that there is exactly one working day between two public holidays?

- (A) 1    (B) 2    (C) 3    (D) 4    (E) 5

26. Two heights of a triangle have lengths 10 cm and 11 cm. Which of the following lengths cannot be the length of the third height?

- (A) 5 cm    (B) 6 cm    (C) 7 cm    (D) 10 cm    (E) 100 cm

27. Jakob writes down four consecutive positive whole numbers. He calculates all possible sums of three of those numbers and realises that none of those sums is a prime number. What is the smallest number that Jakob could have written down?

- (A) 12    (B) 10    (C) 7    (D) 6    (E) 3

28. Four sportswomen and sportsmen are sitting around a round table for dinner. They do four different sports: ice skating, skiing, hockey and sledging. The person who skis sits to the left of Sandra. The person who ice skates sits opposite Benjamin. Eva and Philipp sit next to each other. A woman sits next to the person who plays hockey. Which sport does Eva do?

- (A) Ice skating    (B) Skiing    (C) Hockey    (D) Sledging  
(E) It cannot be determined with this information.

29. A date can be written in the form DD.MM.YYYY; e.g. today's date is 17.03.2016. We call a date "surprising" if all 8 digits used in this notation are different. In which month does the next surprising date occur?

- (A) March    (B) June    (C) July    (D) August    (E) December

30. Exactly 2016 people are taking part in a conference. They are registered as P1 to P2016 in the system. Each person from P1 to P2015 has shaken exactly the amount of other hands that his/her own system number indicates. How many people did P2016 shake hands with?

- (A) 1    (B) 504    (C) 672    (D) 1008    (E) 2015

# Känguru der Mathematik 2016

## Level Student (from grade 11)

### Österreich – 17.03.2016



#### 3 Point Questions

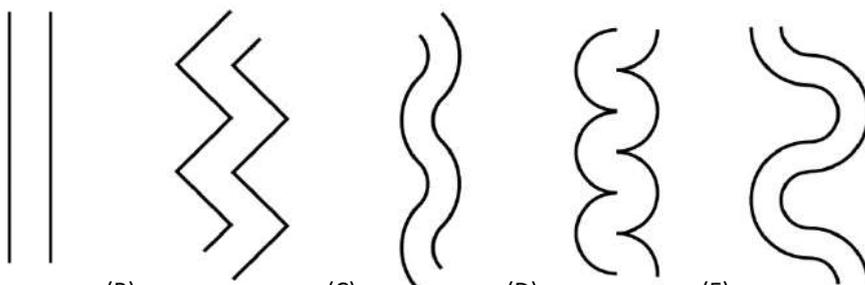
1. The sum of the ages of Tom and Johann is 23. The sum of the ages of Johann and Alex is 24 and the sum of the ages of Alex and Tom is 25. How old is the oldest of them?

- (A) 10      (B) 11      (C) 12      (D) 13      (E) 14

2. The sum  $\frac{1}{10} + \frac{1}{100} + \frac{1}{1000}$  gives

- (A)  $\frac{3}{111}$       (B)  $\frac{111}{1110}$       (C)  $\frac{111}{1000}$       (D)  $\frac{3}{1000}$       (E)  $\frac{3}{1110}$

3. Maria wants to build a bridge across a river. This river has the special feature that from each point along one shore the shortest possible bridge to the other shore has always got the same length. Which of the following diagrams is definitely not a sketch of this river?

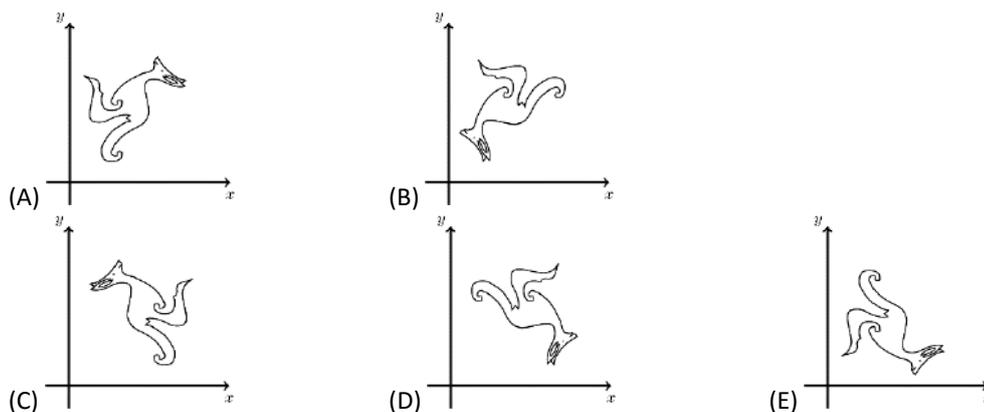
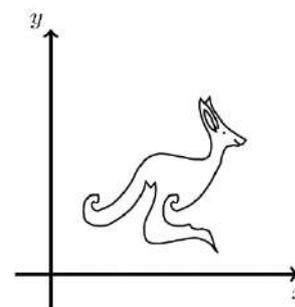


- (A)      (B)      (C)      (D)      (E)

4. How many whole numbers are bigger than  $2015 \times 2017$  but smaller than  $2016 \times 2016$ ?

- (A) 0      (B) 1      (C) 2015      (D) 2016      (E) 2017

5. A scatter diagram on the  $xy$ -plane gives the picture of a kangaroo as shown on the right. Now the  $x$ - and the  $y$ -coordinate are swapped around for every point. What does the resulting picture look like?



- (A)      (B)      (C)      (D)      (E)

6. What is the minimum number of planes necessary to border a certain region in a three-dimensional space?

- (A) 3      (B) 4      (C) 5      (D) 6      (E) 7

7. Diana wants to write whole numbers into each circle in the diagram, so that for all eight small triangles the sum of the three numbers in the corners is always the same. What is the maximum amount of different numbers she can use?

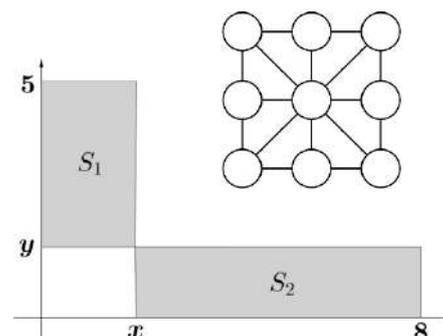
- (A) 1      (B) 2      (C) 3      (D) 5      (E) 8

8. The rectangles  $S_1$  and  $S_2$  shown in the picture have the same area. Determine the ratio  $x : y$ .

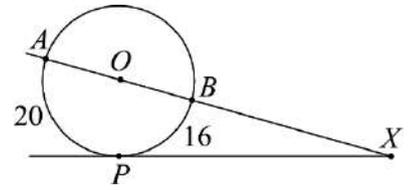
- (A) 1:1      (B) 3:2      (C) 4:3      (D) 7:4      (E) 8:5

9. If  $x^2 - 4x + 2 = 0$  then  $x + \frac{2}{x}$  equals

- (A) -4      (B) -2      (C) 0      (D) 2      (E) 4



10. The diagram shows a circle with centre  $O$  as well as a tangent that touches the circle in point  $P$ . The arc  $AP$  has length 20, the arc  $BP$  has length 16. What is the size of the angle  $\angle AXP$ ?



- (A)  $30^\circ$       (B)  $24^\circ$       (C)  $18^\circ$       (D)  $15^\circ$       (E)  $10^\circ$

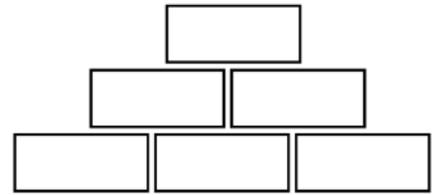
**- 4 Point Questions -**

11.  $a, b, c, d$  are positive whole numbers for which  $a + 2 = b - 2 = c \times 2 = d \div 2$  holds true.

Which of the four numbers  $a, b, c$  and  $d$  is biggest?

- (A)  $a$       (B)  $b$       (C)  $c$       (D)  $d$       (E) It is not uniquely defined.

12. In this number pyramid each number in a higher cell is equal to the product of the two numbers in the cells immediately underneath that number. Which of the following numbers cannot appear in the topmost cell, if the cells on the bottom row hold natural numbers greater than 1 only?



- (A) 56      (B) 84      (C) 90      (D) 105      (E) 220

13. Which value does  $x_4$  take if  $x_1 = 2$  and  $x_{n+1} = x_n^{x_n}$  for  $n \geq 1$ ?

- (A)  $2^{2^3}$       (B)  $2^{2^4}$       (C)  $2^{2^{11}}$       (D)  $2^{2^{16}}$       (E)  $2^{2^{768}}$

14. In rectangle  $ABCD$  the side  $BC$  is exactly half as long as the diagonal  $\overline{AC}$ . Let  $X$  be the point on  $\overline{CD}$  for which  $|\overline{AX}| = |\overline{XC}|$  holds true. How big is the angle  $\angle CAX$ ?

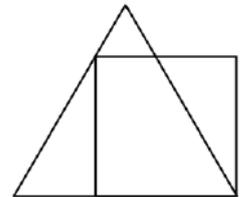
- (A)  $12.5^\circ$       (B)  $15^\circ$       (C)  $27.5^\circ$       (D)  $42.5^\circ$       (E) another angle

15. Diana cuts a rectangle of area 2016 into 56 identical squares. The side lengths of the rectangle and the squares are all whole numbers. For how many different rectangles can she do this? (Two rectangles are said to be different if they are not congruent.)

- (A) 2      (B) 4      (C) 6      (D) 8      (E) 0

16. The square shown in the diagram has a perimeter of 4. The perimeter of the equilateral triangle is

- (A) 4      (B)  $3 + \sqrt{3}$       (C) 3      (D)  $3 + \sqrt{2}$       (E)  $4 + \sqrt{3}$



17. On the island of knights and liars everybody is either a knight (who only tells the truth) or a liar (who always lies). On your journey on the island you meet 7 people who are sitting in a circle around a bonfire. They all tell you "I am sitting between two liars!". How many liars are sitting around the bonfire?

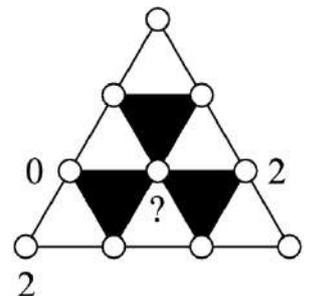
- (A) 3      (B) 4      (C) 5      (D) 6      (E) More information is necessary to make a decision.

18. Three three-digit numbers are built using the digits 1 to 9 so that each of the nine digits is used exactly once. Which of the following numbers cannot be the sum of the three numbers?

- (A) 1500      (B) 1503      (C) 1512      (D) 1521      (E) 1575

19. Each of the ten points in the diagram is labelled with one of the numbers 0, 1 or 2. It is known that the sum of the numbers in the corner points of each white triangle is divisible by 3, while the sum of the numbers in the corner points of each black triangle is not divisible by 3. Three of the points are already labeled as shown in the diagram. With which numbers can the inner point be labeled?

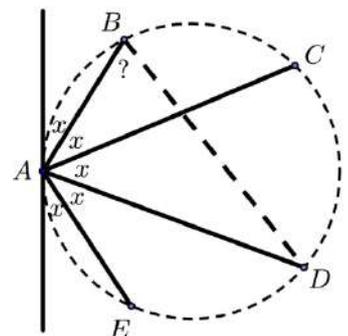
- (A) only 0      (B) only 1      (C) only 2      (D) only 0 and 1      (E) either 0 or 1 or 2



20. Bettina chooses five points  $A, B, C, D$  and  $E$  on a circle and draws the tangent to the circle at point  $A$ . She realizes that the five angles marked  $x$  are all equally big. (Note that the diagram is not drawn to scale!)

How big is the angle  $\angle ABD$ ?

- (A)  $66^\circ$       (B)  $70.5^\circ$       (C)  $72^\circ$       (D)  $75^\circ$       (E)  $77.5^\circ$



**5 Point Questions**

21. How many different real solutions does the following equation have?

$$(x^2 - 4x + 5)^{x^2+x-30} = 1 \quad ?$$

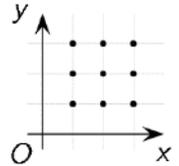
- (A) 1            (B) 2            (C) 3            (D) 4            (E) infinitely many

22. A quadrilateral has an inner circle (i.e. all four sides of the quadrilateral are tangents to the circle). The ratio of the perimeter of the quadrilateral to the circumference of the circle is 4:3. The ratio of the area of the quadrilateral to that of the circle is therefore

- (A)  $4:\pi$             (B)  $3\sqrt{2}:\pi$             (C) 16:9            (D)  $\pi:3$             (E) 4:3

23. How many quadratic functions  $y = ax^2 + bx + c$  (with  $a \neq 0$ ) have graphs that go through at least 3 of the marked points?

- (A) 6            (B) 15            (C) 19            (D) 22            (E) 27



24. In the right-angled triangle  $ABC$  (with the right angle in  $A$ ) the angle bisectors of the acute angles intersect at point  $P$ . The distance of  $P$  to the hypotenuse is  $\sqrt{8}$ . What is the distance of  $P$  to  $A$ ?

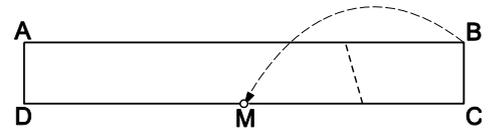
- (A) 8            (B) 3            (C)  $\sqrt{10}$             (D)  $\sqrt{12}$             (E) 4

25. The equations  $x^2 + ax + b = 0$  and  $x^2 + bx + a = 0$  both have real solutions. It is known that the sum of the squares of the solutions of the first equation is equal to the sum of the squares of the solutions of the second equation and that  $a \neq b$ .  $a + b$  equals

- (A) 0            (B) -2            (C) 4            (D) -4            (E) The sum cannot be uniquely determined.

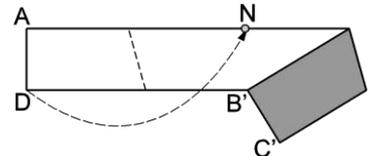
26. In a solid cube  $P$  is a point on the inside. We cut the cube into 6 (sloping) pyramids. Each pyramid has one face of the cube as its base and point  $P$  as its top. The volumes of five of these pyramids are 2, 5, 10, 11 and 14. What is the volume of the sixth pyramid?

- (A) 1            (B) 4            (C) 6            (D) 9            (E) 12



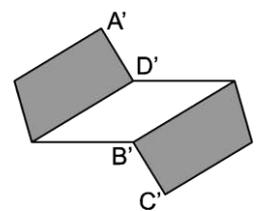
27. A rectangular piece of paper  $ABCD$  is 5 cm wide and 50 cm long. The paper is white on one side and grey on the other. Christina folds the strip as shown so that the vertex  $B$  coincides with  $M$  the midpoint of the edge  $CD$ . Then she folds it so that the vertex  $D$  coincides with  $N$  the midpoint of the edge  $AB$ . How big is the area of the visible white part in the diagram?

- (A) 50 cm<sup>2</sup>            (B) 60 cm<sup>2</sup>            (C) 62.5 cm<sup>2</sup>            (D) 100 cm<sup>2</sup>            (E) 125 cm<sup>2</sup>



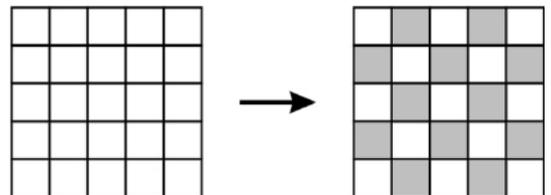
28. Anna chooses a positive whole number  $n$  and writes down the sum of all positive whole numbers from 1 to  $n$ . A prime number  $p$  divides this sum but none of the summands. Which of the following numbers is a possible value of  $n + p$ ?

- (A) 217            (B) 221            (C) 229            (D) 245            (E) 269



29. We consider a  $5 \times 5$  square that is split up into 25 fields. Initially all fields are white. In each move it is allowed to change the colour of three fields that are adjacent in a horizontal or vertical line (i.e. white fields turn black and black ones turn white). What is the smallest number of moves needed to obtain the chessboard colouring shown in the diagram?

- (A) less than 10            (B) 10            (C) 12            (D) more than 12            (E) This colouring cannot be obtained.



30. The positive whole number  $N$  has exactly six different (positive) factors including 1 and  $N$ . The product of five of these factors is 648. Which of these numbers is the sixth factor of  $N$ ?

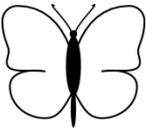
- (A) 4            (B) 8            (C) 9            (D) 12            (E) 24

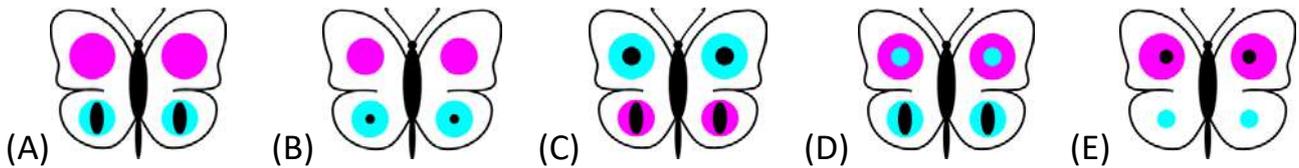
**2016**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
<b>Felix</b>	B	E	C	B	C	A	C	C	B	E	A	D	D	E	C															
<b>Écolier</b>	E	E	A	A	D	B	A	C	B	B	C	B	D	B	C	D	A	B	D	C	B	C	E	B						
<b>Benjamin</b>	C	E	A	C	E	B	D	C	B	A	C	C	D	B	E	D	A	B	C	B	B	D	E	C						
<b>Kadett</b>	C	A	C	D	B	C	A	C	B	C	E	E	C	B	A	B	D	B	D	B	D	D	E	D	E	C	A	E	C	A
<b>Junior</b>	D	B	D	A	B	D	C	D	B	E	D	A	E	C	B	E	C	D	B	A	C	C	B	E	A	A	C	A	B	D
<b>Student</b>	D	C	B	A	A	B	C	E	E	E	D	D	C	E	B	B	B	A	A	C	C	E	D	E	B	C	B	A	A	C

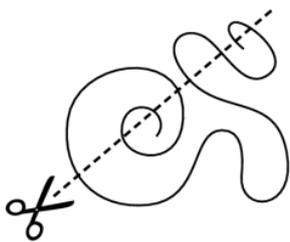
**Känguru der Mathematik 2017**  
**Level Felix (Grade 1 and 2)**  
**Österreich – 16. 3. 2017**

– 3 Points Questions –

1. Ellen wants to decorate the butterfly  using these 6 stickers . Which butterfly can she make?

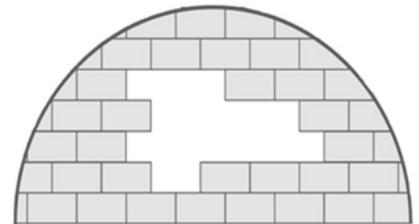


2. Into how many pieces will the string be cut?



- (A) 5      (B) 6      (C) 7      (D) 8      (E) 9

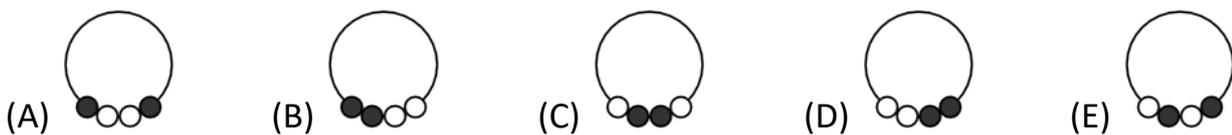
3. How many blocks are missing in this igloo?



- (A) 8      (B) 9      (C) 10      (D) 11      (E) 12

4. This picture  shows a bracelet with pearls.

Which of the bands below shows the same bracelet as above?



5. Four of the numbers 1, 3, 4, 5 and 7 are written into the boxes so that the calculation is correct.

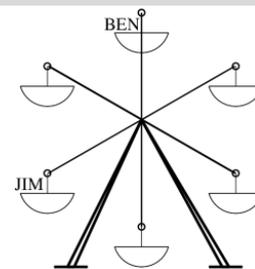
Which number was not used?

$$\square + \square = \square + \square$$

- (A) 1      (B) 3      (C) 4      (D) 5      (E) 7

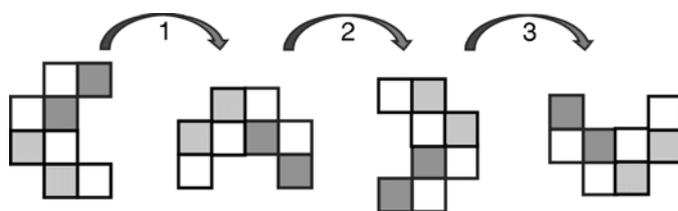
**4 Points Questions**

6. Jim and Ben are sitting in a ferris wheel (see picture on the right).  
The ferris wheel is turning.  
Now Ben is in the position where Jim was beforehand.  
Where is Jim now?



- (A) (B) (C) (D) (E)

7. Alfred turns his building block 90 degrees clockwise 10 times.  
The first three times can be seen in the picture.  
What is the final position of the building block?



- (A) (B) (C) (D) (E)

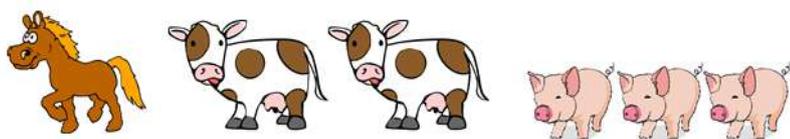
8. In which picture are there half as many circles as triangles and twice as many squares as triangles?

- (A) (B) (C) (D) (E)

9. Leo and Max are standing in a queue that is made up of 11 people in total.  
There are 7 people in front of Leo, Max stands directly behind him in the queue.  
How many people are behind Max?

- (A) 1      (B) 2      (C) 3      (D) 4      (E) 5

10. Old McDonald has a horse, two cows and three pigs.



How many more cows does he need, so that exactly half of all his animals are cows?

- (A) 0      (B) 1      (C) 2      (D) 3      (E) 4

**5 Points Questions**

**11.** Every box shows the result of the addition of the numbers on the very left and on the very top (for example:  $5 + 7 = 12$ ). Which number is written behind the star?

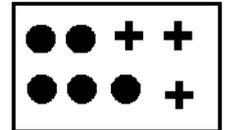
	<b>+ 10</b>	<b>7</b>
<b>5</b>	<b>15</b>	<b>12</b>
<b>?</b>	<b>14</b>	

- (A) 10      (B) 11      (C) 12      (D) 13      (E) 15

**12.** Lisa has several sheets of construction paper like this



and



She wants to make 7 identical crowns:

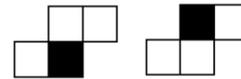


For that she cuts out the necessary parts.

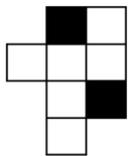
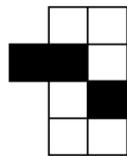
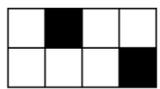
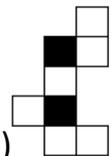
What is the minimum number of sheets of construction paper that she has to cut up?

- (A) 7      (B) 9      (C) 10      (D) 11      (E) 13

**13.** Simon has two identical tiles, whose front look like this:  
The back is white.



Which pattern can he make with those two tiles?

- (A)       (B)       (C)       (D)       (E) 

**14.** A kangaroo always does ten jumps within a minute.

Then he has a three minute break.

How many minutes does it need in order to do 50 jumps?

- (A) 4      (B) 5      (C) 16      (D) 17      (E) 21

**15.** Each one of the four keys locks exactly one padlock. Every letter on a padlock stands for exactly one digit. Same letters mean same digits.

Which letters must be written on the fourth padlock?

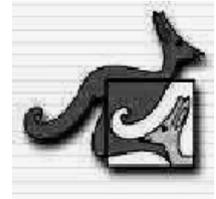


- (A) GDA      (B) ADG      (C) GAD      (D) GAG      (E) DAD

# Känguru der Mathematik 2017

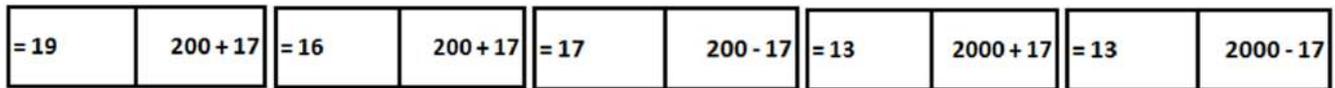
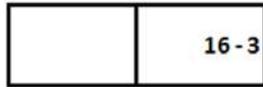
## Level Ecolier (Grade 3 and 4)

### Österreich – 16. 3. 2017



#### - 3 Points Questions -

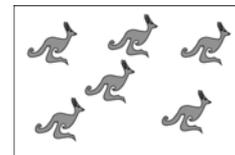
1. Which one of the domino piece's A to E has to be placed in between the shown pieces, so that both calculations are correct?



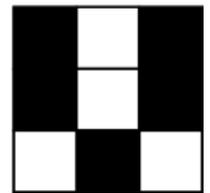
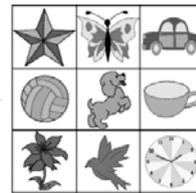
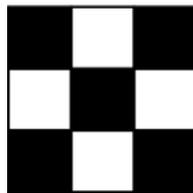
- (A) (B) (C) (D) (E)

2. If John looks out the window he can see half of the kangaroos in the park. How many kangaroos in total are there in the park?

- (A) 6 (B) 7 (C) 8 (D) 12 (E) 14



3. Two square sheets are made up of see-through and black little squares. Both are placed on top of each other onto the sheet in the middle. Which shape can then still be seen?



- (A) (B) (C) (D) (E)

4. The left picture rotated. The right picture shows the new position after the rotation.



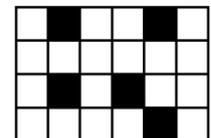
Which footprints are missing after the rotation?



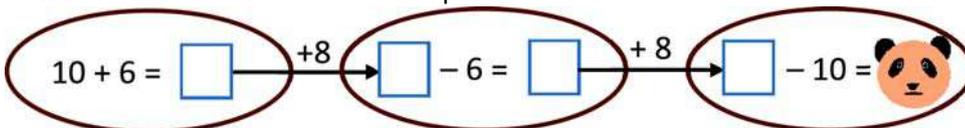
- (A) (B) (C) (D) (E)

5. How many white squares need to be coloured in black, so that there are exactly twice as many white squares as there are black squares?

- (A) 1 (B) 3 (C) 8 (D) 12 (E) 16



6. Which number is hidden behind the panda?



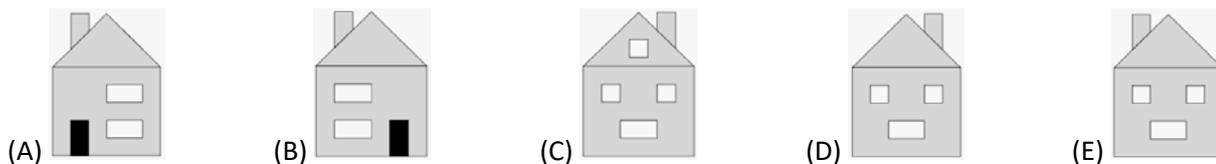
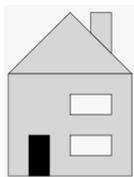
- (A) 16 (B) 18 (C) 20 (D) 24 (E) 28

7. The following picture shows a necklace with six pearls: Which of the following diagrams shows the same necklace?



- (A) (B) (C) (D) (E)

8. This picture shows you Anna's house from the front:  
At the back it has three windows but no door.  
Which picture shows Anna's house from the back?



**- 4 Points Questions -**

9. Every box shows the result of the addition of the numbers on the very left and on the very top (for example:  $6 + 2 = 8$ ). Which number is written behind the question mark?  
(A) 10 (B) 11 (C) 12 (D) 13 (E) 15

	+ 11	7	2
6	17	13	8
		?	10

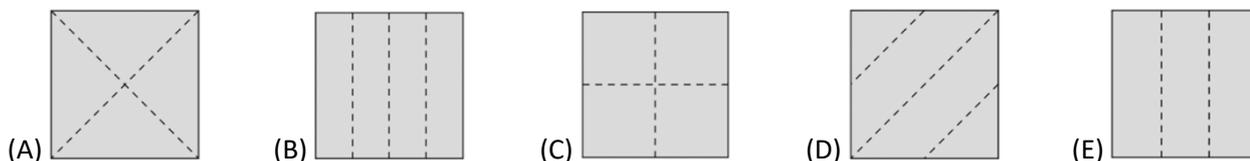
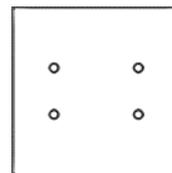
10. Four apples and one pear weigh as much as three pears.  
What is therefore correct?

- (A) One pear weighs as much as one apple. (B) Three apples weigh as much as one pear.  
(C) Three pears weigh as much as one apple. (D) Two pears weigh as much as one apple.  
(E) Two apples weigh as much as one pear.

11. Balloons are sold in packages of 5, 10 or 25 pieces each. Marius buys exactly 70 balloons.  
What is the minimum number of packages he has to buy?

- (A) 3 (B) 4 (C) 5 (D) 6 (E) 7

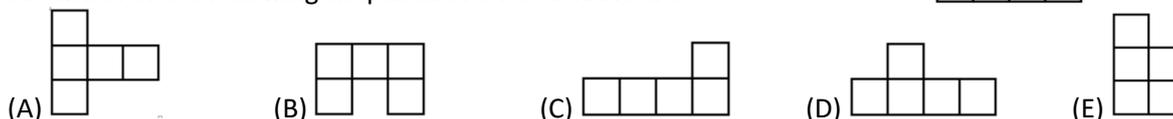
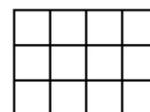
12. Bob folds a piece of paper, then punches a hole into the paper and unfolds it again. The unfolded paper then looks like this:  
Along which dotted line has Bob folded the paper beforehand?



13. 13 children registered for a competition. Then another 19 joined. Six equally big teams are needed for the competition.

- How many more children are needed, so that six equally big teams can be formed?  
(A) 1 (B) 2 (C) 3 (D) 4 (E) 5

14. Ben wants to cut out two identical pieces out of the  $4 \times 3$  grid.  
For which of the following shapes can he not achieve that?



15. David has a stove with two hobs on which he wants to prepare five different dishes.  
The dishes need 40 min, 15 min, 35 min, 10 min and 45 min until they are fully cooked.

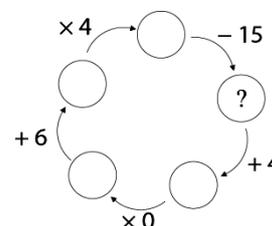
He wants to spend as little time in the kitchen as possible but is only allowed to take dishes off the hob when they are fully cooked.

How long does he need for the preparation?

- (A) 60 min (B) 70 min (C) 75 min (D) 80 min (E) 85 min

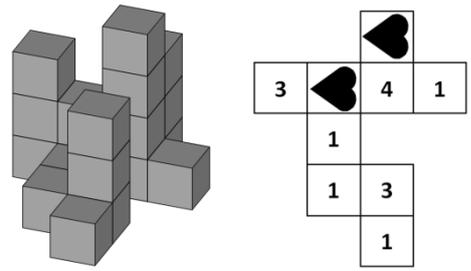
16. Which number must be written into the circle with the question mark so that the calculation is correct?

- (A) 8 (B) 9 (C) 10 (D) 11 (E) 12

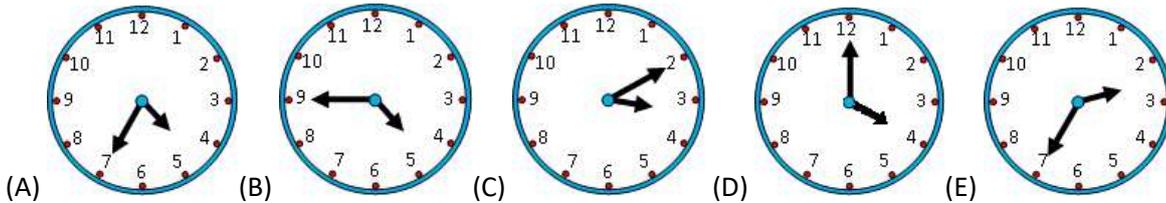


**- 5 Points Questions -**

17. Max builds this construction using some small equally big cubes. If he looks at his construction from above, the plan on the right tells the number of cubes in every tower. How big is the sum of the numbers covered by the two hearts?
- (A) 3      (B) 4      (C) 5      (D) 6      (E) 7



18. Georg starts his training at 5 o'clock in the afternoon. It takes him 5 minutes to get to the bus stop. The bus journey takes 15 minutes. Then he has to walk for 5 minutes to get to the pitch. The bus comes at 6 o'clock in the morning for the first time and then every 10 minutes. What is the latest possible time he has to leave the house in order to be at the pitch on time?



19. Four brothers have eaten 11 biscuits altogether. Everyone has eaten at least one biscuit but all of them have eaten a different amount of biscuits. Three of the brothers ate 9 biscuits altogether, where one of them got exactly 3 biscuits. How many biscuits did the boy who had the most biscuits eat?
- (A) 3      (B) 4      (C) 5      (D) 6      (E) 7

20. A number is written into every square of a 4 x 4 table. Mary is looking for the 2 x 2 table where the sum of the four numbers is greatest. How big is this sum?
- (A) 11      (B) 12      (C) 13      (D) 14      (E) 15

1	2	1	3
4	1	1	2
1	7	3	2
2	1	3	1

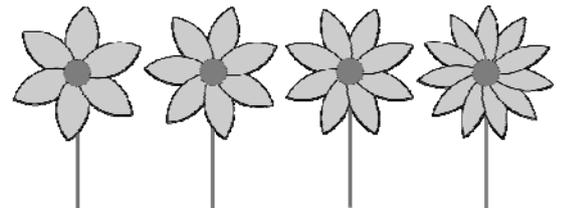
21. Five boys share 10 bags of marbles between themselves. Everyone gets exactly two bags:



- Alex gets 5 marbles, Bob 7, Charles 9 and Dennis 15. Eric gets the two bags that are left over. How many marbles does he get?
- (A) 9      (B) 11      (C) 13      (D) 17      (E) 19

22. A small zoo has a giraffe, an elephant, a lion and a turtle. Susi wants to visit exactly two of the animals today but does not want to start with the lion. How many different possibilities does she have, to visit the two animals one after the other?
- (A) 3      (B) 7      (C) 8      (D) 9      (E) 12

23. Kate has four flowers, which have 6, 7, 8 and 11 petals respectively. She now tears off one petal from each of three different flowers. She repeats this until it is no longer possible to tear off one petal from each of three different flowers. What is the minimum number of petals left over?
- (A) 1      (B) 2      (C) 3      (D) 4      (E) 5



24. Leonie has hidden a Smiley behind some of the grey boxes. The numbers state how many Smileys there are in the neighbouring boxes. Two boxes are neighbouring if they have one side or one corner in common. How many Smileys has Leonie hidden?
- (A) 4      (B) 5      (C) 7      (D) 8      (E) 11

		3	3	
2				
			2	
	1			

# Känguru der Mathematik 2017 Level Benjamin (Grade 5 and 6) Österreich – 16. 3. 2017



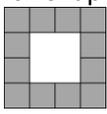
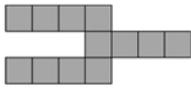
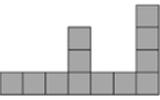
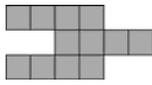
## - 3 Points Questions -

1. Four cards are placed in this order: 2 0 1 7  
Which order cannot be obtained, if only two cards are swapped?

- (A) 2 7 1 0    (B) 0 1 2 7    (C) 1 0 2 7    (D) 0 2 1 7    (E) 2 0 7 1

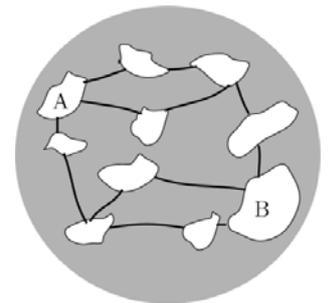
2. A fly has 6 legs, a spider 8.  
Therefore 3 flies and 2 spiders together have the same amount of legs as 9 chickens and  
(A) 2 cats    (B) 3 cats    (C) 4 cats    (D) 5 cats    (E) 6 cats

3. Anna has four identical building blocks that each look like this:   
Which shape can she not form with them?

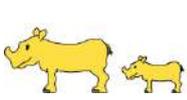
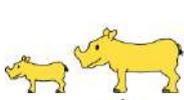
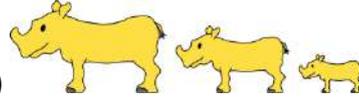
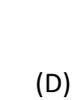
- (A)     (B)     (C)     (D)     (E) 

4. Kevin knows that  $1111 \times 1111 = 1234321$ . Which result does he get for  $1111 \times 2222$ ?  
(A) 3456543    (B) 2345432    (C) 2234322    (D) 2468642    (E) 4321234

5. The 10 islands are connected by 12 bridges (see diagram). All bridges are open for traffic.  
What is the minimum number of bridges that need to be closed off, so that the traffic between A and B comes to a halt?  
(A) 1    (B) 2    (C) 3    (D) 4    (E) 5



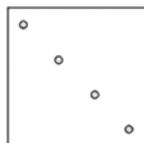
6. Jane, Kate and Lynn go for a walk. Jane walks at the very front, Kate in the middle and Lynn at the very back. Jane weighs 500 kg more than Kate and Kate weighs 1000 kg less than Lynn.  
Which of the following pictures shows Jane, Kate and Lynn in the right order?

- (A)     (B)     (C)     (D)   
(E) 

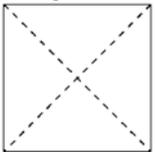
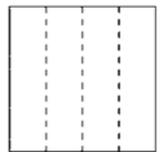
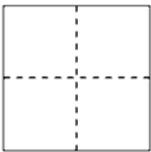
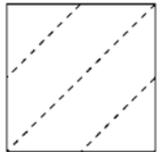
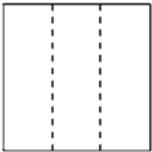
7. Max colours in the squares of the grid, so that one third of all squares are blue and one half of all squares are yellow. The rest he colours in red. How many squares does he have to colour in red?  
(A) 1    (B) 2    (C) 3    (D) 4    (E) 5



8. Bob folds a piece of paper, then punches a hole into the paper and unfolds it again.



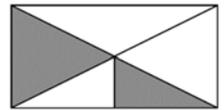
The unfolded paper then looks like this:  
Along which dotted line has Bob folded the paper beforehand?

- (A)     (B)     (C)     (D)     (E) 

**- 4 Points Questions -**

9. A rectangle is twice as long as wide. Which fraction of the rectangle is coloured in grey?

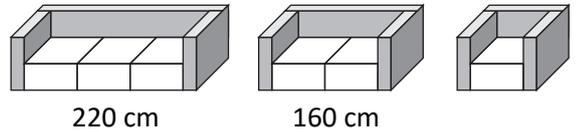
- (A)  $\frac{1}{4}$       (B)  $\frac{3}{8}$       (C)  $\frac{3}{4}$       (D)  $\frac{1}{2}$       (E)  $\frac{3}{5}$



10. Only four players score goals in a handball game. Each one scored a different number of goals. Michael scored the fewest number of goals. If the other players altogether managed to score 20 goals in total, what is the maximum number of goals Michael could have scored?

- (A) 2      (B) 3      (C) 4      (D) 5      (E) 6

11. A furniture shop sells 3-seater, 2-seater and 1-seater sofas that each have an equally wide armrest on the left and the right hand side. Each seat is equally wide (see picture). Together with the armrests the 3-seater sofa is 220 cm and the 2-seater sofa 160 cm wide.



How wide is the 1-seater sofa?

- (A) 60 cm      (B) 80 cm      (C) 90 cm      (D) 100 cm      (E) 120 cm

12. Tom strings together the numbers from 1 to 20 and obtains the 31-digit number 1234567891011121314151617181920.

Then he deletes 24 digits of the number, so that the remaining number is as big as possible. Which number does he obtain?

- (A) 9671819      (B) 9567892      (C) 9781920      (D) 9912345      (E) 9818192

13. There is a number written on every face of a special die. The sum of the numbers, which are on opposite sides to each other, is always equally big. Five of the six numbers are 5, 6, 9, 11 and 14. Which number is on the sixth face?

- (A) 4      (B) 7      (C) 8      (D) 13      (E) 15

14. Paul goes on a 5-day hiking trek. He starts on Monday and finishes on Friday. Every day he covers 2 km more than the day before. In total he hikes 70 km.

Which distance does he cover on Thursday?

- (A) 12 km      (B) 13 km      (C) 14 km      (D) 15 km      (E) 16 km

15. Boris wants to increase his pocket money. To achieve this a fairy gives him three magic wands. He has to use every single one exactly once.

Magic wand "+1" increases his money by 1 €



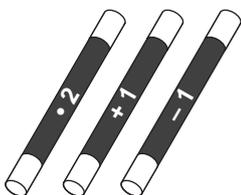
Magic wand "-1" decreases it by 1 €.



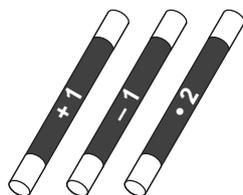
Magic wand "•2" doubles it.



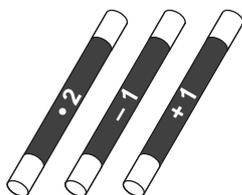
In which order does he have to use the magic wands, in order to get the most money?



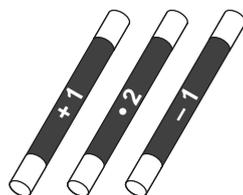
(A)



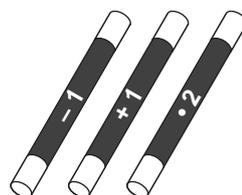
(B)



(C)



(D)

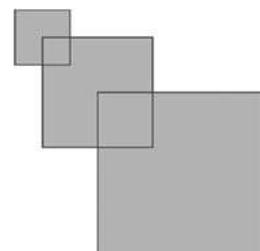


(E)

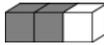
16. Raphael has three squares. The first one has side length 2 cm, the second one has side length 4 cm and one corner is the centre of the first square. The third square has side length 6 cm and one corner is the centre of the second square.

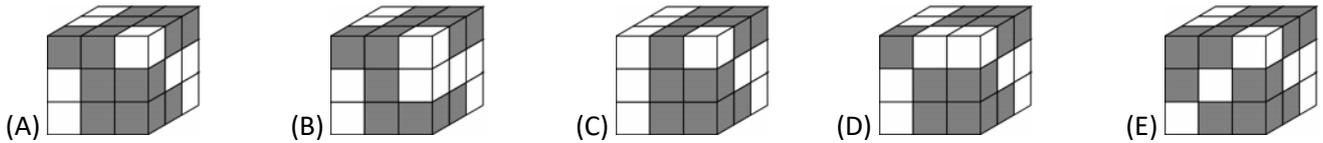
What is the total area of the figure shown?

- (A) 51 cm<sup>2</sup>      (B) 32 cm<sup>2</sup>      (C) 27 cm<sup>2</sup>      (D) 16 cm<sup>2</sup>      (E) 6 cm<sup>2</sup>



**- 5 Points Questions -**

17. A big cube is made up of 9 identical building blocks. Each building block looks like this:  Which big cube is possible?



18. The numbers 1, 2, 3, 4 and 5 have to be written into the five fields of this diagram according to the following rules: If one number is below another number, it has to be greater; if one number is to the right of another, it has to be greater. How many ways are there to place the numbers?



- (A) 3      (B) 4      (C) 5      (D) 6      (E) 8

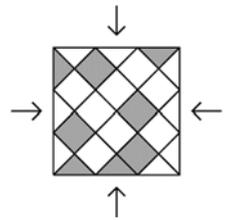
19. There are eight kangaroos in a row, as seen in the picture.



Two kangaroos, that are standing next to each other and that are looking into each others eyes, are changing places by hopping past each other. This is carried out until no more jumps are possible. How often did a change of places occur?

- (A) 2      (B) 10      (C) 12      (D) 13      (E) 16

20. A square floor is made up of triangular and square tiles in grey and white. What is the smallest number of grey tiles that have to be swapped with white tiles, so that the floor looks the same from all four given viewing directions?

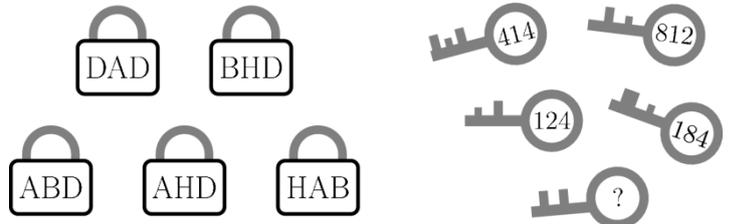


- (A) three triangles, one square      (B) one triangle, three squares      (C) one triangle, one square  
(D) three triangles, three squares      (E) three triangles, two squares

21. In a bag there are only red and green marbles. If one randomly takes out five marbles, there is at least one red one. If one randomly takes out six marbles, there is at least one green one. What is the maximum number of marbles in the bag?

- (A) 11      (B) 10      (C) 9      (D) 8      (E) 7

22. Each one of the 5 keys locks exactly one padlock. Every letter on a padlock stands for exactly one digit, same letters mean same digits. Which digits are on the key with the question mark?

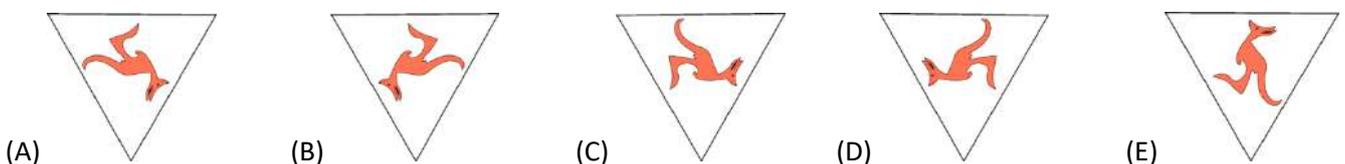
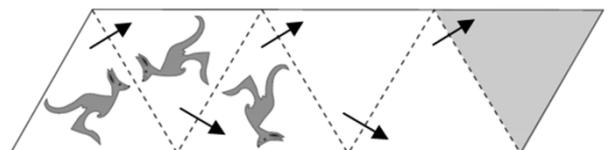


- (A) 382      (B) 282      (C) 284      (D) 823      (E) 824

23. Petra likes even numbers, Ina likes numbers that are divisible by three and Celina numbers that are divisible by 5. In a basket there are 8 balls, each with one number written on them. Each one of the three girls went to the basket on their own and took all balls according to their preferences. Petra took 32 and 52, Ina took 24, 33 and 45, and Celina took 20, 25 and 35. In which order did they go to the basket?

- (A) Petra, Celina, Ina      (B) Celina, Ina, Petra      (C) Ina, Petra, Celina      (D) Ina, Celina, Petra      (E) Celina, Petra, Ina

24. The first kangaroo is repeatedly mirrored along the dotted lines. Two reflections were already carried out. In which position is the kangaroo in the grey triangle?



- (A)      (B)      (C)      (D)      (E)

# Känguru der Mathematik 2017

## Level Kadett (Grade 7 and 8)

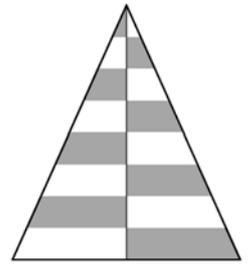
### Österreich – 16. 3. 2017



#### 3 Points Questions

**1** The diagram shows an isosceles triangle, where the height is marked and its area is split up into equally wide white and grey stripes. Which fraction of the area of the triangle is white?

- (A)  $\frac{1}{2}$       (B)  $\frac{1}{3}$       (C)  $\frac{2}{3}$       (D)  $\frac{3}{4}$       (E)  $\frac{2}{5}$



**2** What is the time 17 hours after 17 o'clock?

- (A) 8:00      (B) 10:00      (C) 11:00      (D) 12:00      (E) 13:00

**3** Which number has to be subtracted from  $-17$  in order to obtain  $-33$ ?

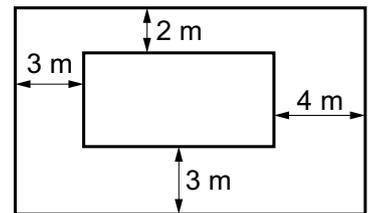
- (A)  $-50$       (B)  $-16$       (C)  $16$       (D)  $40$       (E)  $50$

**4** Which statement is correct?

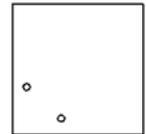
- (A)  $\frac{4}{1} = 1.4$       (B)  $\frac{5}{2} = 2.5$       (C)  $\frac{6}{3} = 3.6$       (D)  $\frac{7}{4} = 4.7$       (E)  $\frac{8}{5} = 5.8$

**5** The diagram shows two rectangles whose sides are parallel to each other. By how much is the perimeter of the bigger rectangle greater than the perimeter of the smaller rectangle?

- (A) 12 m      (B) 16 m      (C) 20 m      (D) 21 m      (E) 24 m



**6** Paul folds a piece of paper, then punches a hole into the paper and unfolds it again. The unfolded paper then looks like the picture on the right.



Along which dotted line can Paul have folded the paper beforehand?

- (A)      (B)      (C)      (D)      (E)

**7** The sum of three different positive whole numbers is 7. How big is their product?

- (A) 12      (B) 10      (C) 9      (D) 8      (E) 5

**8** Petra crafts a piece of jewellery out of two black and two white hearts. The hearts have areas of  $1 \text{ cm}^2$ ,  $4 \text{ cm}^2$ ,  $9 \text{ cm}^2$  and  $16 \text{ cm}^2$  respectively. She places the hearts on top of each other as shown in the diagram and glues them together.

How big is the total area of the visible black parts?

- (A)  $9 \text{ cm}^2$       (B)  $10 \text{ cm}^2$       (C)  $11 \text{ cm}^2$       (D)  $12 \text{ cm}^2$       (E)  $13 \text{ cm}^2$



**9** Yvonne has 20 €, each of her four sisters has 10 €. How much does Yvonne have to give to each of her sisters so that all of them have the same amount of money?

- (A) 2      (B) 4      (C) 5      (D) 8      (E) 10

**10** Some girls are standing in a circle. The teacher makes them do a headcount. Bianca says one, her neighbour says two and so on. If they count in a clockwise direction, Antonia says five. If they count in an anticlockwise direction, Antonia says eight.

How many girls are forming the circle?

- (A) 9      (B) 10      (C) 11      (D) 12      (E) 13

**- 4 Points Questions -**

**11** Ant Annie starts at the left end of the stick and crawls  $\frac{2}{3}$  of the length of the stick. Ladybird Bob starts at the right end of the stick and crawls  $\frac{3}{4}$  of the length of the stick. Which fraction of the length of the stick are they then apart from each other?



- (A)  $\frac{3}{8}$       (B)  $\frac{1}{12}$       (C)  $\frac{5}{7}$       (D)  $\frac{5}{12}$       (E)  $\frac{7}{12}$

**12** One sixth of all spectators in a children's theater are adults, the rest are children. Two fifths of the children are girls. Which fraction of all spectators are boys?

- (A)  $\frac{1}{2}$       (B)  $\frac{1}{3}$       (C)  $\frac{1}{4}$       (D)  $\frac{1}{5}$       (E)  $\frac{2}{5}$

**13** The black and the dashed line together form seven equilateral triangles. The dashed line is 20 cm long. How long is the black line?



- (A) 25 cm      (B) 30 cm      (C) 35 cm      (D) 40 cm      (E) 45 cm

**14** Four cousins are 3, 8, 12 and 14 years old. Emma is younger than Rita. The sum of the ages of Zita and Emma is divisible by 5, as is the sum of the ages of Zita and Rita. How old is Ina (the 4<sup>th</sup> cousin)?

- (A) 14      (B) 12      (C) 8      (D) 2017      (E) 3

**15** More than 800 people take part in the kangaroo-run. Amongst the participants 35 % are female. There are 252 more male than female participants. How many people in total are taking part in the run?

- (A) 802      (B) 810      (C) 822      (D) 824      (E) 840

**16** Ria wants to write a number into each box. She has already written two numbers. The sum of all five numbers should be 35, the sum of the first three numbers should be 22, the sum of the last three numbers should be 25. What is the product Ria gets, if she multiplies the two numbers in the grey boxes?

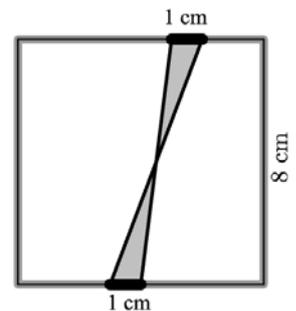


- (A) 63      (B) 108      (C) 0      (D) 48      (E) 39

**17** Simon wants to cut a piece of wire into 9 equally long pieces and makes marks where he needs to make his cuts. Barbara wants to cut the same piece of wire into 8 equally long pieces and makes marks where she needs to make her cuts. Carl cuts the piece of wire at every mark. How many pieces does Carl get?

- (A) 15      (B) 16      (C) 17      (D) 18      (E) 19

**18** Two 1 cm long segments are marked on opposite sides of a square with side length 8 cm. The end points of the segments are connected with each other as shown in the diagram. How big is the area of the grey part?



- (A) 2 cm<sup>2</sup>      (B) 4 cm<sup>2</sup>      (C) 6.4 cm<sup>2</sup>      (D) 8 cm<sup>2</sup>      (E) 10 cm<sup>2</sup>

**19** Tycho plans his running training. Each week he wants to go for a run on the same weekdays. He never wants to go for a run on two consecutive days. But he wants to go for a run two days a week. How many different weekly plans meet those conditions?

- (A) 16      (B) 14      (C) 12      (D) 10      (E) 8

**20** Emily wants to insert nine numbers into the 3 x 3 table so that the sum of the numbers in two adjacent cells (with a common side) is always the same. She has already written two numbers into the table. How big is the sum of all nine numbers?

2		
		3

- (A) 18      (B) 20      (C) 21      (D) 22      (E) 23

**- 5 Points Questions -**

**21** If you measure the angles of a triangle, you obtain three different natural numbers. What is the smallest possible sum of the biggest and the smallest angle of the triangle?

- (A) 61°      (B) 90°      (C) 91°      (D) 120°      (E) 121°

**22** There are 10 kangaroos in a row, as seen in the picture. Two kangaroos, that are standing next to each other and can see each other are allowed to change places by hopping past each other. This is carried out until no more jumps are allowed. How often do two kangaroos swap places?



- (A) 15      (B) 16      (C) 18      (D) 20      (E) 21

**23** Diana adds either 2 or 5 to every whole number from 1 to 9. She wants to achieve as few different sums as possible. What is the minimum number of different values she obtains?

- (A) 5      (B) 6      (C) 7      (D) 8      (E) 9

**24** Every three minutes a bus is leaving the airport to drive to the city centre. A car leaves the airport at the same time as a bus and travels the same route as the bus to the city centre. Every bus takes 60 minutes for the journey from the airport to the city centre, the car only 35 minutes.

How many buses does the car overtake on its way to the city centre? The bus that starts at the same time as the car does not count.

- (A) 8      (B) 9      (C) 10      (D) 11      (E) 13

**25** The diagram shows Maria's square tablecloth to scale. All small light squares are equally big and their diagonals are parallel to the sides of the table cloth.

Which part of the whole table cloth is black?

- (A) 16 %      (B) 24 %      (C) 25 %      (D) 32 %      (E) 36 %

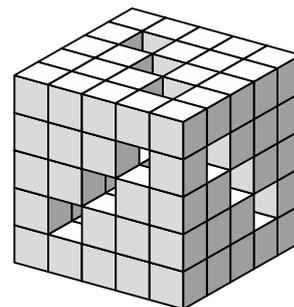


**26** The number sequence 2, 3, 6, 8, 8, ... is created by the following rule: The first two digits are 2 and 3. After that every subsequent digit is the unit digit of the product of the two previous digits. Which digit is the 2017<sup>th</sup> digit of the sequence?

- (A) 2      (B) 3      (C) 4      (D) 6      (E) 8

**27** Mike has 125 small, equally big cubes. He glues some of them together in such a way that one big cube with exactly nine tunnels is created (see diagram). The tunnels go all the way straight through the cube.

- (A) 52      (B) 45      (C) 42      (D) 39      (E) 36



**28** Two runners are training at the same time on a 720 m long, round running track. They run with constant speed in opposite directions. The first runner needs four minutes for one lap, the second five minutes.

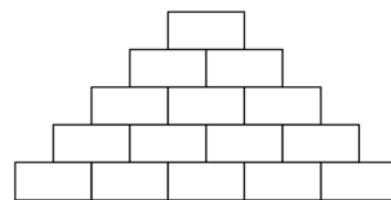
How many meters does the second runner run in between two consecutive meetings of the two runners?

- (A) 355      (B) 350      (C) 340      (D) 330      (E) 320

**29** Sarah wants to write a positive whole number onto every tile in the number wall shown, so that every number is equal to the sum of the two numbers on the tiles that are directly below.

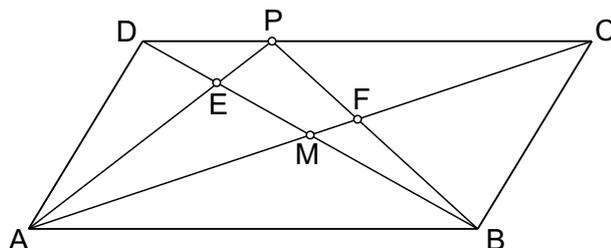
What is the maximum number of odd numbers Sarah can write on the tiles?

- (A) 5      (B) 7      (C) 8      (D) 10      (E) 11



**30** The parallelogram has area 1. The two diagonals intersect each other at point M. Another point P lies on the side DC. E is the point of intersection of the segments AP and BD, and F is the point of intersection of the segments BP and AC. What is the area of the quadrilateral EMFP, if the sum of the areas of the triangles AED and BFC is  $\frac{1}{3}$ ?

- (A)  $\frac{1}{6}$       (B)  $\frac{1}{8}$       (C)  $\frac{1}{10}$       (D)  $\frac{1}{12}$       (E)  $\frac{1}{14}$



# Känguru der Mathematik 2017

## Level Junior (Grade 9 and 10)

### Österreich – 16. 3. 2017



#### - 3 Points Questions -

1 The value of  $\frac{20 \cdot 17}{2+0+1+7}$  equals

- (A) 3.4      (B) 17      (C) 34      (D) 201.7      (E) 340

2 Peter writes the word KANGAROO on a see-through piece of glass, as seen on the right. What can he see when he first flips over the glass onto its back along the right-hand side edge and then turns it about  $180^\circ$  while it is lying on the table?



- (A) (B) (C) (D) (E) (Note: The options in the image are more complex than the text description, showing various reflections and rotations of the word.)

3 Angelika crafts a piece of jewellery out of two grey and two white stars. The stars have areas of  $1 \text{ cm}^2$ ,  $4 \text{ cm}^2$ ,  $9 \text{ cm}^2$  and  $16 \text{ cm}^2$  respectively. She places the stars on top of each other as shown in the diagram and glues them together.



How big is the total area of the visible grey parts?

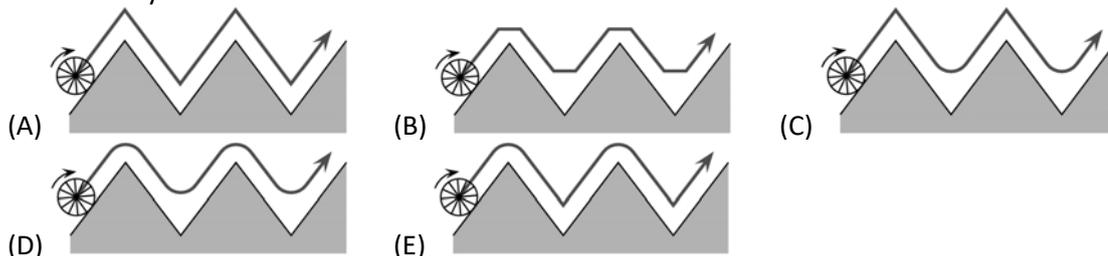
- (A)  $9 \text{ cm}^2$       (B)  $10 \text{ cm}^2$       (C)  $11 \text{ cm}^2$       (D)  $12 \text{ cm}^2$       (E)  $13 \text{ cm}^2$

4 Maria has 24 Euros. Each of her 3 sisters has 12 Euros.

How much does she have to give to each sister so that all four of them have the same amount of Euros?

- (A) 1      (B) 2      (C) 3      (D) 4      (E) 6

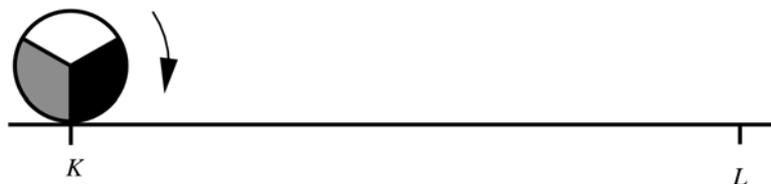
5 A wheel rolls along a zigzag curve as can be seen below. Which of the following pictures shows the curve that is described by the centre of the wheel?



6 Some girls are standing in a circle. The teacher makes them do a headcount. Bianca says one, her neighbour says two and so on. If they count in a clockwise direction, Antonia says six. If they count in an anticlockwise direction, Antonia says nine. How many girls are forming the circle?

- (A) 11      (B) 12      (C) 13      (D) 14      (E) 15

7 A circle with radius 1 rolls along a straight line from point  $K$  to point  $L$ , as shown, with  $KL = 11\pi$ . In which position is the circle when it has arrived in  $L$ ?



- (A) (B) (C) (D) (E)

8 Martina plays chess. This season she has already played 15 games, nine of which she has won. She still has to play 5 more games.

How high is her win rate at the end of the season if she wins all remaining games?

- (A) 60 %      (B) 65 %      (C) 70 %      (D) 75 %      (E) 80 %

9 At a wedding one eighth of the guests is underage. Three sevenths of the adult guests are men. How big is the fraction of adult women amongst all guests?

- (A)  $\frac{1}{2}$  (B)  $\frac{1}{3}$  (C)  $\frac{1}{5}$  (D)  $\frac{1}{7}$  (E)  $\frac{3}{7}$

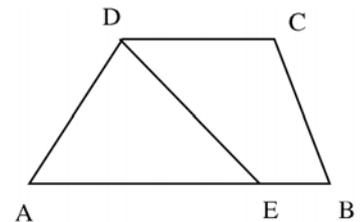
10 A whimsical teacher has a box with 203 red, 117 white and 28 blue buttons. He asks his students to each take one button out of the box without looking. What is the minimum number of students who have to take a button so that definitely at least three of the buttons picked have the same colour?

- (A) 3 (B) 6 (C) 7 (D) 28 (E) 203

**- 4 Points Questions -**

11  $ABCD$  is a trapezium with parallel sides  $AB$  and  $CD$ . Let  $AB = 50$  and  $CD = 20$ . Point  $E$  lies on side  $AB$  in such a way that the straight line  $DE$  divides the trapezium into two shapes of equal area. How long is the straight line  $AE$ ?

- (A) 25 (B) 30 (C) 35 (D) 40 (E) 45



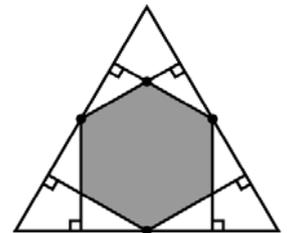
12 How many positive whole numbers  $n$  have the property that exactly one of the two numbers  $n$  and  $n + 20$  has four digits?

- (A) 19 (B) 20 (C) 38 (D) 39 (E) 40

13 In an equilateral triangle with area 1, we draw the six perpendicular lines from the midpoints of each side to the other two sides as seen in the diagram.

How big is the area of the grey hexagon that has been created this way?

- (A)  $\frac{1}{3}$  (B)  $\frac{2}{5}$  (C)  $\frac{4}{9}$  (D)  $\frac{1}{2}$  (E)  $\frac{2}{3}$

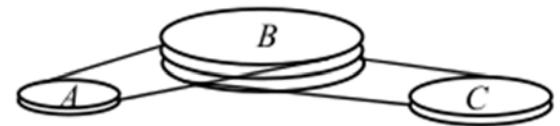


14 The sum of the squares of three consecutive positive whole numbers is 770. What is the biggest of these numbers?

- (A) 15 (B) 16 (C) 17 (D) 18 (E) 19

15 A belt system is made up of wheels  $A$ ,  $B$  and  $C$ , which rotate without sliding.  $B$  rotates 4 times around, while  $A$  turns 5 times around, and  $B$  rotates 6 times around, while  $C$  turns 7 times around. The circumference of  $C$  is 30 cm. How big is the circumference of  $A$ ?

- (A) 27 cm (B) 28 cm (C) 29 cm (D) 30 cm (E) 31 cm



16 Tycho plans his running training. Each week he wants to go for a run on the same weekdays. He never wants to go for a run on two consecutive days. But he wants to go for a run three days a week. How many different weekly plans meet those conditions?

- (A) 6 (B) 7 (C) 9 (D) 10 (E) 35

17 Four brothers have different heights. Tobias is as many centimeters smaller than Viktor, as he is taller than Peter. Oskar on the other hand is equally many centimeters smaller than Peter. Tobias is 184 cm tall, and on average the four brothers are 178 cm tall. How tall is Oskar?

- (A) 160 cm (B) 166 cm (C) 172 cm (D) 184 cm (E) 190 cm

18 During our holidays it rained on 7 days. If it rained before noon, then there was no rain in the afternoon. If it rained in the afternoon, there was no rain before noon. There were 5 days without rain before noon and six days without rain in the afternoon. How many days long was our holiday?

- (A) 7 (B) 8 (C) 9 (D) 10 (E) 11

19 Jenny wants to write numbers into the cells of a  $3 \times 3$ -table so that the sum of the numbers in each of the four  $2 \times 2$ -squares are equally big. As it is shown in the diagram, she has already inserted three numbers. What number does she have to write into the cell in the fourth corner?

- (A) 5 (B) 4 (C) 1 (D) 0 (E) The number cannot be uniquely determined.

3		1
2		?

20 Seven positive whole numbers  $a, b, c, d, e, f, g$  are written down next to each other in this order. The sum of all seven numbers is 2017. Every two adjacent numbers always differ by 1. Which number can be equal to 286?

- (A) only  $a$  or  $g$  (B) only  $b$  or  $f$  (C) only  $c$  or  $e$  (D) only  $d$  (E) all

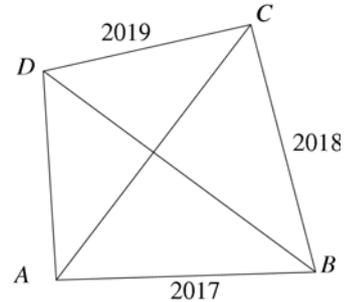
- 5 Points Questions -

**21** In the primate enclosure in a zoo there are four gorillas. They are all younger than 18 years old. No two have the same age, and all their ages are whole numbers. The product of their ages is 882. How big is the sum of their ages?  
 (A) 23      (B) 25      (C) 27      (D) 31      (E) 33

**22** The numbers -3, -2, -1, 0, 1, 2 are written on the six faces of a die. The die is rolled twice. The numbers that were rolled are multiplied. How big is the probability that this product is negative?

- (A)  $\frac{1}{2}$       (B)  $\frac{1}{4}$       (C)  $\frac{11}{36}$       (D)  $\frac{13}{36}$       (E)  $\frac{1}{3}$

**23** In a convex quadrilateral  $ABCD$  the diagonals are perpendicular to each other. The length of the edges are  $AB = 2017$ ,  $BC = 2018$  and  $CD = 2019$  (diagram not to scale). How long is side  $AD$ ?



- (A) 2016    (B) 2018    (C)  $\sqrt{2020^2 - 4}$     (D)  $\sqrt{2018^2 + 2}$     (E) 2020

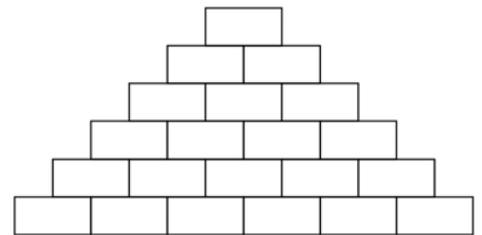
**24** A popular two-digit number is made up of the digits  $a$  and  $b$ . If the number pair is written down three times one after the other, a six-digit number is obtained. This new number is always divisible by

- (A) 2      (B) 5      (C) 7      (D) 9      (E) 11

**25** My friend Heinz wants to use a special password that is made up of seven digits. Each digit used in the password appears as many times in the password as is the value of the digit. Additionally, equal digits are always next to each other. Therefore he can for example use 4444333 or 1666666 as passwords. How many possible passwords can he choose from?

- (A) 6    (B) 7    (C) 10    (D) 12    (E) 13

**26** Paul wants to write a positive whole number onto every tile in the number wall shown, so that every number is equal to the sum of the two numbers on the tiles that are directly below.



What is the maximum number of odd numbers he can write on the tiles?

- (A) 13      (B) 14      (C) 15      (D) 16      (E) 17

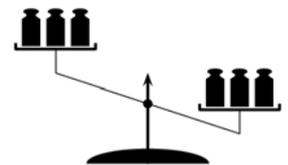
**27** Lisa places some points on a circle and then connects them in sequence to make a polygon. She adds up the interior angles of the polygon. By mistake she misses out one angle and obtains the sum 2017. How big is the angle that she has overlooked?

- (A)  $37^\circ$       (B)  $53^\circ$       (C)  $97^\circ$       (D)  $127^\circ$       (E)  $143^\circ$

**28** 30 dancers are standing in a circle facing the centre. The dance instructor shouts "Left" and many of them turn  $90^\circ$  to the left. Unfortunately, some are confused and turn right, so that some dancers are now directly facing each other. All of the ones that are facing each other are shaking their head. It turns out that 10 dancers shake their head. Then the dance instructor says "Turn around" and all of them turn  $180^\circ$  to look in the opposite direction. Again, all of the ones that are directly facing each other shake their head. How many dancers are shaking their head second time round?

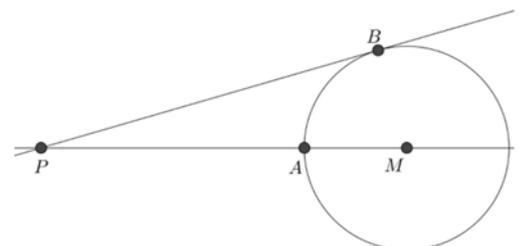
- (A) 10    (B) 20    (C) 8    (D) 15    (E) It cannot be uniquely determined.

**29** Three weights are randomly placed on each tray of a beam balance. The balance dips to the right hand side as shown on the picture. The masses of the weights are 101, 102, 103, 104, 105 and 106 grams. For how many percent of the possible distributions is the 106-grams-weight on the right (heavier) side?



- (A) 75 %    (B) 80 %    (C) 90 %    (D) 95 %    (E) 100 %

**30** The points  $A$  and  $B$  lie on a circle with centre  $M$ . The point  $P$  lies on the straight line through  $A$  and  $M$ .  $PB$  touches the circle in  $B$ . The lengths of the segments  $PA$  and  $MB$  are whole numbers, and  $PB = PA + 6$ . How many possible values for  $MB$  are there?



- (A) 0      (B) 2      (C) 4      (D) 6      (E) 8

# Känguru der Mathematik 2017

## Level Student (Grade 11 to 13)

### Österreich - 16. 3. 2017

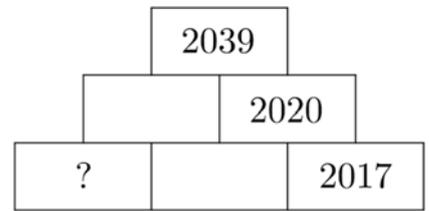


#### 3 Point Questions

**1** On the number wall shown the number on each tile is equal to the sum of the numbers on the two tiles directly below it.

Which number is on the tile marked with “?” ?

- (A) 15      (B) 16      (C) 17      (D) 18      (E) 19

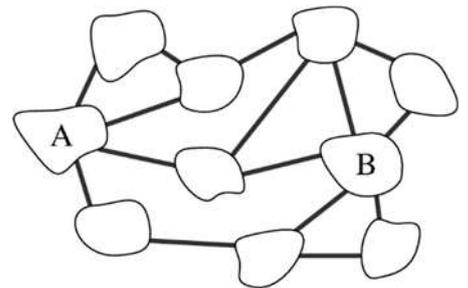


**2** Many model railways use the H0-scale 1:87. For his railway Benjamin owns a 2 cm high model of his brother in H0-scale. How tall is his brother in reality?

- (A) 1.74 m      (B) 1.62 m      (C) 1.86 m      (D) 1.94 m      (E) 1.70 m

**3** In the diagram we see 10 islands that are connected by 15 bridges. What is the minimum number of bridges that need to be closed off so that there is no connection from A to B anymore?

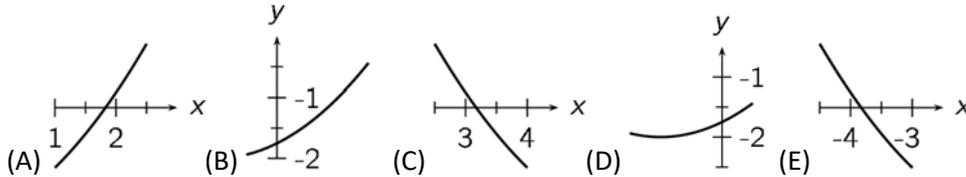
- (A) 1      (B) 2      (C) 3      (D) 4      (E) 5



**4** Two positive numbers  $a$  and  $b$  have the following property: 75 % of  $a$  is equal to 40 % of  $b$ . From that follows:

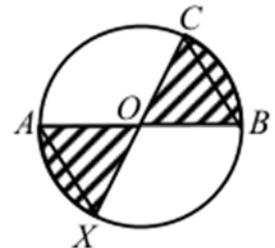
- (A)  $15a = 8b$       (B)  $7a = 8b$       (C)  $3a = 2b$       (D)  $5a = 12b$       (E)  $8a = 15b$

**5** Four of the following five pictures show pieces of the graph of the same quadratic function. Which piece does not belong?

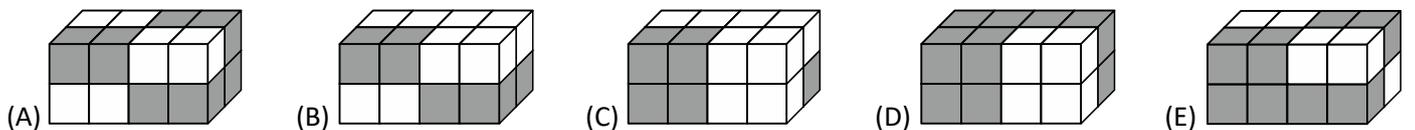


**6** The diagram shows a circle with centre  $O$  and the diameters  $AB$  and  $CX$ . Let  $OB = BC$ . Which fraction of the circle area is shaded?

- (A)  $\frac{2}{5}$       (B)  $\frac{1}{3}$       (C)  $\frac{2}{7}$       (D)  $\frac{3}{8}$       (E)  $\frac{4}{11}$

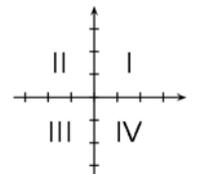


**7** A  $4 \times 1 \times 1$  cuboid is made up of 2 white and 2 grey cubes as shown. Which of the following cuboids can be build entirely out of such  $4 \times 1 \times 1$  cuboids?



**8** Which quadrant contains no points of the graph of the linear function  $f(x) = -3.5x + 7$ ?

- (A) I      (B) II      (C) III      (D) IV      (E) Every quadrant contains at least one point of the graph.



**9** In each of the five boxes (A) to (E) there are red and blue balls. Benedict wants to take exactly one ball without looking, out of one of these boxes and hopes to get a blue ball. In which box is the probability of that happening greatest?

- (A) 10 blues, 8 reds      (B) 6 blues, 4 reds      (C) 8 blues, 6 reds      (D) 7 blues, 7 reds      (E) 12 blues, 9 reds

**10** The graph of which of the following functions has the most intersections with the graph of the function  $f(x) = x$  ?

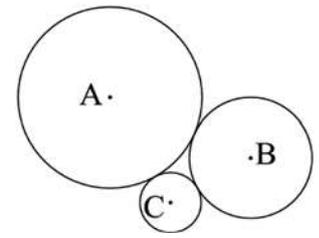
- (A)  $g_1(x) = x^2$       (B)  $g_2(x) = x^3$       (C)  $g_3(x) = x^4$       (D)  $g_4(x) = -x^4$       (E)  $g_5(x) = -x$

- 4 Point Questions -

**11** Three circles with centres  $A, B, C$  touch each other in pairs from the outside (see diagram). Their radii are 3, 2 and 1.

How big is the area of the triangle  $ABC$ ?

- (A) 6            (B)  $4\sqrt{3}$             (C)  $3\sqrt{2}$             (D) 9            (E)  $2\sqrt{6}$



**12** The positive number  $p$  is smaller than 1, and the number  $q$  is greater than 1.

Which of the following numbers is biggest?

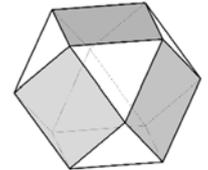
- (A)  $p \times q$             (B)  $p + q$             (C)  $\frac{p}{q}$             (D)  $p$             (E)  $q$

**13** Two cylinders  $A$  and  $B$  have the same volume. The radius of the base of  $B$  is 10% bigger than that of  $A$ . How much is the height of  $A$  greater than that of  $B$ ?

- (A) 5%            (B) 10%            (C) 11%            (D) 20%            (E) 21%

**14** Each face of the polyhedron shown is either a triangle or a square. Each square borders 4 triangles, and each triangle borders 3 squares. The polyhedron has 6 squares. How many triangles does it have?

- (A) 5            (B) 6            (C) 7            (D) 8            (E) 9



**15** The four faces of a regular tetrahedron are labelled with the four digits 2, 0, 1 and 7 (one digit on each face). For a game, four such tetrahedrons are used as fair dice. All four dice are thrown simultaneously. Three of the four faces of each die can then be seen from above.

What is the probability that we can form the number 2017 using exactly one of the three visible digits of each die?

- (A)  $\frac{1}{256}$             (B)  $\frac{63}{64}$             (C)  $\frac{81}{256}$             (D)  $\frac{3}{32}$             (E)  $\frac{29}{32}$

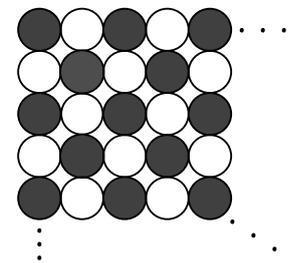
**16** The polynomial  $5x^3 + ax^2 + bx + 24$  has whole number coefficients  $a$  and  $b$ .

Which of the following numbers is definitely not a solution to the equation  $5x^3 + ax^2 + bx + 24 = 0$ ?

- (A) 1            (B) -1            (C) 3            (D) 5            (E) 6

**17** Julia has 2017 round discs available: 1009 black ones and 1008 white ones. Using them, she wants to lay the biggest square pattern (as shown) possible and starts by using a black disc in the left upper corner. Subsequently she lays the discs in such a way that the colours alternate in each row and column. How many discs are left over when she has laid the biggest square possible?

- (A) none            (B) 40 of each colour            (C) 40 black and 41 white ones  
(D) 41 of each colour            (E) 40 white and 41 black ones

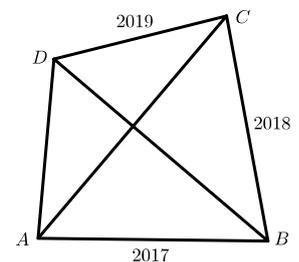


**18** Two consecutive positive whole numbers are written on a board. The sum of the digits of each number is divisible by 7. What is the minimum number of digits the smaller of the two numbers has to have?

- (A) 3            (B) 4            (C) 5            (D) 6            (E) 7

**19** In a convex quadrilateral  $ABCD$  the diagonals are perpendicular to each other. The length of the edges are  $AB = 2017$ ,  $BC = 2018$  and  $CD = 2019$  (diagram not to scale). How long is side  $AD$ ?

- (A) 2016            (B) 2018            (C)  $\sqrt{2020^2 - 4}$             (D)  $\sqrt{2018^2 + 2}$             (E) 2020



**20** Lilli tries to be a well-behaved kangaroo but she is having just too much fun not to

lie every now and then. Therefore every third statement of hers is a lie and the rest is true. Sometimes she starts with a lie and sometimes with one or two true statements. Lilli thinks of a two-digit number and says to her friend:

- 1: "One digit of the number is a 2."            2: "The number is greater than 50."            3: "It is an even number."  
4: "The number is less than 30."            5: "The number is divisible by 3."            6: "One digit of the number is a 7."

How big is the sum of the digits of the number, Lilli is thinking of?

- (A) 9            (B) 12            (C) 13            (D) 15            (E) 17

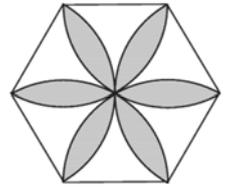
- 5 Point Questions -

**21** How many positive whole numbers have the property that, if you delete the last digit you obtain a new number, which is exactly equal to  $1/14$  of the original number?

- (A) 0            (B) 1            (C) 2            (D) 3            (E) 4

**22** The diagram shows a regular hexagon with side length 1. The grey flower is outlined by circular arcs with radius 1 whose centre's lie in the vertices of the hexagon. How big is the area of the grey flower?

- (A)  $\frac{\pi}{2}$             (B)  $\frac{2\pi}{3}$             (C)  $2\sqrt{3} - \pi$             (D)  $\frac{\pi}{2} + \sqrt{3}$             (E)  $2\pi - 3\sqrt{3}$

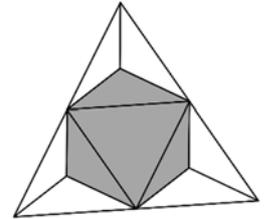


**23** We look at the sequence  $\langle a_n \rangle$  with  $a_1 = 2017$  and  $a_{n+1} = \frac{a_n - 1}{a_n}$ . Then:  $a_{999} =$

- (A)  $-2017$             (B)  $2017$             (C)  $\frac{2016}{2017}$             (D)  $1$             (E)  $-\frac{1}{2016}$

**24** We look at a regular tetrahedron with volume 1. Its four vertices are cut off by planes that go through the midpoints of the respective edges (see diagram). How big is the volume of the remaining solid?

- (A)  $\frac{4}{5}$             (B)  $\frac{3}{4}$             (C)  $\frac{2}{3}$             (D)  $\frac{1}{2}$             (E)  $\frac{1}{3}$



**25** The sum of the three side lengths of a right-angled triangle equals 18. The sum of the squares of these three side lengths equals 128. How big is the area of the triangle?

- (A) 18            (B) 16            (C) 12            (D) 10            (E) 9

**26** Anna has five boxes, as well as five black balls and five white balls. She is allowed to decide how she shares out the balls between the boxes as long as she puts at least one ball into each box. Beate randomly chooses one box and takes one ball without looking. Beate wins if she draws a white ball. Otherwise Anna wins. How should Anna distribute the balls in order to get the highest probability of winning?

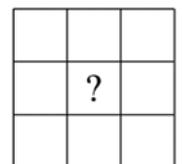
- (A) Anna puts one white and one black ball into each box.  
 (B) Anna distributes the black balls into three of the boxes and the white ones into the remaining two boxes.  
 (C) Anna distributes the black balls into four of the boxes and puts all of the white ones into the remaining box.  
 (D) Anna puts all of the white balls into one box and then puts one black ball into each box.  
 (E) Anna puts all of the black balls into one box and then puts one white ball into each box.

**27** Nine whole numbers were written into the cells of a  $3 \times 3$ -table. The sum of these nine numbers is 500. We know that the numbers in two adjacent cells (with a common sideline) differ by exactly 1. Which number is in the middle cell?

- (A) 50            (B) 54            (C) 55            (D) 56            (E) 57

**28** How big is  $x + y$ , if  $|x| + x + y = 5$  as well as  $x + |y| - y = 10$  holds true?

- (A) 1            (B) 2            (C) 3            (D) 4            (E) 5



**29** How many different three-digit numbers  $ABC$  are there so that  $(A + B)^C$  is a three-digit power of two?

- (A) 15            (B) 16            (C) 18            (D) 20            (E) 21

**30** 2017 people live on an island. Each person is either a liar (who always lies) or a nobleman (who always tells the truth). Over a thousand of them attend a banquet where they all sit together around one big round table. Everyone is saying, "Of my two neighbours, one is a liar and one is a nobleman." What is the maximum number of noblemen on the island?

- (A) 1683            (B) 668            (C) 670            (D) 1344            (E) 1343

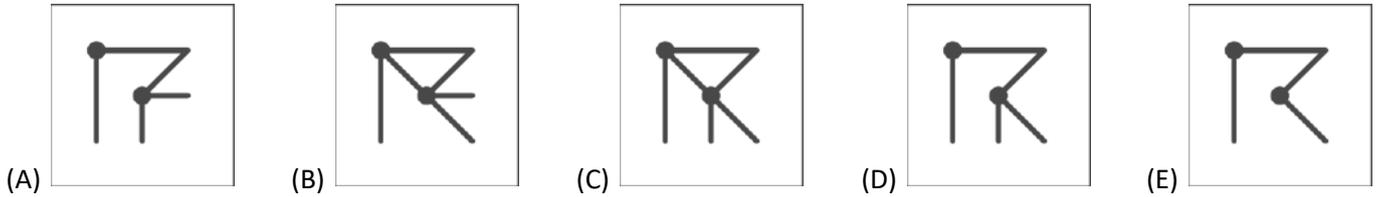
**2017**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
<b>Felix</b>	A	E	C	E	C	C	D	E	B	C	B	B	A	D	D															
<b>Écolier</b>	D	D	E	C	B	A	A	E	E	E	B	C	D	A	C	B	C	A	C	D	E	D	B	B						
<b>Benjamin</b>	B	C	E	D	B	A	C	D	B	C	D	C	E	E	D	A	A	D	D	C	C	C	D	E						
<b>Kadett</b>	A	B	C	B	E	D	D	B	A	C	D	A	D	A	E	A	B	B	B	D	C	C	B	A	D	A	D	E	D	D
<b>Junior</b>	C	E	B	C	E	C	E	C	A	C	C	E	D	C	B	B	A	C	D	A	D	E	D	C	E	B	E	A	B	D
<b>Student</b>	B	A	C	A	C	B	A	C	B	B	A	B	E	D	B	D	E	C	D	D	C	E	E	D	E	D	D	A	E	A

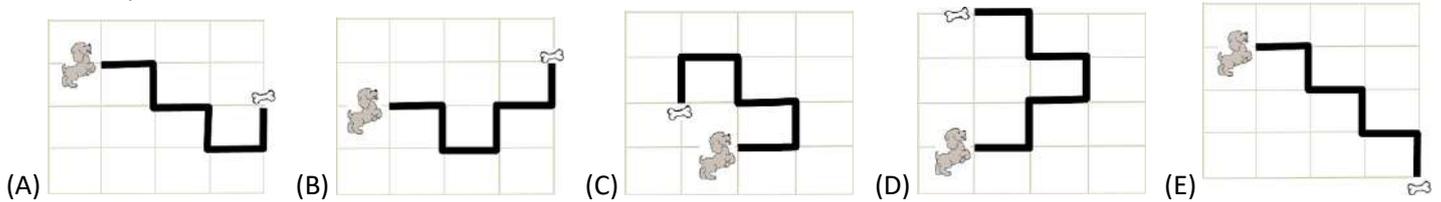


- 4 Point Examples -

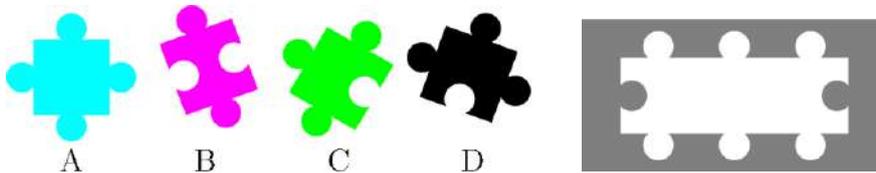
6. This diagram shows two see-through sheets. You place the sheets on top of each other. Which pattern do you get?



7. In order to get to his bone, the dog has to follow the black line. In total he turns 3-times to the right and 2-times to the left. Which path does he take?



8. Lisa needs exactly 3 pieces to complete her jigsaw. Which of the 4 pieces is left over?

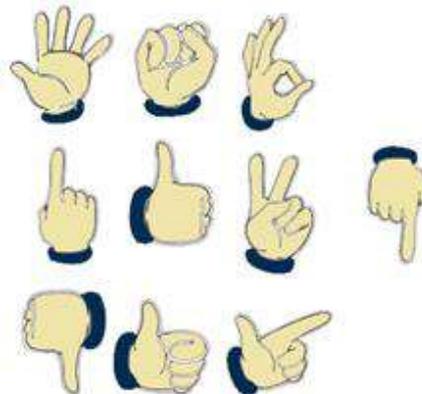


- (A) A      (B) B      (C) C      (D) D      (E) C or D

9. Charles cuts a rope into 3 equally long pieces. Then he makes one knot in one of the pieces, 2 in the next and in the third piece 3 knots. Then he lays the three pieces down in a random order. Which picture does he see?



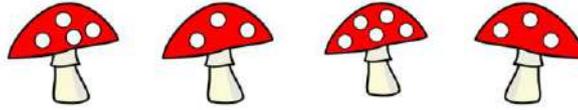
10. How many of the hands pictured show a right hand?



- (A) 3      (B) 4      (C) 5      (D) 6      (E) 7

5 Point Examples

11. The number of spots on the fly agarics (toadstools) shows how many dwarfs fit under it. We can see one side of the fungi. The other side has the same amount of spots. When it rains 36 dwarfs are trying to hide under the fungi. How many dwarfs get wet?



- (A) 2      (B) 3      (C) 4      (D) 5      (E) 6

12. You are forming two-digit numbers using the digits 2, 0, 1 or 8. They have to be bigger than 10 and smaller than 25. Every number is made up of two different digits.

How many different numbers to you get?

- (A) 4      (B) 5      (C) 6      (D) 7      (E) 8

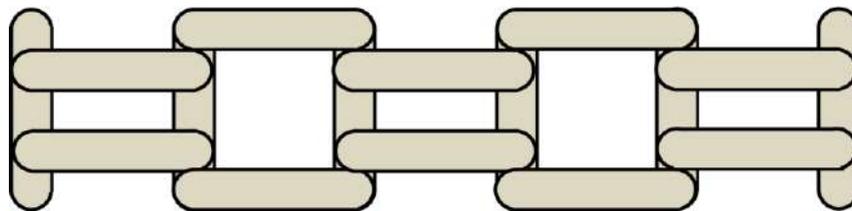
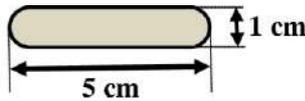
13. Alice has 3 white, 2 black and 2 grey pieces of paper. First she cuts every piece of paper that is not black into two pieces. Then she halves every piece of paper that is not white.

How many pieces of paper does she obtain in total?

- (A) 14      (B) 16      (C) 17      (D) 18      (E) 20

14. Susi makes this pattern using ice-lolly sticks. Each stick is 5 cm long and 1 cm wide.

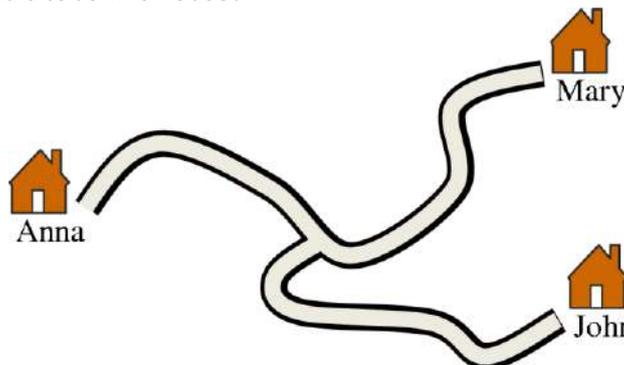
How long is Susi's pattern?



- (A) 20 cm      (B) 21 cm      (C) 22 cm      (D) 23 cm      (E) 25 cm

15. The road from Anna's to Mary's house is 16 km long. The road from Mary's to John's house is 20 km long. The road from the crossing to Mary's house is 9 km long.

How long is the road from Anna's to John's house?



- (A) 7 km      (B) 9 km      (C) 11 km      (D) 16 km      (E) 18 km

# Känguru der Mathematik 2018

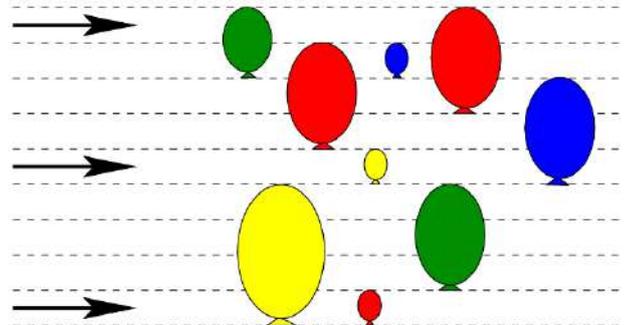
## Level Ecolier (Grade 3 and 4)

### Austria – 15. 3. 2018



#### - 3 Point Examples -

1. As seen in the diagram, 3 darts are flying towards 9 fixed balloons. If a balloon is hit by a dart, it bursts and the dart continues in the same direction it had beforehand. How many balloons are hit by the darts?

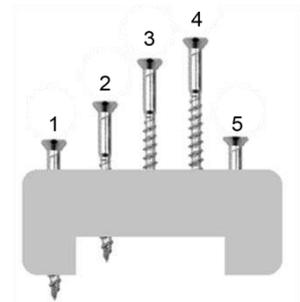


- (A) 2      (B) 3      (C) 4      (D) 5      (E) 6

2. Susanne is 6 years old. Her sister Lisa is 2 years younger. Brother Max is 2 years older than Susanne. How old are the 3 siblings altogether?

- (A) 15      (B) 16      (C) 17      (D) 18      (E) 19

3. The diagram shows a wooden block with 5 screws. 4 of which are equally long, one screw is shorter. Which is the shorter screw?



- (A) 1      (B) 2      (C) 3      (D) 4      (E) 5

4. Leonie has one stamp for each of the digits 0, 1, 2, 3, 4, 5, 6, 7, 8, 9. Using them, she stamps the date of the kangaroo-competition.



- How many of the stamps does Leonie use to do that?

- (A) 5      (B) 6      (C) 7      (D) 9      (E) 10

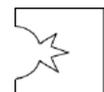
5. On the right you can see a picture of ladybird Sophie. Sophie turns.



Which of the pictures below is not Sophie?

- (A)      (B)      (C)      (D)      (E)

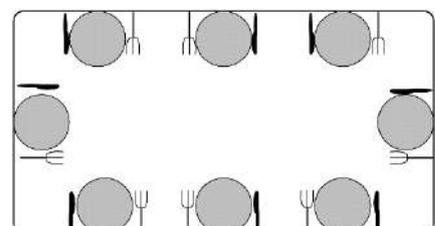
6. Lucy folds a piece of paper exactly half way and then cuts out a figure: Then she unfolds the paper again.



Which of the five pictures can she see?

- (A)      (B)      (C)      (D)      (E)

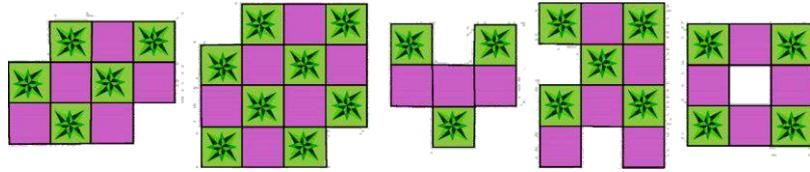
7. Mike sets the table for 8 people: The fork has to lie to the left and the knife to the right of the plate.



For how many people is the cutlery set correctly?

- (A) 5      (B) 4      (C) 6      (D) 2      (E) 3

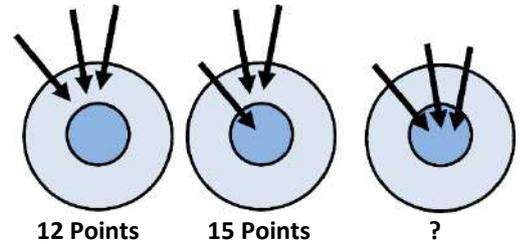
8. Using these tiles   Robert makes different patterns. How many of the patterns shown below can he make?



- (A) 1 (B) 2 (C) 3 (D) 4 (E) 5

- 4 Point Examples -

9. Diana shoots 3 darts, three times at a target board with two fields. The first time she scores 12 points, the second time 15. The number of points depends on which field she has hit.



How many points does she score the third time?

- (A) 18 (B) 19 (C) 20 (D) 21 (E) 22

- 10.

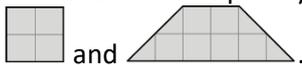
				
				
				
			?	
				

Albert places these 5 figures , , , ,  on a 5x5-grid. Each figure is only allowed to appear once in every column and in every row.

Which figure does Albert have to place on the field with the question mark?

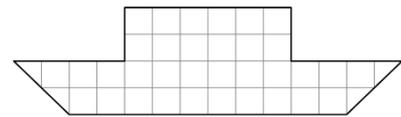
- (A)  (B)  (C)  (D)  (E) 

11. Tom wants to completely cover his paper boat using the shapes



What is the smallest number of shapes he needs for that?

- (A) 5 (B) 6 (C) 7 (D) 8 (E) 9

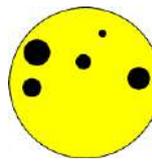
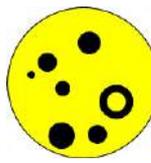
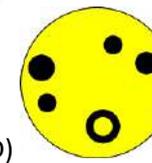
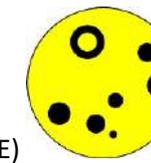


12. The two colours of this picture are swapped.

Then the picture is turned.

Which of the pictures below is obtained?



- (A)  (B)  (C)  (D)  (E) 

13.  Felix the rabbit has 20 carrots. Every day he eats 2 of them. He has eaten the 12th carrot on a Wednesday.

On which day of the week did he start eating the carrots?

- (A) Monday (B) Tuesday (C) Wednesday (D) Thursday (E) Friday

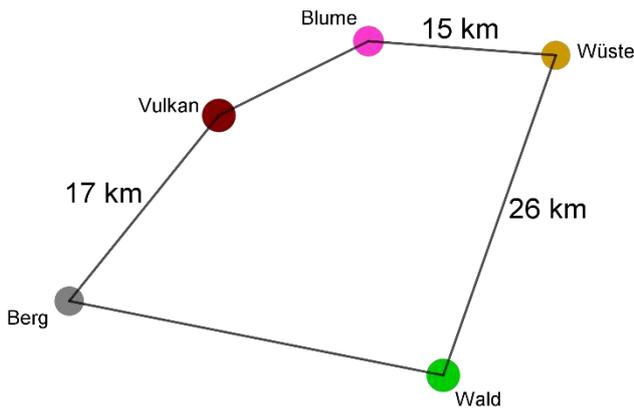
14. A rose bush has 8 flowers on which butterflies and dragonflies are sitting. On every flower there is at most one insect sitting on it. More than half of the flowers are occupied.



The number of butterflies is twice as big as the number of dragonflies.  
How many butterflies are sitting on the rose blossoms?

- (A) 2      (B) 3      (C) 4      (D) 5      (E) 6

15.



The map shows the roundtrip that Captain Bluebear covers during his journey. Three distances are given on the map.

He sails from island to island and starts at the island Berg. In total he covers a distance of 100 km. The distances between the islands Wüste and Wald is equal to the distance between the islands Berg and Blume via Vulkan.

How big is the distance between Berg and Wald?

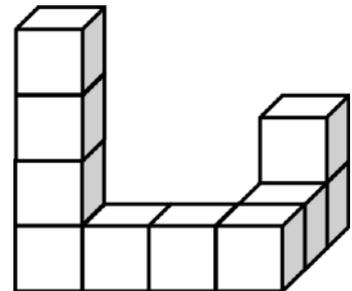
- (A) 17 km      (B) 23 km      (C) 26 km      (D) 33 km      (E) 35 km

16. Tobias glues 10 cubes together so that the following object is formed:

He paints all of it, even the bottom.

How many cubes then have exactly 4 faces coloured in?

- (A) 6      (B) 7      (C) 8      (D) 9      (E) 10



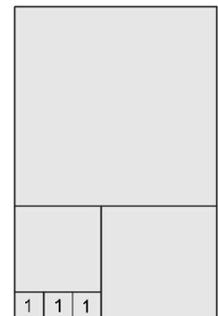
- 5 Point Examples -

17. The big rectangle consists of various squares of different sizes.

Each of the three smallest squares has area 1.

How big is the area of the big rectangle?

- (A) 65      (B) 71      (C) 77      (D) 87      (E) 98



18. In order to slay a dragon, Mathias has to cut off all of its heads. As soon as he has cut off 3 heads, a new one grows back immediately. After Mathias has cut off 13 heads the dragon is dead.

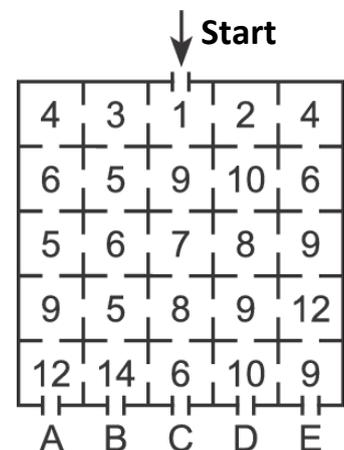
How many heads did the dragon have initially?

- (A) 8      (B) 9      (C) 10      (D) 11      (E) 12

19. The rooms in Kanga's house are numbered. Eva enters the house through the main entrance. Eva has to walk through the rooms in such a way that each room that she enters has a number higher than the previous one.

Through which door does Eva leave the house?

- (A) A      (B) B      (C) C      (D) D      (E) E



20. The symbols     stand for one of the digits 1, 2, 3, 4 or 5.  
It is known that

$$\text{atom} + \text{atom} = \text{fish} \quad \text{sun} + \text{sun} = \text{atom} \quad \text{sun} + \text{fish} = \text{fish}$$

Which symbol stands for the digit 3?

- (A)  (B)  (C)  (D)  (E) 

21. A belt can be joined together in 5 different ways.

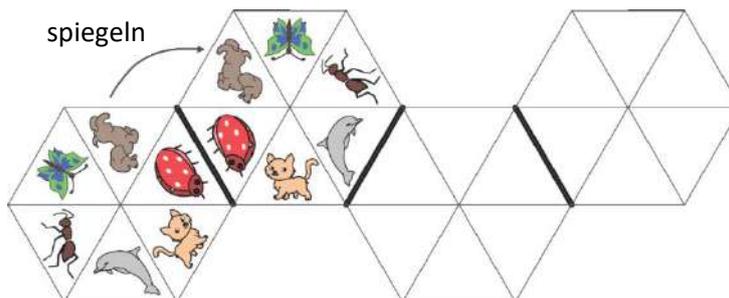


How many cm is the belt longer if it is only closed in the first hole instead of in all 5 holes?

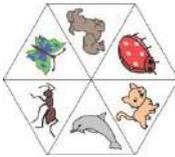
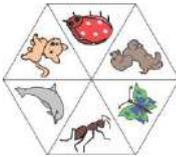


- (A) 4 cm (B) 8 cm (C) 10 cm (D) 16 cm (E) 20 cm

22. A decorated glass tile is mirrored several times along the boldly printed edge. The first mirror image is shown.



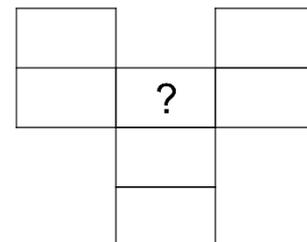
What does the tile on the far right look like after the third reflection?

- (A)  (B)  (C)  (D)  (E) 

23. Lea should write the numbers 1 to 7 in the fields of the given figure. There is only one number allowed in every field.

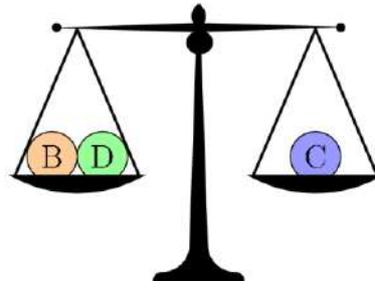
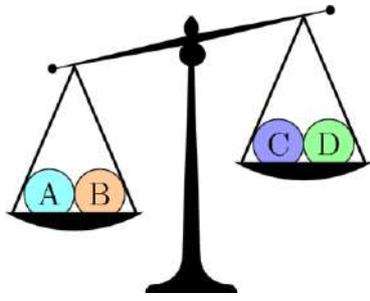
Two consecutive numbers are not allowed to be in adjacent fields. Two fields are adjacent if they have one edge or one corner in common.

Which numbers can she write into the field with the question mark?



- (A) all 7 numbers (B) only odd numbers (C) only even numbers (D) the number 4 (E) the numbers 1 or 7

24. Each of the four balls weighs either 10 or 20 or 30 or 40 grams.  
Which ball weighs 30 grams?



(A) A

(B) B

(C) C

(D) D

(E) It can be A or B.

# Känguru der Mathematik 2018

## Group Benjamin (Grade 5 and 6)

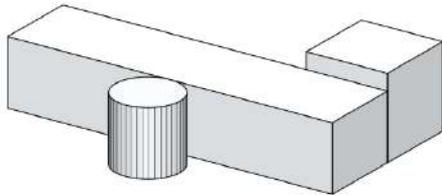
### Austria – 15. 3. 2018



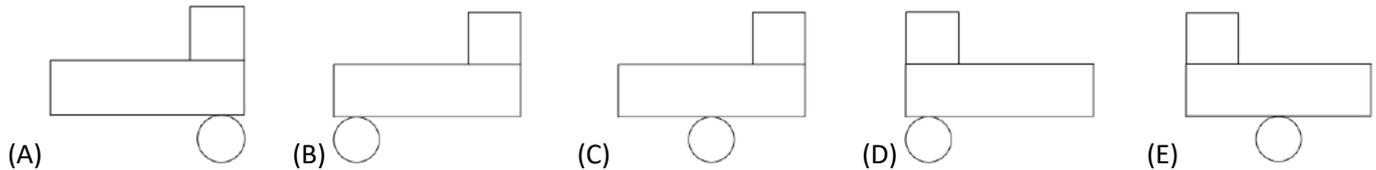
#### - 3 Points Examples -

1. As seen in the diagram, three darts are thrown at nine fixed balloons. If a balloon is hit it will burst and the dart continues in the same direction it had beforehand. How many balloons will not be hit by a dart?

- (A) 2 (B) 3 (C) 4 (D) 5 (E) 6



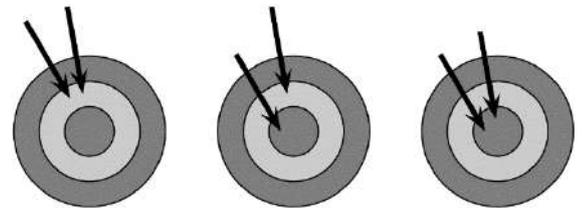
2. Peter places three building blocks on a table, as shown. What does he see when he is looking at them from above?



3. If you hit the target board, you score points.

The number of points depends on which one of the three areas you hit. Diana throws two darts, three times at the target board. On the first attempt she scores 14 points and on the second 16 points. How many points does she score on the third attempt?

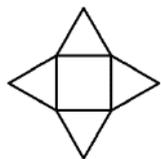
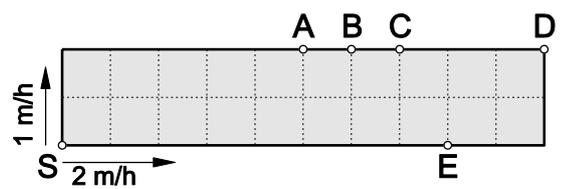
- (A) 17 (B) 18 (C) 19 (D) 20 (E) 22



14 Points 16 Points ???

4. A garden is split into equally sized square-shaped lots. A fast and a slow snail crawl in different directions along the outside edge of the garden. Both start at the corner S. The slow snail crawls 1 m in one hour and the fast one crawls 2 m in one hour. In which position will the two snails meet for the first time?

- (A) A (B) B (C) C (D) D (E) E

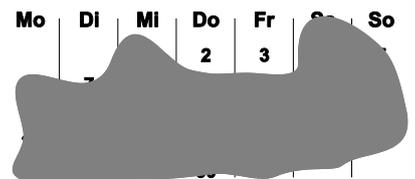


5. A star consist of a square and four triangles. All sides of the triangles are equally long. The perimeter of the square is 36 cm. What is the perimeter of the star?

- (A) 144 cm (B) 120 cm (C) 104 cm (D) 90 cm (E) 72 cm

6. A big spot of ink covers most of a calendar page of a certain month. Which day of the week does the 25th day of that month fall on?

- (A) Monday (B) Wednesday (C) Thursday (D) Saturday (E) Sunday

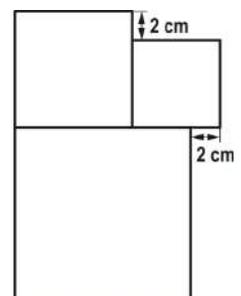


7. How many times do you have to roll an ordinary die in order to be certain that at least one number is rolled twice?

- (A) 5 (B) 6 (C) 7 (D) 12 (E) 18

8. A figure is made up of three squares. The side length of the smallest square is 6 cm. How long is the side length of the biggest square?

- (A) 8 cm (B) 10 cm (C) 12 cm (D) 14 cm (E) 16 cm



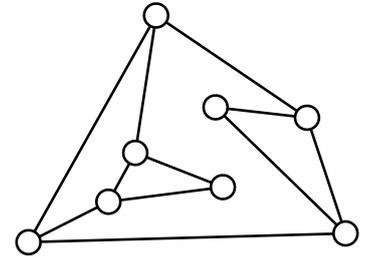
**- 4 Point Examples -**

**9.** Alice subtracts one two-digit number from another two-digit number. Afterwards she paints over two digits in the calculation. How big is the sum of the two painted digits?



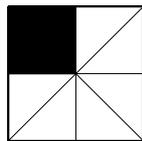
- (A) 8                      (B) 9                      (C) 12                      (D) 13                      (E) 15

**10.** In the diagram the circles represent light bulbs which are connected to some other light bulbs. Initially all light bulbs are switched off. If you touch a light bulb then that light bulb and all directly adjacent light bulbs switch themselves on. What is the minimum number of light bulbs you have to touch in order to switch on all the light bulbs?

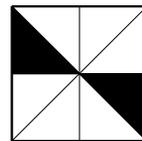


- (A) 2                      (B) 3                      (C) 4                      (D) 5                      (E) 6

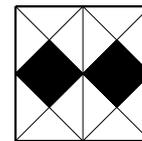
**11.** Four equally big squares are partially coloured in black. In which of the four squares is the total area of the black parts biggest?



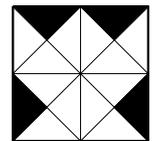
**A**



**B**



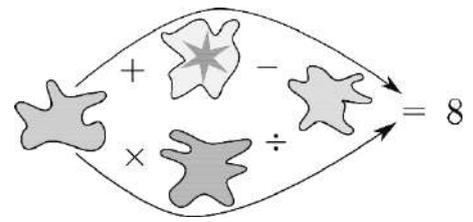
**C**



**D**

- (A) A                      (B) B                      (C) C                      (D) D  
 (E) The total area of the black parts is always equally big.

**12.** The four smudges hide four of the numbers 1, 2, 3, 4, 5. The calculations along the two arrows are correct. Which number hides behind the smudge with the star?



- (A) 1                      (B) 2                      (C) 3                      (D) 4                      (E) 5

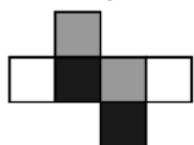
**13.** A lion hides in one of three rooms. On the door to room number 1 a note reads: „The lion is not here“. On the door to room number 2 a note reads: „The lion is here“. On the door to room number 3 a note reads: „2 + 3 = 5“. Exactly one of the three notes is true. In which room is the lion?

- (A) Room 1                      (B) Room 2                      (C) Room 3  
 (D) It can be in any room.                      (E) It is either in room 1 or room 2.

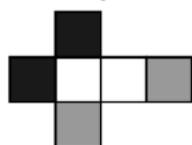
**14.** The two girls Eva and Olga and the three boys Adam, Isaac and Urban play together with a ball. If a girl has the ball she throws it either to the second girl or to a boy. Every boy only throws the ball to another boy, however not to the one where the ball has just come from. The first throw is made by Eva to Adam. Who makes the 5th throw?

- (A) Adam                      (B) Eva                      (C) Isaac                      (D) Olga                      (E) Urban

**15.** The faces of a die are either white, grey or black. Opposite faces are always a different colour. Which of the following nets does not belong to such a die?



(A)



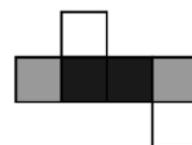
(B)



(C)



(D)



(E)

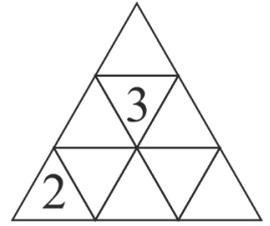
**16.** From a list with the numbers 1, 2, 3, 4, 5, 6, 7, Monika chooses 3 different numbers whose sum is 8. From the same list Daniel chooses 3 different numbers whose sum is 7. How many of the numbers were chosen by both Monika and Daniel?

- (A) none                      (B) 1                      (C) 2                      (D) 3                      (E) It cannot be determined.

**- 5 Point Examples -**

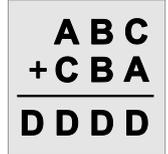
**17.** Emily wants to write a number into every free small triangle. The sum of the numbers in two triangles with a common side should always be the same. Two numbers are already given. How big is the sum of all numbers in the figure?

- (A) 18      (B) 20      (C) 21      (D) 22      (E) it cannot be calculated



**18.** Instead of digits Hannes uses the letters A, B, C and D in a calculation. Different letters stand for different digits. Which digit does the letter B stand for?

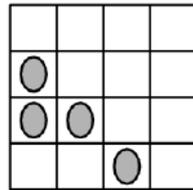
- (A) 0      (B) 2      (C) 4      (D) 5      (E) 6



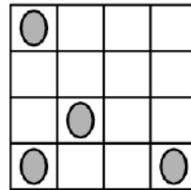
**19.** Four ladybirds each sit on a different cell of a 4 x 4 grid. One is asleep and does not move. On a whistle the other three each move to an adjacent free cell.

They can crawl up, down, to the right or to the left but are not allowed on any account to move back to the cell that they have just come from.

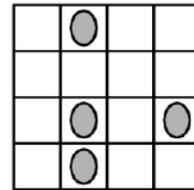
Where could the ladybirds be after the fourth whistle?



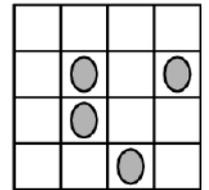
*Initial position*



*After the first whistle*



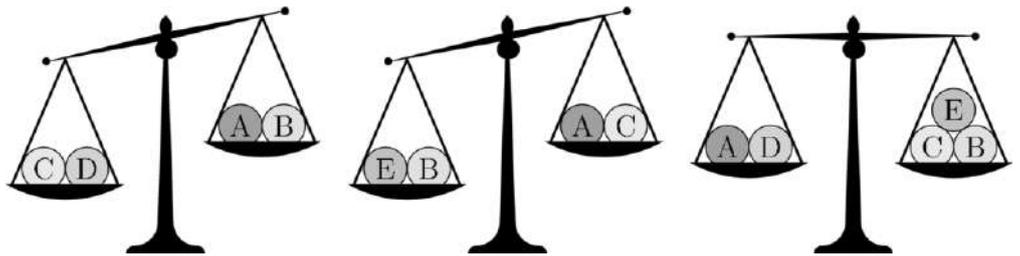
*After the second whistle*



*After the third whistle*

- (A) (B) (C) (D) (E)

**20.** The five balls weigh 30 g, 50 g, 50 g, 50 g and 80 g. Which of the balls weighs 30 g?



- (A) A      (B) B      (C) C      (D) D      (E) E

**21.** Three different digits A, B and C are chosen. Then the biggest possible six-digit number is built where the digit A appears 3 times, the digit B 2 times and the digit C 1 time.

Which representation is definitely not possible for this number?

- (A) AAABBC      (B) CAAABB      (C) BBAAAC      (D) AAABCB      (E) AAACBB

**22.** The sum of Kathi's age and the age of her mother is 36. The sum of the age of her mother and the age of her grandmother is 81. How old was Kathi's grandmother when Kathi was born?

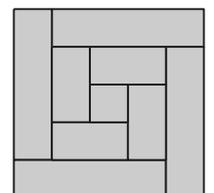
- (A) 28      (B) 38      (C) 45      (D) 53      (E) 56

**23.** Nick wants to split the numbers 2, 3, 4, 5, 6, 7, 8, 9, 10 into some groups so that the sum of the numbers in each group is equally big. What is the biggest number of groups he can build this way?

- (A) 2      (B) 3      (C) 4      (D) 6      (E) another number

**24.** The figure shown on the right consists of one square part and eight rectangular parts. Each part is 8 cm wide. Peter assembles all parts to form one long, 8 cm wide rectangle. How long is this rectangle?

- (A) 150 cm      (B) 168 cm      (C) 196 cm      (D) 200 cm      (E) 232 cm



# Känguru der Mathematik 2018

## Level Kadett (Grade 7 and 8)

### Austria – 15. 3. 2018



#### - 3 Point Examples -

1. Which result is obtained by the calculation  $(20 + 18) : (20 - 18)$ ?  
 (A) 18                      (B) 19                      (C) 20                      (D) 34                      (E) 36

2. If the letters of the Word MAMA are written underneath each other then the word has a vertical axis of symmetry. For which of these words does that also hold true?  
 (A) ADAM                      (B) BAUM                      (C) BOOT                      (D) LOGO                      (E) TOTO

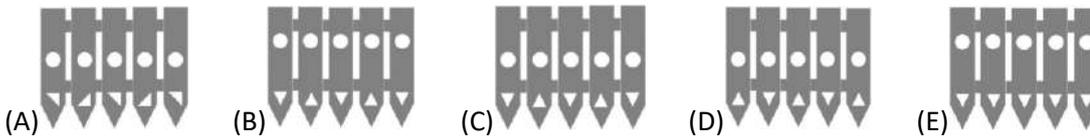


3. A triangle ABC has side lengths 6 cm, 10 cm and 11 cm. An equilateral triangle XYZ has the same perimeter as the triangle ABC. What are the side lengths of the triangle XYZ?  
 (A) 6 cm                      (B) 9 cm                      (C) 10 cm                      (D) 11 cm                      (E) 27 cm

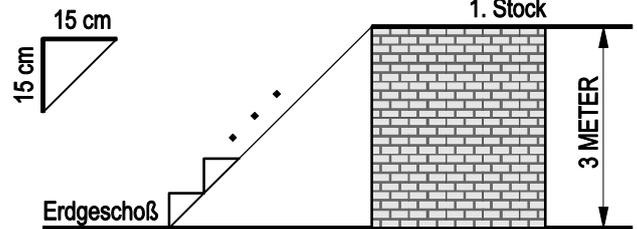
4. Which number has to replace the ☆ in the calculation so that it is true?  
 (A) 8                      (B) 9                      (C) 10                      (D) 12                      (E) 15

$$2 \cdot 18 \cdot 14 = 6 \cdot \star \cdot 7$$

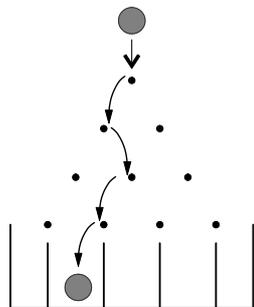
5. The fence on the right has many holes. One morning the fence falls over and lies on the floor. Which of the following pictures shows the fallen down fence?



6. Bernd produces steps for a staircase which are 15 cm high and 15 cm deep (see diagram). The staircase should reach from the ground floor to the first floor which is 3 m higher. How many steps does Bernd have to produce?



- (A) 8                      (B) 10                      (C) 15  
 (D) 20                      (E) 25

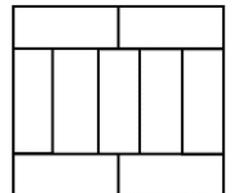


7. In a game of luck, A ball rolls downwards towards hammered nails and is diverted either to the right or the left by a nail immediately below it. One possible path is shown in the diagram. How many different ways are there for the ball to reach the second compartment from the left?

- (A) 2                      (B) 3                      (C) 4                      (D) 5                      (E) 6

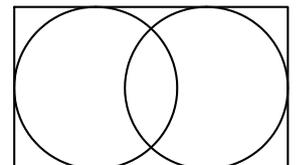
8. A large rectangle is made up of 9 equally big rectangles. The longer side of each small rectangle is 10 cm long. What is the perimeter of the large rectangle?

- (A) 40 cm                      (B) 48 cm                      (C) 76 cm                      (D) 81 cm                      (E) 90 cm



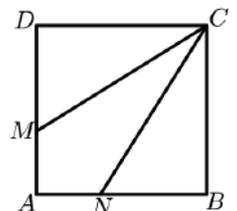
9. Two circles are inscribed into an 11 cm long and 7 cm wide rectangle so that they each touch three sides of the rectangle. How big is the distance between the centres of the two circles?

- (A) 1 cm                      (B) 2 cm                      (C) 3 cm                      (D) 4 cm                      (E) 5 cm



10. The square ABCD has side length 3 cm. The points M and N, which lie on the sides AD and AB respectively, are joined to the corner C. That way the square is split up into three parts with equal area. How long is the line segment DM?

- (A) 0.5 cm                      (B) 1 cm                      (C) 1.5 cm                      (D) 2 cm                      (E) 2.5 cm



**- 4 Point Examples -**

**11.** Martina multiplies two, two-digit numbers and then paints over some of the digits. How big is the sum of the three digits that Martina has painted over?



- (A) 5                      (B) 6                      (C) 9                      (D) 12                      (E) 14

**12.** A rectangle is split up into 40 equally big squares. The rectangle consists of more than one row of squares. Andreas colours in all squares of the middle row. How many squares did he not colour in?

- (A) 20                      (B) 30                      (C) 32                      (D) 35                      (E) 39

**13.** Philipp wants to know how much his book weighs correct to half a gram. However, his scale only shows correct to 10 g and therefore he weighs several identical books all together. What is the minimum number of identical books he has to put on the scale in order to reach his aim?

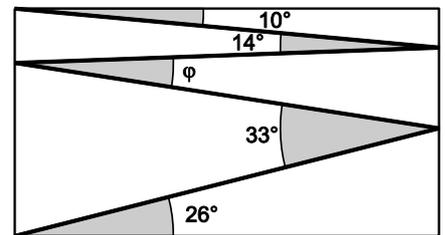
- (A) 5                      (B) 10                      (C) 15                      (D) 20                      (E) 50

**14.** A lion hides in one of three rooms. On the door to room number 1 a note reads: „The lion is here“. On the door to room number 2 a note reads: „The lion is not here“. On the door to room number 3 a note reads: „ $2 + 3 = 2 \times 3$ “. Exactly one of the three notes is true. Which room is the lion in?

- (A) Room 1                      (B) Room 2                      (C) Room 3  
(D) It can be in any room.                      (E) It is either in room 1 or room 2.

**15.** Valentin draws a zig-zag line inside a rectangle as shown in the diagram. For that he uses the angles  $10^\circ$ ,  $14^\circ$ ,  $33^\circ$  and  $26^\circ$ . How big is angle  $\varphi$ ?

- (A)  $11^\circ$                       (B)  $12^\circ$                       (C)  $16^\circ$                       (D)  $17^\circ$                       (E)  $33^\circ$



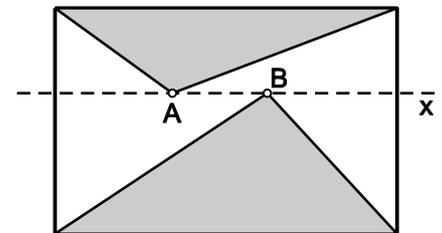
**16.** Alice writes down three prime numbers that are all less than 100. She only uses the digits 1, 2, 3, 4 and 5, in fact she uses each digit exactly once. Which of the following prime numbers did she definitely write down?

- (A) 2                      (B) 5                      (C) 31                      (D) 41                      (E) 53

**17.** A hotel in the caribbean correctly advertises using the slogan: „350 days of sun in the year!“ How many days does Mr. Happy have to spend in the hotel in a year with 365 days to be guaranteed to have two consecutive days of sunshine to enjoy?

- (A) 17                      (B) 21                      (C) 31                      (D) 32                      (E) 35

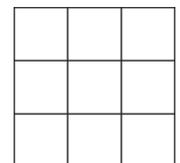
**18.** The diagram shows a rectangle and a straight line  $x$ , which is parallel to one of the sides of the rectangle. There are two points A and B on  $x$  inside the rectangle. The sum of the areas of the two triangles shaded in grey is  $10 \text{ cm}^2$ . How big is the area of the rectangle?



- (A)  $18 \text{ cm}^2$                       (B)  $20 \text{ cm}^2$                       (C)  $22 \text{ cm}^2$                       (D)  $24 \text{ cm}^2$                       (E) It depends on the position of the points A and B.

**19.** Jakob writes one of the natural numbers 1 to 9 into each cell of the  $3 \times 3$ -table. Then he works out the sum of the numbers in each row and in each column. Five of his results are 12, 13, 15, 16 and 17. What is the sixth sum?

- (A) 17                      (B) 16                      (C) 15                      (D) 14                      (E) 13



**20.** 11 points are marked left to right on a straight line and their distances recorded. The sum of the distances from the first point to every other point is 2018. The sum of all distances from the second point to every other point, including the first point, is 2000. What is the distance between the first and the second point?

- (A) 1                      (B) 2                      (C) 3                      (D) 4                      (E) 5

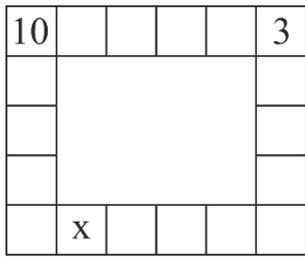
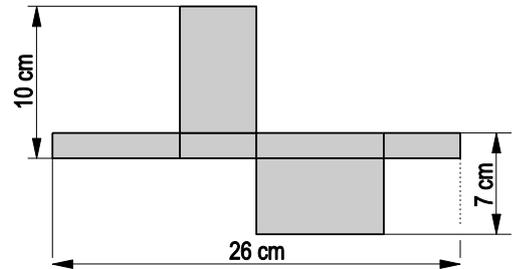
**- 5 Point Examples -**

**21.** At an election for student representatives there are three candidates. 130 students have voted. The candidate that has the most votes wins. Currently Samuel has 24, Kevin 29 and Alfred 37 votes. How many of the currently not yet counted votes does Alfred need to get in order to definitely win the election?

- (A) 13                      (B) 14                      (C) 15                      (D) 16                      (E) 17

22. The diagram shows the net of a box consisting only of rectangles. How big is the volume of the box?

- (A)  $43 \text{ cm}^3$  (B)  $70 \text{ cm}^3$  (C)  $80 \text{ cm}^3$  (D)  $100 \text{ cm}^3$  (E)  $1820 \text{ cm}^3$

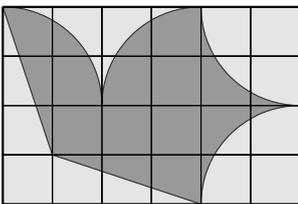
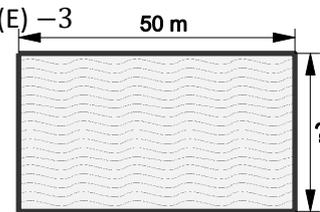


23. Rita wants to write a number into every square of the diagram shown. Every number should be equal to the sum of the two numbers from the adjacent squares. Squares are adjacent if they share one edge. Two numbers are already given. Which number is she going to write into the square marked with x?

- (A) 10 (B) 7 (C) 13 (D) -13 (E) -3

24. Simon runs along the edge round a 50 m long rectangular swimming pool, while at the same time Jan swims lengths in the pool. Simon runs three times as fast as Jan swims. While Jan swims 6 lengths, Simon manages 5 rounds around the pool. How wide is the swimming pool?

- (A) 25 m (B) 40 m (C) 50 m (D) 80 m (E) 180 m

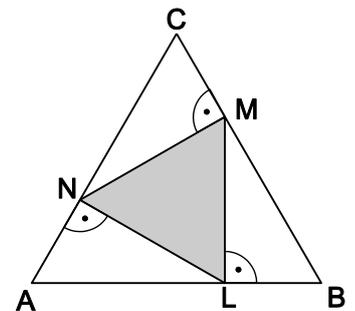


25. Lisas aviation club designs a flag with a flying „dove“ on a 4x6-grid. The area of the „dove“ is  $192 \text{ cm}^2$ . The perimeter of the „dove“ is made up of straight lines and circular arcs. What measurements does the flag have?

- (A) 6 cm x 4 cm (B) 12 cm x 8 cm (C) 20 cm x 12 cm  
(D) 24 cm x 16 cm (E) 30 cm x 20 cm

26. The points N, M and L lie on the sides of an equilateral triangle ABC so that  $NM \perp BC$ ,  $ML \perp AB$  and  $LN \perp AC$  holds true. The area of the triangle ABC is  $36 \text{ cm}^2$ . What is the area of the triangle LMN?

- (A)  $9 \text{ cm}^2$  (B)  $12 \text{ cm}^2$  (C)  $15 \text{ cm}^2$  (D)  $16 \text{ cm}^2$  (E)  $18 \text{ cm}^2$



27. Anna, Bettina and Claudia go shopping. Bettina spends 85% less than Claudia. Anna spends 60% more than Claudia. Together they spend 55 €. How much money does Anna spend?

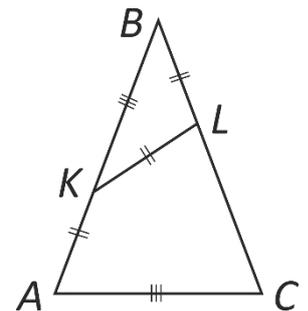
- (A) 3 € (B) 20 € (C) 25 € (D) 26 € (E) 32 €

28. Viola practices long-jumping. On average she has jumped 3.80 m so far. On the next jump she reaches 3.99 m and thus the mean increases to 3.81 m. How far does she have to jump on her next attempt in order to increase her mean to 3.82 m?

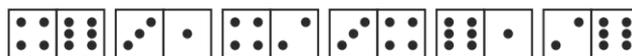
- (A) 3.97 m (B) 4.00 m (C) 4.01 m (D) 4.03 m (E) 4.04 m

29. In the isosceles triangle ABC (with base AC) the points K and L are added on the sides AB and BC respectively so that  $AK = KL = LB$  and  $KB = AC$ . How big is the angle  $\angle ABC$ ?

- (A)  $30^\circ$  (B)  $35^\circ$  (C)  $36^\circ$  (D)  $40^\circ$  (E)  $44^\circ$



30. In a game of dominoes the tiles always have to be placed so that the touching halves of two adjacent domino tiles show the same number of dots. Paul has six domino tiles in front of him (see diagram).



In several steps Paul tries to arrange them in a correct order. In each step he is either allowed to swap any two domino tiles or he is allowed to turn one domino tile  $180^\circ$  around. What is the minimum number of steps he needs in order to arrange the domino tiles correctly?

- (A) 1 (B) 2 (C) 3 (D) 4 (E) This is impossible.

# Känguru der Mathematik 2018

## Level Junior (Grade 9 and 10)

### Austria – 15.3.2018



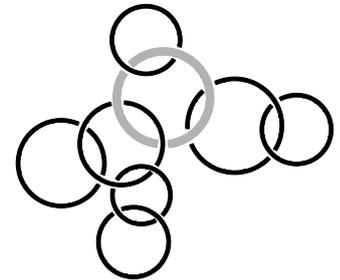
- 3 Point Examples -

1. Every child in my family has at least two brothers and at least one sister. What is the minimum number of children in my family?

- (A) 3                      (B) 4                      (C) 5                      (D) 6                      (E) 7

2. The rings shown are partially interlinked. How long is the longest chain built this way which also contains the thick light ring?

- (A) 3                      (B) 4                      (C) 5                      (D) 6                      (E) 7

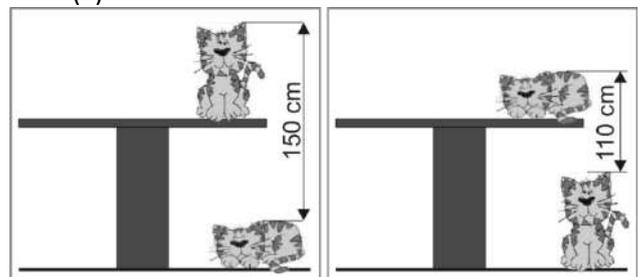


3. In a triangle one side has length 5 and another side has length 2. The length of the third side is an odd whole number. Determine the length of the third side.

- (A) 3                      (B) 4                      (C) 5                      (D) 6                      (E) 7

4. The distance between the top of the cat that is sitting on the table to the top of the cat that is sleeping on the floor is 150 cm. The distance from the top of the cat that is sleeping on the table to the top of the cat that is sitting on the floor is 110 cm. How high is the table?

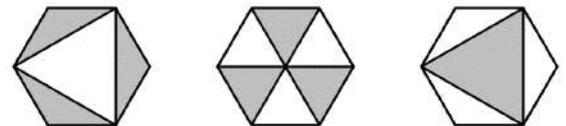
- (A) 110 cm   (B) 120 cm   (C) 130 cm   (D) 140 cm   (E) 150 cm



5. The sum of 5 consecutive whole numbers is  $10^{2018}$ . What is the middle number of those numbers?

- (A)  $10^{2013}$    (B)  $5^{2017}$    (C)  $10^{2017}$    (D)  $2^{2018}$    (E)  $2 \cdot 10^{2017}$

6. In the three regular hexagons shown, X, Y and Z describe in this order the areas of the grey shaded parts. Which of the following statements is true?



- (A)  $X = Y = Z$    (B)  $Y = Z \neq X$    (C)  $Z = X \neq Y$    (D)  $X = Y \neq Z$    (E) Each of the areas has a different value.

7. Maria wants to divide 42 apples, 60 peaches and 90 cherries fairly amongst her friends. In order to do so she divides the entire fruit into baskets, each with the same amount of apples, peaches and cherries, to then give each of her friends one such basket with fruit. At most, how many baskets of fruit can she fill this way?

- (A) 3                      (B) 6                      (C) 10                      (D) 14                      (E) 42

8. In the (correct) calculation shown, some of the digits were replaced by the letters P, Q, R and S. What is the value of  $P + Q + R + S$ ?

- (A) 14                      (B) 15                      (C) 16                      (D) 17                      (E) 24

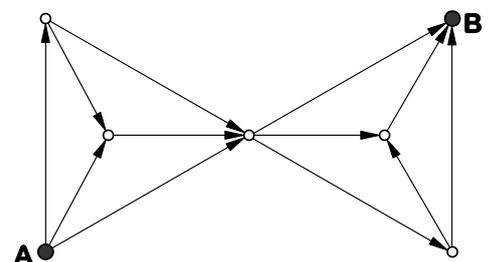
P 4 5
+ Q R S
-----
6 5 4

9. How big is the sum of 25 % of 2018 and 2018 % of 25?

- (A) 1009                      (B) 2016                      (C) 2018                      (D) 3027                      (E) 5045

10. In the diagram shown, you should follow the arrows to get from A to B. How many different ways are there that fulfill this condition?

- (A) 20                      (B) 16                      (C) 12                      (D) 9                      (E) 6



- 4 Point Examples -

**11.** The entrances of two student halls lie in a plain street 250 m apart from each other. There are 100 students in the first one and 150 students in the second one. Where should a bus stop be built if the total sum of the distances that each student of both halls has to cover to get to the bus stop should be a minimum?

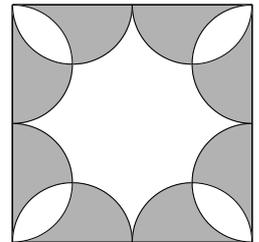
- (A) directly in front of the first hall (B) 100 m away from the entrance of the first hall  
 (C) 100 m away from the entrance of the second hall (D) directly in front of the second hall  
 (E) in any place between the two hall entrances

**12.** 105 numbers are written in a row: 1, 2, 2, 3, 3, 3, 4, 4, 4, 4, 5, 5, 5, 5, ... Where each number  $n$  is written exactly  $n$ -times. How many of those numbers are divisible by 3?

- (A) 4 (B) 12 (C) 21 (D) 30 (E) 45

**13.** Eight congruent semi-circles are drawn inside a square with side length 4. How big is the area of the white part?

- (A)  $2\pi$  (B) 8 (C)  $6 + \pi$  (D)  $3\pi - 2$  (E)  $3\pi$



**14.** On one particular day there are a total of 40 trains from one of the towns M, N, O, P and Q to exactly one other of those towns. There are 10 trains either from or to M. There are 10 trains either from or to N. There are 10 trains either from or to O. There are 10 trains either from or to P. How many trains are there either from or to Q?

- (A) 0 (B) 10 (C) 20 (D) 30 (E) 40

**15.** At a humanistic university you can study languages, history and philosophy. Some of the students there study exactly one language. (Nobody studies several languages at the same time.) Amongst those, 35 % study English. Amongst all students of the university 13 % study a language other than English. Which percentage of the students studies a language?

- (A) 13 % (B) 20 % (C) 22 % (D) 48 % (E) 65 %

**16.** Peter wants to buy a book but has no money. He can only buy this book with his father's and his two brother's help. His father gives him half as much money as his brothers give him jointly. His older brother gives him a third of the sum that the two others give him. The youngest brother gives him 10 €. How expensive is the book?

- (A) 24 € (B) 26 € (C) 28 € (D) 30 € (E) 32 €

**17.** How many three-digit numbers are there with the property that the two-digit number obtained by deleting the middle number is exactly a ninth of the original number?

- (A) 1 (B) 2 (C) 3 (D) 4 (E) 5

**18.** How often does the summand  $2018^2$  appear under the root, if the following statement is correct?

$$\sqrt{2018^2 + 2018^2 + \dots + 2018^2} = 2018^{10}$$

- (A) 5 (B) 8 (C) 18 (D)  $2018^8$  (E)  $2018^{18}$

**19.** How many digits has the final result of the calculation  $\frac{1}{9} \cdot 10^{2018} \cdot (10^{2018} - 1)$ ?

- (A) 2017 (B) 2018 (C) 4035 (D) 4036 (E) 4037

**20.** In a regular 2018-sided shape the vertices are numbered 1 to 2018 in order. Two diagonals of the polygon are drawn in, where one of them connects the vertices 18 and 1018 and the other one the vertices 1018 and 2000. How many vertices do the three resulting polygons have?

- (A) 38, 983, 1001 (B) 37, 983, 1001 (C) 38, 982, 1001 (D) 37, 982, 1000 (E) 37, 983, 1002

- 5 Point Examples -

**21.** Some whole numbers are written on a board, amongst them the number 2018. The sum of all these number is 2018. The product of all these number is also 2018. Which of the following numbers could be the amount of numbers on the board?

- (A) 2016      (B) 2017      (C) 2018      (D) 2019      (E) 2020

**22.** Given are four positive numbers. Take three of them, work out their mean and then add the fourth number. This can be done in four different ways. The results obtained this way are 17, 21, 23 and 29. Which number is the biggest of the four numbers?

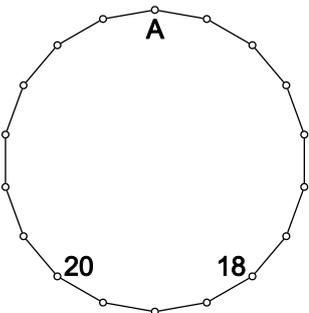
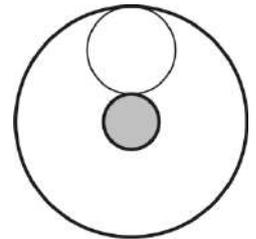
- (A) 12      (B) 15      (C) 21      (D) 24      (E) 29

**23.** The points  $A_0, A_1, A_2, \dots$  all lie on a straight line. It is true that  $\overline{A_0 A_1} = 1$  and  $A_n$  is the midpoint of every line segment  $A_{n+1}A_{n+2}$ , for every non-negative index  $n$ . How long is the line segment  $A_0A_{11}$ ?

- (A) 171      (B) 341      (C) 512      (D) 587      (E) 683

**24.** Two concentric circles with radii 1 and 9 form an annulus.  $n$  circles without overlap are drawn inside this annulus, where every circle touches both circles of the annulus. (The diagram shows an example for  $n=1$  and the other radii as given.) What is the biggest possible value of  $n$ ?

- (A) 1      (B) 2      (C) 3      (D) 4      (E) 5



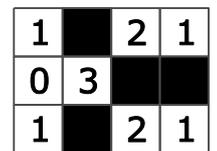
**25.** A number is to be written into every vertex of the 18-sided shape so that it is equal to the sum of the two numbers from the adjacent vertices. Two of these numbers are given. Which number is written in vertex A?

- (A) 2018      (B) -20      (C) 18      (D) 38      (E) -38

**26.** Diana draws a rectangle made up of twelve squares onto a piece of squared paper. Some of the squares are coloured in black. She writes the number of adjacent black squares into every white square. The

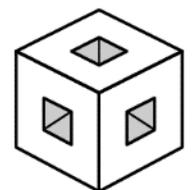
diagram shows an example of such a rectangle. Now she does the same with a rectangle made up of 2018 squares. What is the biggest number that she can obtain as the sum of all numbers in the white squares?

- (A) 1262      (B) 2016      (C) 2018      (D) 3025      (E) 3027



**27.** Seven little dice were removed from a  $3 \times 3 \times 3$  die, as can be seen in the diagram. The remaining (completely symmetrical) figure is cut along a plane through the centre and perpendicular to one of the four space diagonals. What does the cross-section look like?

- (A)      (B)      (C)      (D)      (E)



**28.** Every number of the set  $\{1, 2, 3, 4, 5, 6\}$  is written into exactly one cell of a  $2 \times 3$  table. In how many ways can this be done so that the sum of the numbers in every column and every row is divisible by 3?

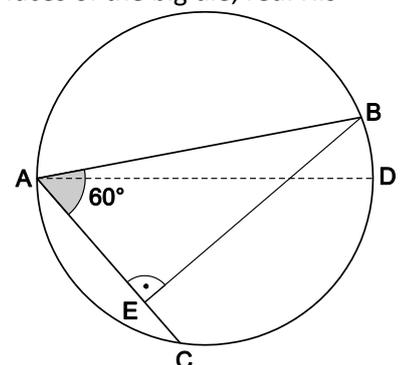
- (A) 36      (B) 42      (C) 45      (D) 48      (E) another number

**29.** Ed forms a big die using several identical small white dice and colours some of the faces of the big die, red. His sister Nicole drops the die and it again breaks into the original small dice. 45 of which do not have a red face. How many faces of the big die did Ed colour in red?

- (A) 2      (B) 3      (C) 4      (D) 5      (E) 6

**30.** Two chords  $AB$  and  $AC$  are drawn into a circle with diameter  $AD$ .  $\angle BAC = 60^\circ$ ,  $\overline{AB} = 24$  cm,  $E$  lies on  $AC$  so that  $\overline{EC} = 3$  cm, and  $BE$  is perpendicular to  $AC$ . How long is the chord  $BD$ ?

- (A)  $\sqrt{3}$  cm      (B) 2 cm      (C) 3 cm      (D)  $2\sqrt{3}$  cm      (E)  $3\sqrt{2}$  cm



# Känguru der Mathematik 2018

## Level Student (Grade 11 onwards)

### Austria - 15. 3. 2018



#### - 3 Points Examples -

1. In the diagram you can see the calendar page of a certain month. Unfortunately ink has run across parts of the page. Which day of the week does the 27th of that month fall on?

- (A) Monday (B) Wednesday (C) Thursday (D) Saturday (E) Sunday

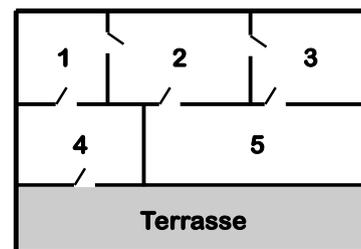


2. Which of the following expressions has the biggest value?

- (A)  $2 - 0 \cdot 1 + 8$  (B)  $2 + 0 \cdot 1 \cdot 8$  (C)  $2 \cdot 0 + 1 \cdot 8$  (D)  $2 \cdot (0 + 1 + 8)$  (E)  $2 \cdot 0 + 1 + 8$

3. The diagram shows the floor plan of Renate's house. Renate enters her house from the terrace (Terrasse) and walks through every door of the house exactly once. Which room does she end up in?

- (A) 1 (B) 2 (C) 3 (D) 4 (E) 5

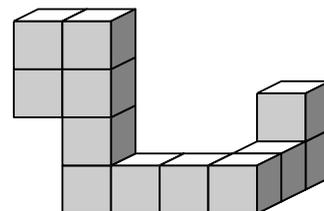


4. Thor has seven stones and a hammer. With his hammer he hits a stone and it breaks into five small stones. He does that a few times. Which of these numbers could be the number of stones he ends up with?

- (A) 17 (B) 20 (C) 21 (D) 23 (E) 25

5. The diagram shows an object made up of 12 dice glued-together. The object is dipped into some colour so that the entire outside is coloured in this new colour. How many of the small dice will have exactly four faces coloured in?

- (A) 8 (B) 9 (C) 10 (D) 11 (E) 12

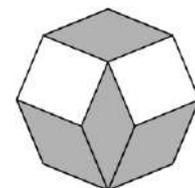


6. The following two statements are true: Some aliens are green and all others are purple. Green aliens live on Mars only. Which one of the following logical conclusions can be made?

- (A) All aliens live on Mars. (B) There are only green aliens on Mars.  
 (C) Some purple aliens live on Venus (D) All purple aliens live on Venus.  
 (E) There are no green aliens on Venus.

7. Four identical rhombuses (diamonds) and two squares are fitted together to form a regular octagon as shown. How big are the obtuse interior angles in the rhombuses?

- (A)  $135^\circ$  (B)  $140^\circ$  (C)  $144^\circ$  (D)  $145^\circ$  (E)  $150^\circ$

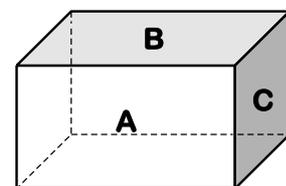


8. There are 65 balls in a box, 8 of which are white, the rest are black. Up to 5 balls can be taken out of the box in one draw. It is not allowed to put any balls back into the box. What is the minimum number of draws which have to be made to be certain that at least one white ball is drawn from the box?

- (A) 11 (B) 12 (C) 13 (D) 14 (E) 15

9. The faces of the brick have the areas A, B and C as shown. How big is the volume of the brick?

- (A)  $ABC$  (B)  $\sqrt{ABC}$  (C)  $\sqrt{AB + BC + CA}$  (D)  $\sqrt[3]{ABC}$  (E)  $2(A + B + C)$



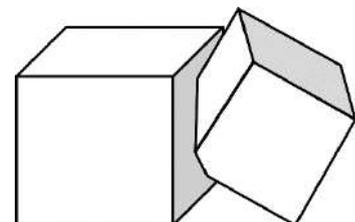
10. How many ways are there to write the number 1001 as the sum of two prime numbers?

- (A) no way (B) one way (C) two ways (D) three ways (E) more than three ways

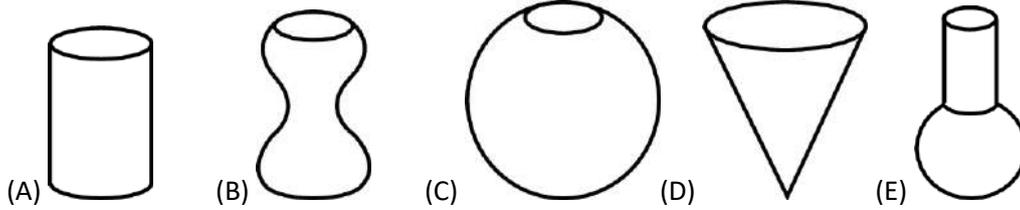
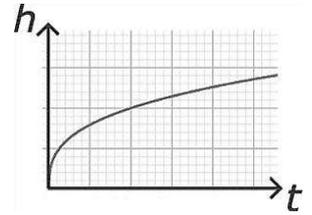
#### - 4 Point Examples -

11. Two dice with volumes  $V$  and  $W$  intersect each other as shown. 90% of the volume of the die with volume  $V$  does not belong to both dice. 85% of the volume of the die with volume  $W$  does not belong to both dice. What is the relationship between the volumes of the two dice?

- (A)  $V = \frac{2}{3} W$  (B)  $V = \frac{3}{2} W$  (C)  $V = \frac{85}{90} W$  (D)  $V = \frac{90}{85} W$  (E)  $V = W$



12. The five vases shown are filled with water. The filling rate is constant. For which of the five vases does the graph shown describe the height of the water  $h$  as a function of the time  $t$ ?

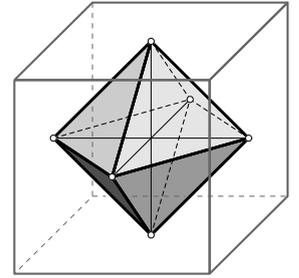


13.  $|\sqrt{17} - 5| + |\sqrt{17} + 5| =$

- (A) 10 (B)  $2\sqrt{17}$  (C)  $\sqrt{34} - 10$  (D)  $10 - \sqrt{34}$  (E) 0

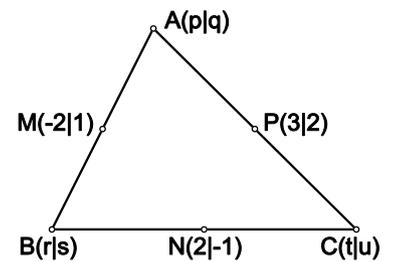
14. An octahedron is inscribed into a die with side length 1. The vertices of the octahedron are the midpoints of the faces of the die. How big is the volume of the octahedron?

- (A)  $\frac{1}{3}$  (B)  $\frac{1}{4}$  (C)  $\frac{1}{5}$  (D)  $\frac{1}{6}$  (E)  $\frac{1}{8}$



15. The vertices of a triangle have the co-ordinates  $A(p|q)$ ,  $B(r|s)$  and  $C(t|u)$  as shown. The midpoints of the sides of the triangle are the points  $M(-2|1)$ ,  $N(2|-1)$  and  $P(3|2)$ . Determine the value of the expression  $p + q + r + s + t + u$

- (A) 2 (B)  $\frac{5}{2}$  (C) 3 (D) 5 (E) another value



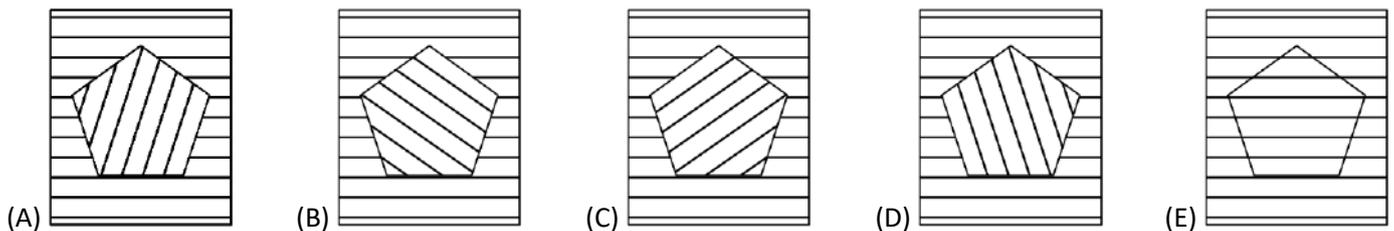
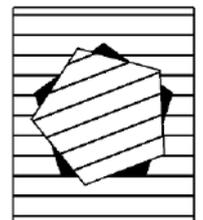
16. Before the football game, Real Madrid vs. Manchester United, the following five predictions were made:

- i) The game will not end in a draw.
- ii) Real Madrid will score at least one goal.
- iii) Real Madrid will not lose.
- iv) Real Madrid will win.
- v) Exactly three goals will be scored.

It turns out that exactly three of these predictions then come true. How many goals did Real Madrid score?

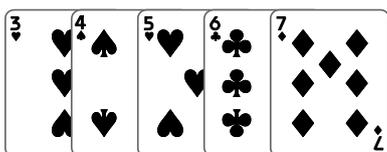
- (A) 0 (B) 1 (C) 2 (D) 3 (E) This cannot be determined for certain.

17. A regular pentagon is cut out of a page of lined paper. Step by step this pentagon is then rotated  $21^\circ$  counter clockwise about its midpoint. The result after step one is shown in the diagram. Which of the diagrams shows the situation when the pentagon fills the hole entirely again for the first time?



18. Which of the following numbers is not a factor of  $18^{2017} + 18^{2018}$ ?

- (A) 8 (B) 18 (C) 28 (D) 38 (E) 48

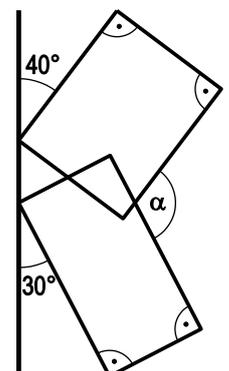


19. Three of the cards shown will be dealt to Nadia, the rest to Riny. Nadia multiplies the three values of her cards and Riny multiplies the two values of his cards. It turns out that the sum of those two products is a prime number. Determine the sum of the values of Nadia's cards.

- (A) 12 (B) 13 (C) 15 (D) 17 (E) 18

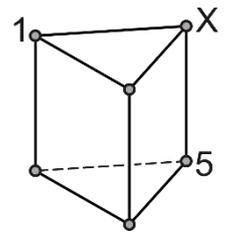
20. Two rectangles form the angles  $40^\circ$  and  $30^\circ$  respectively, with a straight line (see diagram). How big is angle  $\alpha$ ?

- (A)  $105^\circ$  (B)  $120^\circ$  (C)  $130^\circ$  (D)  $135^\circ$  (E) another value



**5 Point Examples**

**21.** The faces of the prism shown, are made up of two triangles and three squares. The six vertices are labelled using the numbers 1 to 6. The sum of the four numbers around each square is always the same. The numbers 1 and 5 are given in the diagram. Which number is written at vertex X?



- (A) 2      (B) 3      (C) 4      (D) 6      (E) This situation is impossible.

**22.**  $m$  and  $n$  are the solutions of the equation  $x^2 - x - 2018 = 0$ . What is the value of the expression  $n^2 + m$ ?

- (A) 2016      (B) 2017      (C) 2018      (D) 2019      (E) 2020

**23.** Four brothers with the harmonious names  $A$ ,  $B$ ,  $C$  and  $D$  are all of different heights. They make the following claims:

- $A$ : I am neither the tallest nor the smallest.       $B$ : I am not the smallest.  
 $C$ : I am the tallest.       $D$ : I am the smallest.

Exactly one of them lies. Who is the tallest brother?

- (A)  $A$     (B)  $B$     (C)  $C$     (D)  $D$     (E) Not enough information is given to be able to make a definite decision.

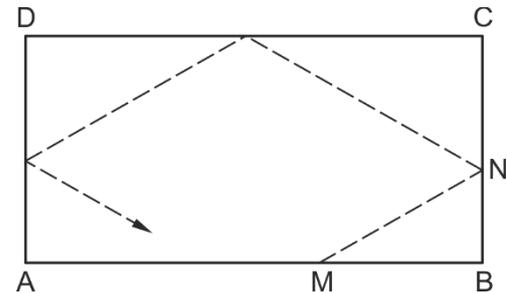
**24.** A function  $f$  fulfills the property  $f(x + y) = f(x) \cdot f(y)$  for all whole numbers  $x$  and  $y$ . Furthermore  $f(1) = 1/2$ . Determine the value of the expression  $f(0) + f(1) + f(2) + f(3)$ .

- (A)  $1/8$       (B)  $3/2$       (C)  $5/2$       (D)  $15/8$       (E) 6

**25.** A quadratic function of the form  $f(x) = x^2 + px + q$  intersects the  $x$ -axis and the  $y$ -axis in three different points. The circle through these three points intersects the graph of the function  $f$  in a fourth point. What are the coordinates of this fourth point of intersection?

- (A)  $(0 | -q)$     (B)  $(p | q)$     (C)  $(-p | q)$     (D)  $(-\frac{q}{p} | \frac{q^2}{p^2})$     (E)  $(1 | p + q + 1)$

**26.** On an idealised rectangular billiard table with side lengths 3 m and 2 m a ball (point-shaped) is pushed away from point  $M$  on the long side  $AB$ . It is reflected exactly once on each of the other sides as shown. at which distance from the vertex  $A$  will the ball hit this side again if  $BM = 1,2$  m and  $BN = 0,8$  m?

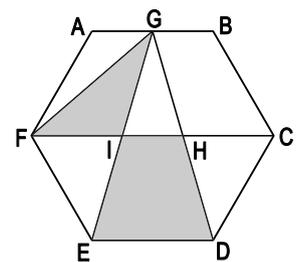


- (A) 2 m      (B) 1,5 m      (C) 1,2 m      (D) 2,8 m      (E) 1,8 m

**27.** How many real solutions does the equation  $||4^x - 3| - 2| = 1$  have?

- (A) 2      (B) 3      (C) 4      (D) 5      (E) 6

**28.**  $ABCDEF$  is a regular hexagon, as shown in the diagram.  $G$  is the midpoint of  $AB$ .  $H$  and  $I$  are the intercepts of the line segments  $GD$  and  $GE$  respectively, with the line segment  $FC$ . How big is the ratio of the areas of the triangle  $GIF$  and the trapezium  $IHDE$ ?



- (A)  $\frac{1}{2}$       (B)  $\frac{1}{3}$       (C)  $\frac{1}{4}$       (D)  $\frac{\sqrt{3}}{3}$       (E)  $\frac{\sqrt{3}}{4}$

**29.** In a class there are 40% more girls than boys. The probability that a student representative team of two students randomly selected from this class is made up of exactly one girl and one boy is exactly  $\frac{1}{2}$ . How many children are there in this class?

- (A) 20      (B) 24      (C) 36      (D) 38      (E) This situation is not possible.

**30.** Archimedes has calculated  $15!$ . The result is on the board.

Unfortunately two of the digits, the second and the tenth, cannot be read.

1 ■ 0767436 ■ 000

What are the two missing digits?

(Remark:  $15! = 15 \cdot 14 \cdot 13 \cdot \dots \cdot 2 \cdot 1$ )

- (A) 2 and 0      (B) 4 and 8      (C) 7 and 4      (D) 9 and 2      (E) 3 and 8

2018

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Felix	D	B	B	D	C	D	E	A	B	C	E	A	D	B	E	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Écolier	E	D	E	B	D	D	A	D	D	A	B	E	E	C	D	C	C	B	D	A	B	B	E	C	-	-	-	-	-	
Benjamin	B	C	B	B	E	D	C	C	D	A	E	E	A	A	E	C	C	A	A	C	D	C	B	D	-	-	-	-	-	
Kadett	B	E	B	D	C	D	C	C	D	D	B	C	D	C	A	D	D	B	A	B	E	C	B	B	D	B	E	C	C	C
Junior	C	C	C	C	E	A	B	B	A	B	D	D	B	E	B	A	D	E	D	A	B	C	E	C	D	D	A	D	C	D
Student	A	D	B	D	C	E	A	B	B	A	B	D	A	D	D	B	B	C	B	E	A	D	B	D	C	E	B	A	C	E

# Känguru der Mathematik 2019

## Level Felix (Grade 1 and 2)

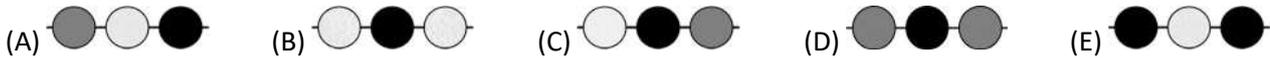
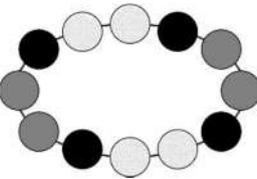
### Austria – 21. 3. 2019

- 3 Point Examples -

1. Which of these clouds contain only numbers that are smaller than 7?



2. Which of the 5 pictures shows a part of this chain?



3. Mother kangaroo and her son Max together weigh 60 kg (kilograms).  
The mother on her own weighs 52 kg.  
How heavy is Max?

- (A) 4 kg      (B) 8 kg      (C) 30 kg      (D) 56 kg      (E) 112 kg



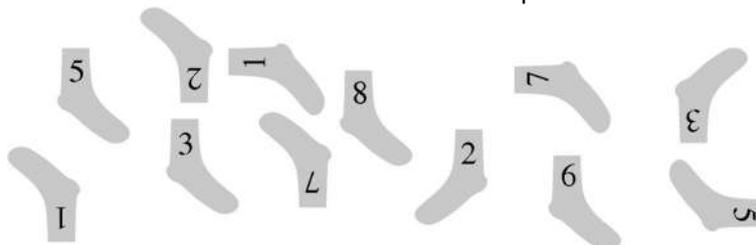
4. There are 12 children in front of a zoo. Susi is the 7th from the front and Kim the 2nd from the back.



How many children are there between Susi and Kim?

- (A) 2      (B) 3      (C) 4      (D) 5      (E) 6

5. Jörg is sorting his socks. Two socks with the same number are one pair.



How many pairs can he find?

- (A) 8      (B) 6      (C) 5      (D) 4      (E) 3

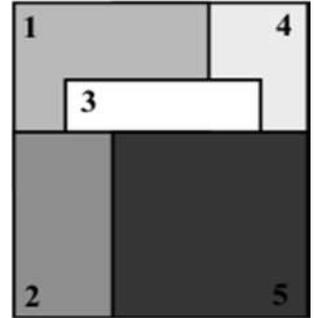
- 4 Point Examples -

6. Five equally big square pieces of card are placed on a table on top of each other. The picture on the side is created this way.

The cards are collected up from top to bottom.

In which order are they collected?

- (A) 5-4-3-2-1    (B) 5-2-3-4-1    (C) 5-4-2-3-1    (D) 5-3-2-1-4    (E) 5-2-3-1-4



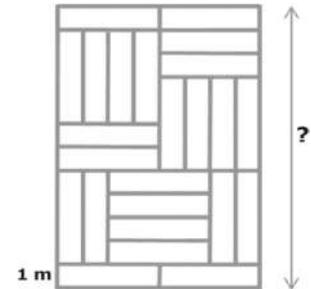
7. There are two kinds of camels: bactrian camels that have 2 humps, dromedaries that have 1 hump. Exactly 10 camels live in a certain zoo. Together they have 14 humps. How many bactrian camels are there in this zoo?

- (A) 1                (B) 2                (C) 3                (D) 4                (E) 5

8. The floor of a room is covered with equally big rectangular tiles (see picture).

How long is the room?

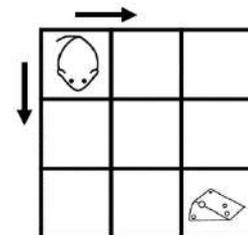
- (A) 6 m            (B) 8 m            (C) 10 m            (D) 11 m            (E) 12 m



9. The picture shows a mouse and a piece of cheese. The mouse is only allowed to move to the neighbouring fields in the direction of the arrows.

How many paths are there from the mouse to the cheese?

- (A) 2                (B) 3                (C) 4                (D) 5                (E) 6



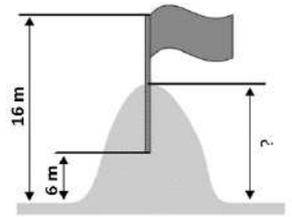
10. Which of the figures can be cut into these 3 pieces?



- (A)    (B)    (C)    (D)    (E)

**- 5 Point Examples -**

- 11.** The giants Tim and Tom build a sandcastle and decorate it with a flag. They insert half the flagpole into the highest point of the sandcastle. The highest point of the flagpole is now 16 m above the floor, the lowest 6 m (see diagram). How high is the sandcastle?

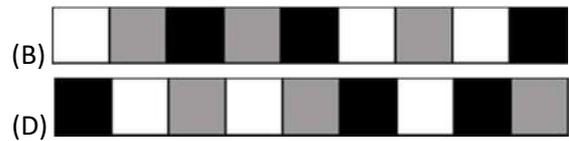
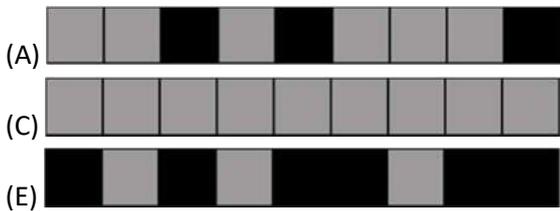


- (A) 11 m      (B) 12 m      (C) 13 m      (D) 14 m      (E) 15 m

- 12.** There are white, grey and black squares. Three children use these to make this pattern.



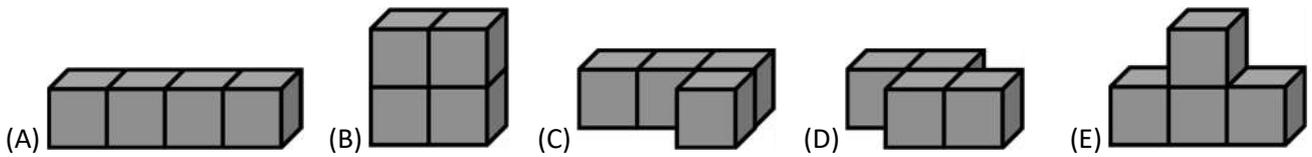
First Anni replaces all black squares with white squares.  
 Then Bob replaces all grey squares with black squares.  
 Finally Chris replaces all white squares with grey squares.  
 Which picture have the three children now created?



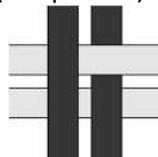
- 13.** Together the three squirrels Anni, Asia and Elli have 10 nuts. Each one has a different number of nuts but at least 2 nuts. Anni has the least number of nuts. Asia has the most nuts. How many nuts does Elli have?

- (A) 1      (B) 2      (C) 3      (D) 4      (E) 5

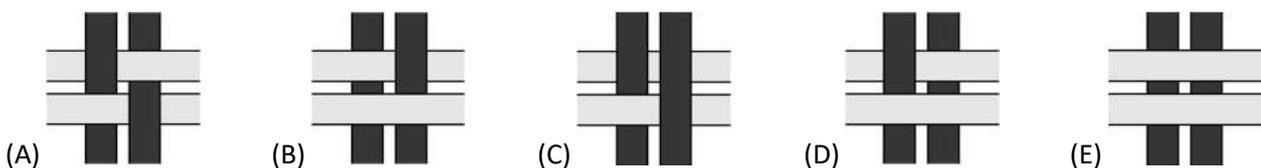
- 14.** Each figure is made up of 4 equally big cubes and coloured in. Which figure needs the least amount of colour?



- 15.** Four strips of paper are used to make a pattern (see picture).



What do you see when you look at it from behind?



# Känguru der Mathematik 2019

## Level Écolier (Schulstufe 3 and 4)

### Austria – 21. 3. 2019

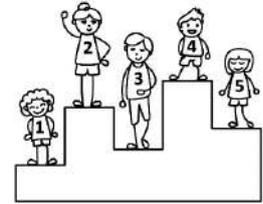


#### - 3 Point Examples -

1. The higher someone stands on the podium, the better the ranking.

Which number got third place?

- (A) 1      (B) 2      (C) 3      (D) 4      (E) 5



2. The diagram  shows the number 8. A dot stands for the number 1 and a line for the number 5.

Which diagram represents the number 12?

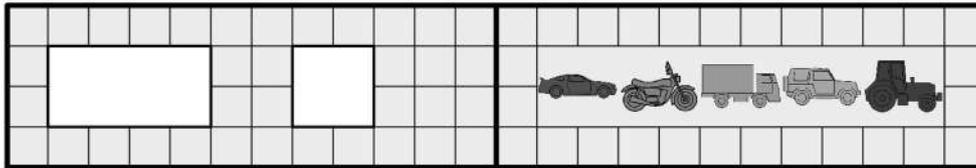
- (A)       (B)       (C)       (D)       (E) 

3. Yesterday it was Sunday.

Which day will it be tomorrow?

- (A) Saturday      (B) Thursday      (C) Wednesday      (D) Tuesday      (E) Monday

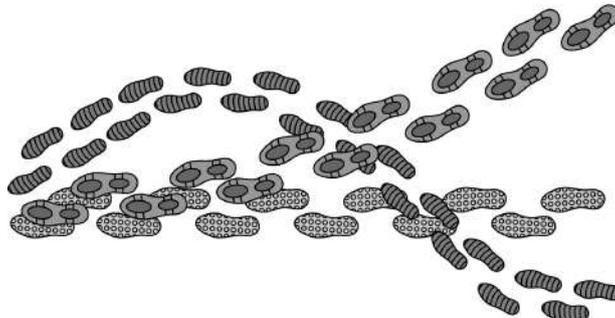
4. There are two holes in the cover of a book. The book lies on the table opened up (see diagram).



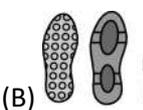
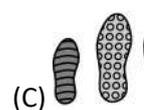
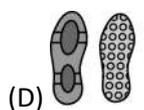
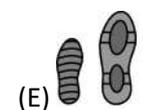
After closing up the book which vehicles can Olaf see?

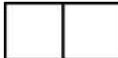
- (A)       (B)       (C)   
 (D)       (E) 

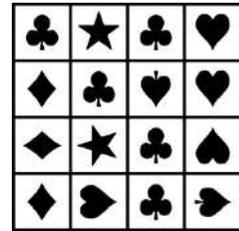
5. Three people walked through the snow in their winter boots.

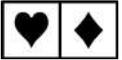


In which order did they walk through the snow?

- (A)       (B)       (C)       (D)       (E) 

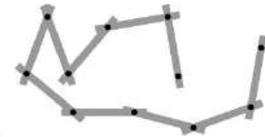
6. Karina cuts out a piece of this form  from the diagram on the right. Which one of the following pieces can she cut out?

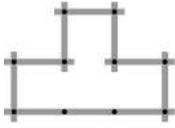
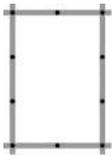
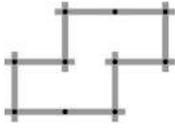
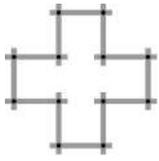
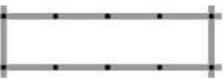


- (A)  (B)  (C)  (D)  (E) 

7. Using the connected sticks shown, Pia forms different shapes.

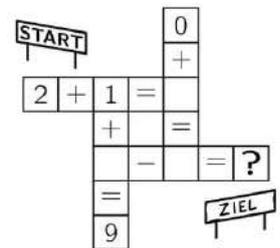
Which shape can she not make?



- (A)  (B)  (C)  (D)  (E) 

8. Which number goes into the field with the question mark, if all calculations are solved correctly?

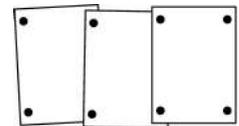
- (A) 4 (B) 5 (C) 6 (D) 7 (E) 8



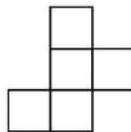
- 4 Point Examples -

9. Linda fixes 3 photos on a pin board next to each other. She uses 8 pins to do so. Peter wants to fix 7 photos in the same way. How many pins does he need for that?

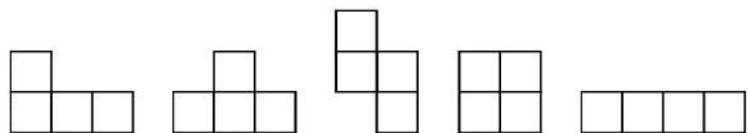
- (A) 14 (B) 16 (C) 18 (D) 22 (E) 26



10. Dennis takes off one of the squares of this shape



How many of these 5 shapes can he get?

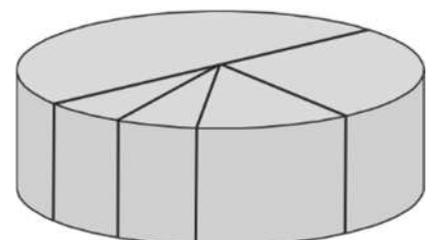


- (A) 1 (B) 2 (C) 3 (D) 4 (E) 5

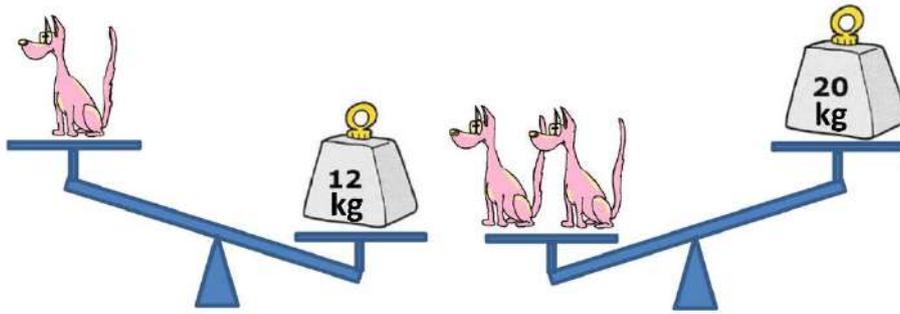
11. Mother halves the birthday cake. One half she then halves again. Of that she again halves one of the smaller pieces. Of these smaller pieces she once more halves one of them (see diagram). One of the two smallest pieces weighs 100 g.

How much does the entire cake weigh?

- (A) 600 g (B) 800 g (C) 1200 g (D) 1600 g (E) 2000 g



12. All dogs are equally heavy.



How much could one dog weigh?

- (A) 7 kg      (B) 8 kg      (C) 9 kg      (D) 10 kg      (E) 11 kg

13. Sara has 16 blue marbles. She can swap her marbles in the following way:

For 3 blue marbles she gets 1 red marble.

For 2 red marbles she gets 5 green marbles.

What is the maximum number of green marbles she can get?

- (A) 5      (B) 10      (C) 13      (D) 15      (E) 20

14. Steven wants to write each of the digits 2, 0, 1 and 9 into the boxes of this addition:

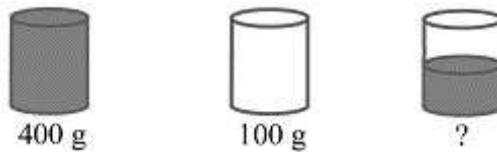
$$\square \square \square + \square$$

He wants to obtain the biggest result possible.

Which digit does he have to use for the single-digit number?

- (A) either 0 or 1      (B) either 0 or 2      (C) only 0      (D) only 1      (E) only 2

15. A full glass of water weighs 400 grams. An empty glass weighs 100 grams.



How much does a half-full glass of water weigh?

- (A) 150 g      (B) 200 g      (C) 225 g      (D) 250 g      (E) 300 g

16. The pictures show how much 2 pieces of fruit cost altogether.



- (A) 8 Taler      (B) 9 Taler      (C) 10 Taler      (D) 11 Taler      (E) 12 Taler

**- 5 Point Examples -**

17. Each shape represents exactly one digit.

○	★	♡	15
○	○	○	12
★	♡	♡	16

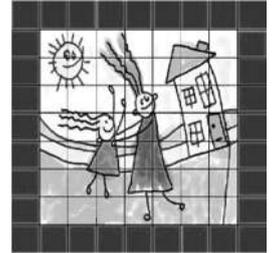
The sum of the digits in each row is stated on the right hand-side of each row.

Which digit does the star stand for? ★

- (A) 2            (B) 3            (C) 4            (D) 5            (E) 6

18. Anna uses 32 small grey squares to frame a 7 cm by 7 cm big picture.  
How many small grey squares does she have to use to frame a 10 cm by 10 cm big picture?

- (A) 36            (B) 40            (C) 44            (D) 48            (E) 52

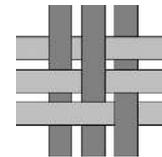


19. The pages of a book are numbered with 1, 2, 3, 4, 5 and so on.  
The digit 5 appears exactly 16 times.

What is the maximum number of pages the book can have?

- (A) 56            (B) 64            (C) 72            (D) 80            (E) 88

20. Six paper strips are used to weave a pattern (see diagram).  
What do you see when you look at the pattern from behind?



- (A)      (B)      (C)      (D)      (E)

21. There live exactly 15 animals on a farm: cows, cats and kangaroos. We know that exactly 10 animals are not cows and exactly 8 animals are not cats.  
How many kangaroos live on the farm?

- (A) 2            (B) 3            (C) 4            (D) 10            (E) 18

22. Marta sticks several triangles on top of each other and makes a star that way.  
What is the minimum number of triangles she has used?

- (A) 2            (B) 3            (C) 4            (D) 5            (E) 6



23. One of the 5 children Alex, Bartek, Cora, Dani and Emil has eaten a cake.

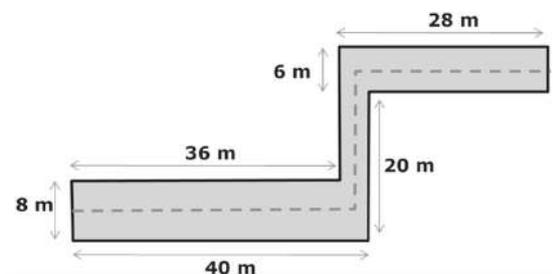
- Alex says: „I did not eat a cake.“
- Bartek says: „I ate a cake.“
- Cora says: „Emil has not eaten a cake.“
- Dani says: „I did not eat a cake.“
- Emil says: „Alex has eaten a cake.“

One of the children lies.  
Which child has eaten a cake?

- (A) Alex            (B) Bartek            (C) Cora            (D) Dani            (E) Emil

24. From above, the corridor of a school looks like in the diagram.  
A cat walks along the dotted line drawn in the middle of the room.  
How many meters does the cat walk?

- (A) 75 m            (B) 77 m            (C) 79 m            (D) 81 m            (E) 83 m



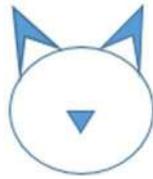
# Känguru der Mathematik 2019

## Level Benjamin (Schulstufe 5 and 6)

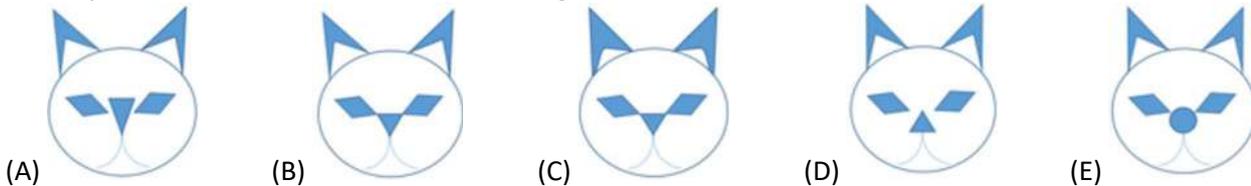
### Austria – 21. 3. 2019



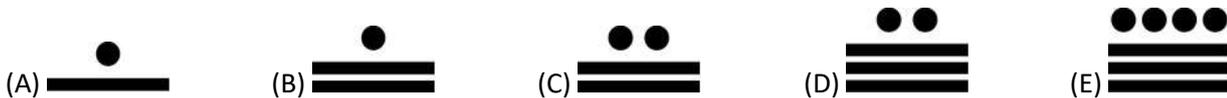
#### - 3 Point Examples -



1. Carina has started to draw a cat. She then adds some eyes. Which picture could show her finished drawing?



2. The Mayas used points and lines to write numbers. A point stands for 1, a line for 5. Which of the following Maya-numbers stands for 17?



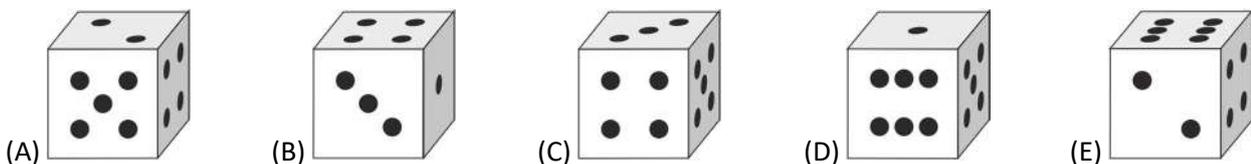
3. In a nursery group there are 14 girls and 12 boys. Half of the group go for a walk. What is the minimum number of girls that have to be amongst that group?
- (A) 5      (B) 4      (C) 3      (D) 2      (E) 1



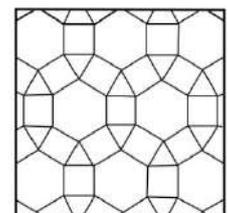
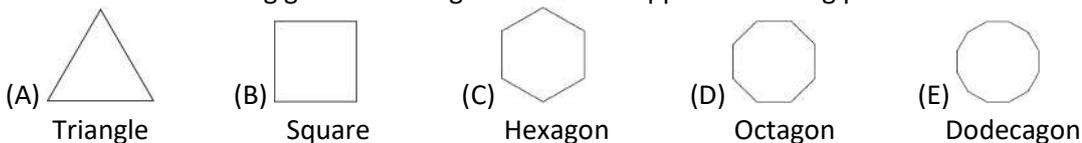
4. A digital clock shows the following time: What time is it when it uses the exactly same digits again for the first time after that?



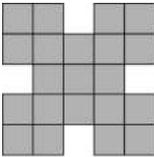
5. The sum of the dots on opposite sides of an ordinary die is 7. Which of the following dice could be an ordinary die?



6. Which of the following geometrical figures does not appear in the big picture?

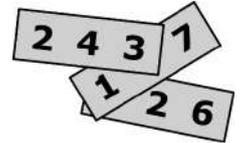


7. In an enclosure there is a group of kangaroos. If you add up the ages of all kangaroos you get 36 years. In two years all the kangaroos together will be 60 years old. How many kangaroos are in the enclosure?
- (A) 12      (B) 15      (C) 18      (D) 20      (E) 24

8. Laura wants to colour in exactly one  $2 \times 2$  square  in the figure given . How many ways are there for her to do that?  
 (A) 5 (B) 6 (C) 7 (D) 8 (E) 9

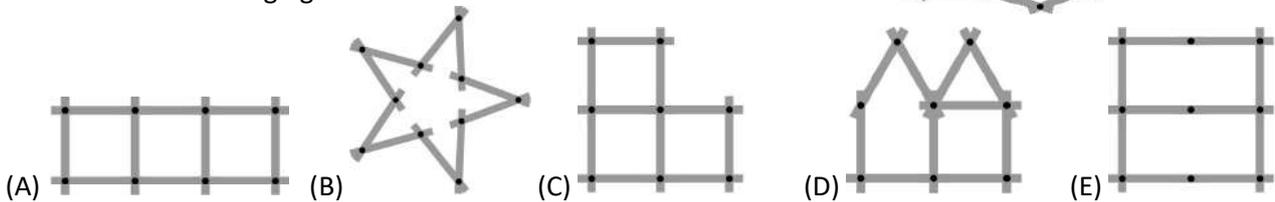
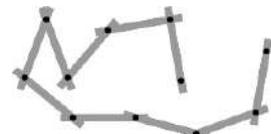
**- 4 Point Examples -**

9. On each of the three separate pieces of paper there is a three-digit number. The sum of the three numbers is 826. What is the sum of the two hidden digits?  
 (A) 7 (B) 8 (C) 9 (D) 10 (E) 11

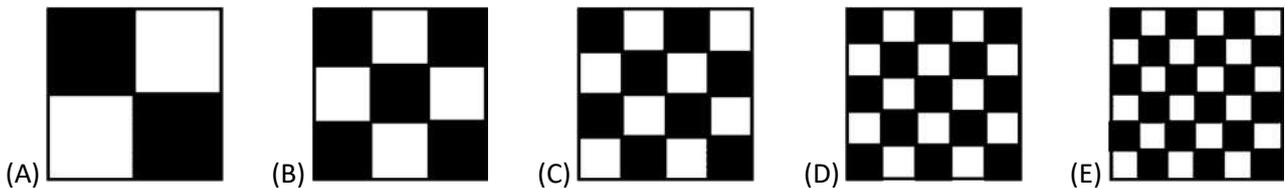


10. The six smallest odd natural numbers are written on the sides of a die. Toni rolls the die three times and adds the numbers. Which sum will Toni not be able to make?  
 (A) 3 (B) 19 (C) 21 (D) 29 (E) 35

11. Pia has a folding yardstick consisting of 10 equally long pieces. Which of the following figures can she not make?

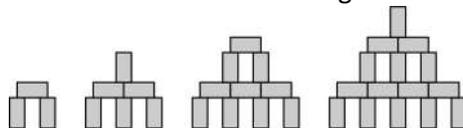


12. Which of the five squares has the biggest proportion of black area?



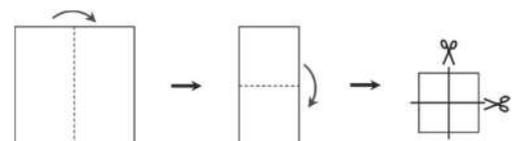
13. In a witch's garden there are 30 animals: dogs, cats and mice. The witch changes 6 dogs into 6 cats and then 5 cats into 5 mice. Now there is an equal number of dogs, cats and mice. How many cats were there to start with?  
 (A) 4 (B) 5 (C) 9 (D) 10 (E) 11

14. Maxi builds towers made up of little  $1 \text{ cm} \times 1 \text{ cm} \times 2 \text{ cm}$  building blocks as can be seen in the picture.

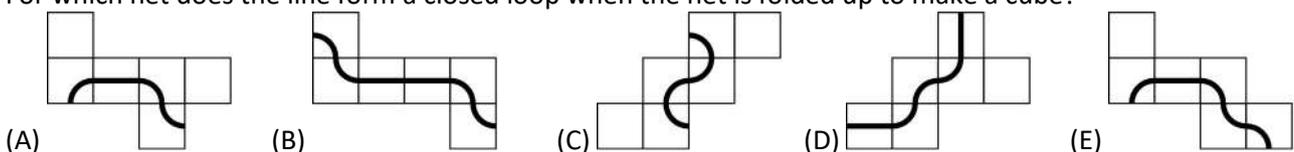


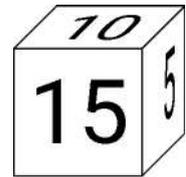
He continues to build his towers in the same way. Finally he uses 28 building blocks for one tower. What is the height of this tower?  
 (A) 9 cm (B) 10 cm (C) 11 cm (D) 12 cm (E) 14 cm

15. Bridget folds a square piece of paper twice and subsequently cuts it along the two lines as shown in the picture. How many pieces of paper does she obtain this way?  
 (A) 6 (B) 8 (C) 9 (D) 12 (E) 16



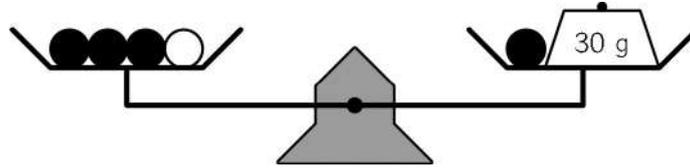
16. Each of the nets of a cube has a line drawn on. For which net does the line form a closed loop when the net is folded up to make a cube?



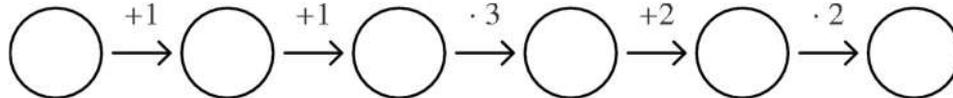


17. A natural number greater than 0 is written on each side of the die shown.  
All products of opposite numbers are of the same value.  
What is the smallest possible sum of all 6 numbers?  
(A) 36 (B) 37 (C) 41 (D) 44 (E) 60

18. 4 equally heavy black pearls, 1 white pearl and a piece of iron weighing 30 g are placed on a beam balance as shown in the diagram. The beam balance is balanced.  
How heavy are 6 black and 3 white pearls altogether?

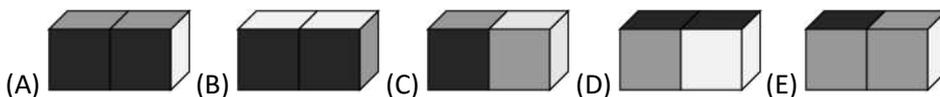
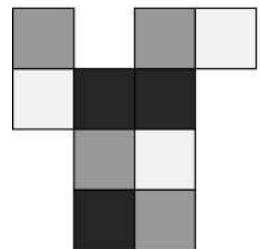


- (A) 100 g (B) 99 g (C) 96 g (D) 94 g (E) 90 g
19. Robert makes 5 statements. One of which is wrong.  
(A) My son Basil has 3 sisters.  
(B) My daughter Ann has 2 brothers.  
(C) My daughter Ann has 2 sisters.  
(D) My son Basil has 2 brothers.  
(E) I have 5 children.  
Which statement is wrong?  
(A) Statement A (B) Statement B (C) Statement C (D) Statement D (E) Statement E
20. Benjamin writes a number into the first circle. He then carries out the calculations as instructed and each time writes down the results in the respective circles.  
How many of the six numbers are divisible by 3?



- (A) 1 (B) 2 (C) 1 or 2 (D) 2 or 3 (E) 3 or 4
21. Emil takes selfies with his 8 cousins. Each one of the 8 cousins are on two or three of the pictures.  
There are exactly 5 cousins on each of the pictures.  
How many selfies does Emil take?  
(A) 3 (B) 4 (C) 5 (D) 6 (E) 7

22. The cardboard is folded up into a  $2 \times 1 \times 1$  box.  
Which of the pictures does not show the box?



23. Jette and Willi throw balls at two identically built pyramids each made up of 15 tins. Jette hits 6 tins and gets 25 points. Willi hits 4 tins.  
How many points does Willi get?  
(A) 22 (B) 23 (C) 25 (D) 26 (E) 28



24. Linus builds a  $4 \times 4 \times 4$  cube made up of 32 white and 32 black  $1 \times 1 \times 1$  cubes. He arranges the cubes so that the surface of the big cube has as much white as possible.  
Which fraction of the surface is white?  
(A)  $\frac{3}{4}$  (B)  $\frac{2}{3}$  (C)  $\frac{1}{2}$  (D)  $\frac{3}{8}$  (E)  $\frac{1}{4}$

# Känguru der Mathematik 2019

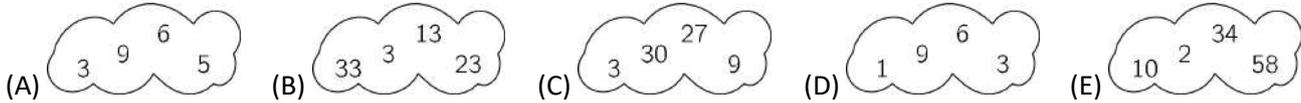
## Level Kadett (Schulstufe 7 and 8)

### Austria – 21. 3. 2019



#### - 3 Point Examples -

1. Which cloud contains even numbers only?

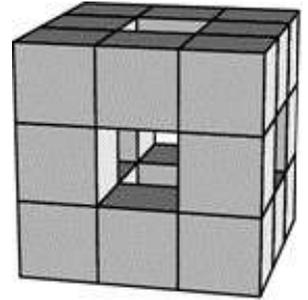


2. Ten quarters of an hour correspond to how many hours?

- (A) 40      (B)  $5\frac{1}{2}$       (C) 4      (D) 3      (E)  $2\frac{1}{2}$

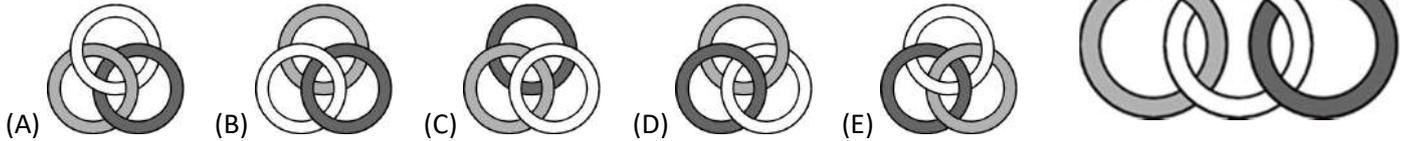
3. A  $3 \times 3 \times 3$  cube is made up of small  $1 \times 1 \times 1$  cubes. Then the middle cubes from front to back, from top to bottom and from right to left are removed (see diagram). How many  $1 \times 1 \times 1$  – cubes remain?

- (A) 15      (B) 18      (C) 20      (D) 21      (E) 22

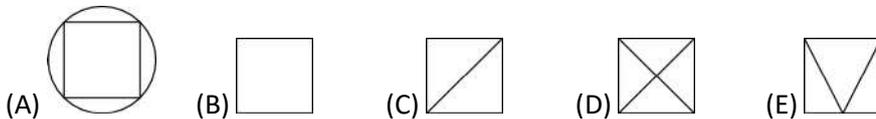


4. Three rings are connected to each other as shown.

Which of the following pictures also shows three rings connected in the same way?



5. Four of the following five diagrams can be drawn without lifting the pencil and without going over a line twice. For one diagram this is not true. Which one is it?



6. Five friends bake ginger bread and subsequently meet up for a tasting session. Each one gives one of his ginger breads to each other person. Then each person eats all of the ginger bread they were given. After that the number of ginger breads halves. How many ginger breads did the five friends have to start with?

- (A) 20      (B) 24      (C) 30      (D) 40      (E) 60

7. Lothar finishes a race in front of Manfred. Victor finishes the race after Jan, Manfred in front of Jan and Eddy in front of Victor. Which of the five finishes the race last?

- (A) Victor      (B) Manfred      (C) Lothar      (D) Jan      (E) Eddy

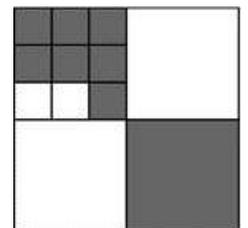
8. Julia reads a book whose pages are all numbered. The digit 0 appears five times and the digit 8 six times. What is the page number of the last page?

- (A) 48      (B) 58      (C) 60      (D) 68      (E) 88

9. A big square is divided up into smaller squares of different sizes as shown. Some of the smaller squares are shaded in grey.

Which fraction of the big square is shaded in grey?

- (A)  $\frac{2}{3}$       (B)  $\frac{2}{5}$       (C)  $\frac{4}{7}$       (D)  $\frac{4}{9}$       (E)  $\frac{5}{12}$



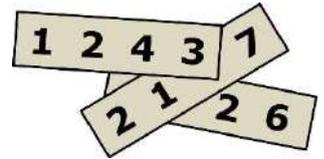
10. Andreas distributes some apples equally into six baskets. Boris distributes the same amount of apples equally into five baskets. Boris realises that each of his baskets contains two more apples than Andreas' basket.

How many apples did Andreas distribute?

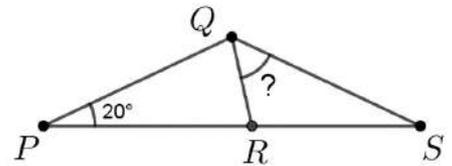
- (A) 60      (B) 65      (C) 72      (D) 75      (E) 90

**- 4 Point Examples -**

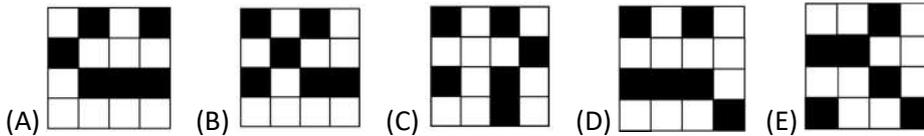
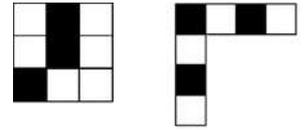
11. Three four-digit numbers are written onto three separate pieces of paper as shown. The sum of the three numbers is 10126. Three of the digits in the picture are hidden. Which are the hidden digits?  
 (A) 5, 6 and 7      (B) 4, 5 and 7      (C) 4, 6 and 7      (D) 4, 5 and 6      (E) 3, 5 and 6



12. The following information is known about triangle PSQ:  $\angle QPS = 20^\circ$ . The triangle PSQ has been split up into two smaller triangles by the line QR as shown. It is known that  $PQ = PR = QS$ . How big is the angle RQS?  
 (A)  $50^\circ$       (B)  $60^\circ$       (C)  $65^\circ$       (D)  $70^\circ$       (E)  $75^\circ$



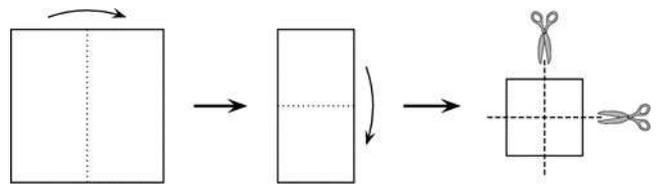
13. A 4 x 4 square is made up of the two pieces shown. Which of the following 4 x 4 squares cannot be made this way?



14. Anna, Bella, Claire, Dora and Erika meet at a party. Each pair who know each other shake hands exactly once. Anna shakes hands only once, Bella twice, Claire three times and Dora four times. How many people does Erika shake hands with?  
 (A) 1      (B) 2      (C) 3      (D) 4      (E) 5

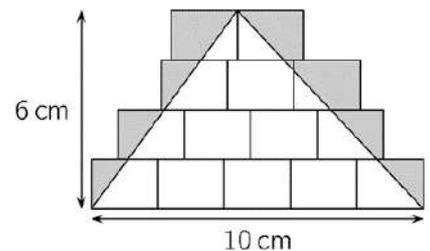
15. Jane plays basketball. Of her first 20 throws 55% are successful. After five more throws her success rate increases to 56%. How many of her last five throws were successful?  
 (A) 1      (B) 2      (C) 3      (D) 4      (E) 5

16. Kathi folds a square piece of paper twice and subsequently cuts it along the two lines as shown in the picture. The resulting pieces of paper are then unfolded if possible. How many of the pieces of paper are squares?  
 (A) 3      (B) 4      (C) 5      (D) 6      (E) 8



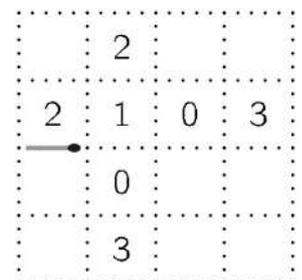
17. Michaela has 24 animals, namely dogs, cows, cats and kangaroos. One eighth of the animals are dogs. Three quarters of the animals are *not* cows and two thirds are *not* cats. How many kangaroos does Michaela have?  
 (A) 4      (B) 5      (C) 6      (D) 7      (E) 8

18. Mia draws some congruent rectangles and one triangle. She then shades in grey those parts of the rectangles that lie outside the triangle (see diagram). How big is the resulting grey area?  
 (A)  $10 \text{ cm}^2$       (B)  $12 \text{ cm}^2$       (C)  $14 \text{ cm}^2$       (D)  $15 \text{ cm}^2$       (E)  $21 \text{ cm}^2$



19. Julius has two cylinder-shaped candles of different heights and diameters. The first candle burns down in 6 hours, the second one in 8 hours. They both burn down evenly. He lights both candles at the same time and after three hours they are both equally high. What was the ratio of the original heights?  
 (A) 4:3      (B) 8:5      (C) 5:4      (D) 3:5      (E) 7:3

20. Anna has placed matches along the dotted lines to create a path. She has placed the first match as shown in the diagram. The path is in such a way that in the end it leads back to the left end of the first match. The numbers in the small squares state how many sides of the square she has placed matches on. What is the minimum number of matches she has used?  
 (A) 12      (B) 14      (C) 16      (D) 18      (E) 20





# Känguru der Mathematik 2019

## Level Junior (Schulstufe 9 and 10)

### Austria – 21. 3. 2019



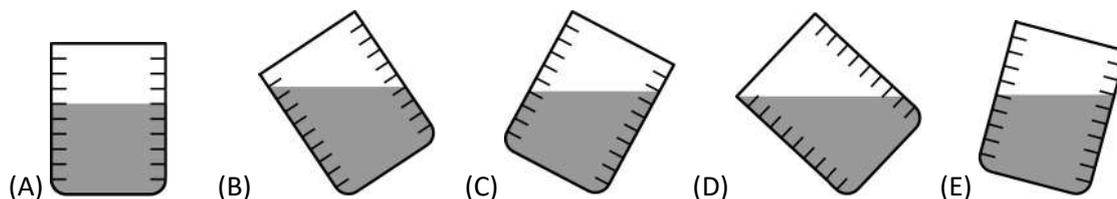
#### - 3 Point Examples -

- $20 \times 19 + 20 + 19 =$   
 (A) 389      (B) 399      (C) 409      (D) 419      (E) 429
- A model railway goes round in circles. It drives with constant speed and needs exactly 1 minute and 11 seconds for one circuit. How long does it need for six circuits?  
 (A) 6 minutes 56 seconds      (B) 7 minutes 6 seconds      (C) 7 minutes 16 seconds  
 (D) 7 minutes 26 seconds      (E) 7 minutes 36 seconds

- A barber wants to write the word SHAVE on a board so that a customer who sees the word in the mirror can read the word normally. How does he have to write the word on the board?



- How many different sums of the dots can one obtain if three ordinary dice are thrown at the same time?  
 (A) 14      (B) 15      (C) 16      (D) 17      (E) 18
- Five identical measuring jugs are filled with water. Four of them contain exactly the same amount of water. Which measuring jug contains a different amount?



- A park has five entrances. Monika wants to enter the park through one entrance and leave the park through another entrance. How many ways are there in which she can enter and leave the park?

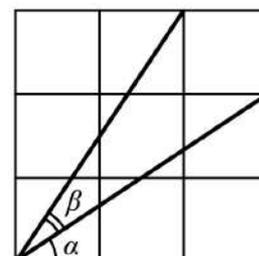
(A) 25      (B) 20      (C) 16      (D) 15      (E) 10

- The individual masses (in kg) of three kangaroos are three different integers. Together they weigh 97 kg. What is the maximum weight the lightest of the three can have?

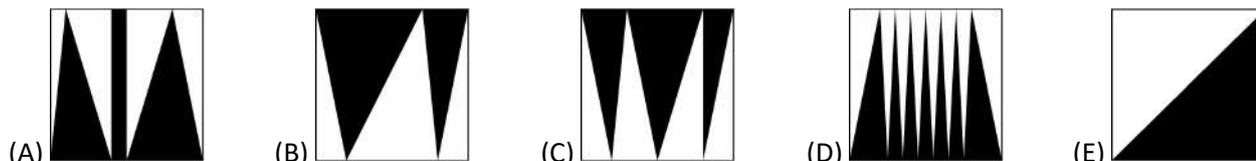
(A) 1      (B) 30      (C) 31      (D) 32      (E) 33

- Which of the following statements is definitely true for the angle marked in the diagram which is made up of nine squares?

(A)  $\alpha = \beta$     (B)  $2\alpha + \beta = 90^\circ$     (C)  $\alpha + \beta = 60^\circ$     (D)  $2\beta + \alpha = 90^\circ$     (E)  $\alpha + \beta = 45^\circ$



- Inside a unit square a certain area has been coloured in black. In which square is the black area biggest?

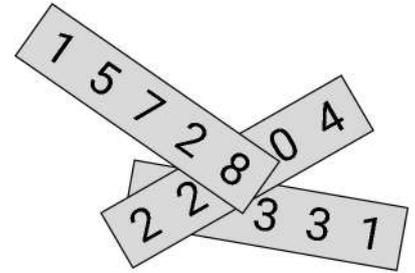


- Julia reads a book whose pages are all numbered. The digit 0 appears six times and the digit 8 seven times. What is the page number of the last page?

(A) 58      (B) 68      (C) 70      (D) 78      (E) 98

- 4 Point Examples -

11. Three five-digit numbers are written onto three separate pieces of paper as shown. Three of the digits in the picture are hidden. The sum of the three numbers is 57263. Which are the hidden digits?



- (A) 0, 2 and 2 (B) 1, 2 and 9 (C) 2, 4 and 9 (D) 2, 7 and 8 (E) 5, 7 and 8

12. Anna, Bella, Claire, Dora, Erika and Frieda meet at a party. Each pair who know each other shake hands exactly once. Anna shakes hands only once, Bella twice, Claire three times, Dora four times and Erika five times. How many people does Frieda shake hands with?

- (A) 1 (B) 2 (C) 3 (D) 4 (E) 5

13. The vertices of a square  $ABCD$  are labelled anti-clockwise.  $A$  and  $C$  are the vertices of an equilateral triangle  $AEC$ , whose vertices are also labelled anti-clockwise.

How big is the angle  $CBE$ ?

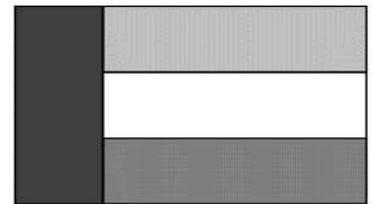
- (A)  $30^\circ$  (B)  $45^\circ$  (C)  $135^\circ$  (D)  $145^\circ$  (E)  $150^\circ$

14. The numbers  $a, b, c$  and  $d$  are pairwise different integers between 1 and 10 (1 and 10 including).

What is the smallest possible value of the expression  $\frac{a}{b} + \frac{c}{d}$ ?

- (A)  $\frac{2}{10}$  (B)  $\frac{3}{19}$  (C)  $\frac{14}{45}$  (D)  $\frac{29}{90}$  (E)  $\frac{25}{72}$

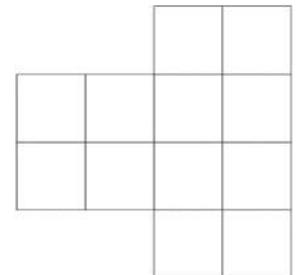
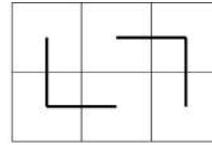
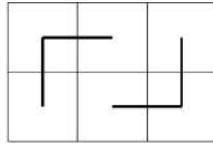
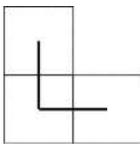
15. The flag of Kanguria is a rectangle whose side lengths are in the ratio 3:5. The flag is split into four rectangles of equal area as shown.



In which ratio are the side lengths of the white rectangle?

- (A) 1:3 (B) 1:4 (C) 2:7 (D) 3:10 (E) 4:15

16. A  $3 \times 2$  rectangle can be covered in two ways by two of the L-shaped figures as shown:



In how many ways can the diagram on the right be covered by these L-shaped figures?

- (A) 1 (B) 2 (C) 3 (D) 4 (E) 48

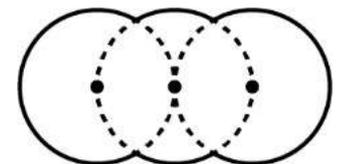
17. A triathlon consists of three disciplines swimming, running and cycling. The cycle route is three quarters of the entire distance, the running route is one fifth of the entire distance and the swimming route is 2 km long. How long is the whole distance of the triathlon in km?

- (A) 10 (B) 20 (C) 38 (D) 40 (E) 60

18. A 1-liter-bottle of syrup is still half full. The syrup shall be diluted in the ratio 1:7 to make juice. Which fraction of the syrup should be used to obtain 2 litres of juice?

- (A)  $\frac{1}{4}$  (B)  $\frac{1}{2}$  (C)  $\frac{2}{7}$  (D)  $\frac{4}{7}$  (E) the whole syrup

19. The diagram consists of three circles of equal radius  $R$ . The centre of those circles lie on a common straight line where the middle circle goes through the centres of the other two circles (see diagram). How big is the perimeter of the figure?



- (A)  $\frac{10\pi R}{3}$  (B)  $\frac{5\pi R}{3}$  (C)  $\frac{2\pi R\sqrt{3}}{3}$  (D)  $2\pi R\sqrt{3}$  (E)  $4\pi R$

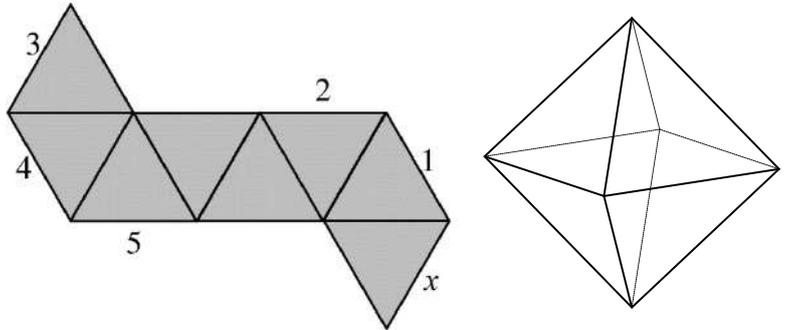
20. The sum of the seven digits of a seven-digit phone number  $aaabbbb$  is a two-digit number  $ab$ . How big is the value of the sum  $a + b$ ?

- (A) 8 (B) 9 (C) 10 (D) 11 (E) 12

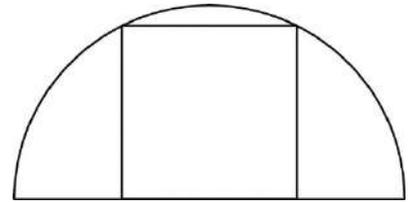
**- 5 Point Examples -**

21. If one of the digits of a two-digit number is deleted, the result in both cases is a factor of the original number. How many two-digit numbers have this property?  
 (A) 5            (B) 9            (C) 14            (D) 19            (E) 23
22. 60 apples and 60 pears in total are shared out in several boxes. There should be the same amount of apples in each box but no two boxes should contain the same amount of pears. Each box contains both fruits. What is the maximum number of boxes that can be filled in this way?  
 (A) 20            (B) 15            (C) 12            (D) 10            (E) 6

23. The diagram shows the net of an octahedron. Which edge meets the edge labelled with  $x$  if the net is folded up to form an octahedron?



- (A) 1            (B) 2            (C) 3            (D) 4            (E) 5
24. Two vertices of a square lie on a semi-circle as shown, while the other two lie on its diameter. The radius of the circle is 1 cm. How big is the area of the square?

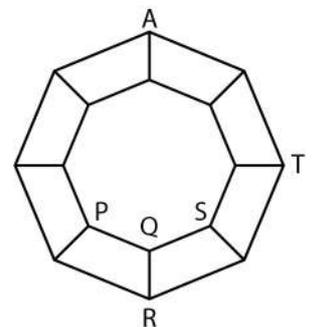


- (A)  $\frac{4}{5} \text{ cm}^2$     (B)  $\frac{\pi}{4} \text{ cm}^2$     (C)  $1 \text{ cm}^2$     (D)  $\frac{4}{3} \text{ cm}^2$     (E)  $\frac{2}{\sqrt{3}} \text{ cm}^2$
25. Two points are marked on a circular disc that rotates about its centre. The outer point is 3 cm further away from the centre than the inner point and it moves 2.5 times as fast as the inner point. How big is the distance between the outer point and the centre of the circular disc?  
 (A) 10 cm    (B) 9 cm    (C) 8 cm    (D) 6 cm    (E) 5 cm

26. The integers from 1 to 99 are written down in ascending order without a gap. This sequence of numbers is divided up into triples (groups of three):  
 $123456789101112 \dots 979899 \rightarrow (123)(456)(789)(101)(112) \dots (979)(899)$ .  
 Which of the following triples is not obtained?

- (A) (222)    (B) (444)    (C) (464)    (D) (646)    (E) (888)
27. How many planes exist that go through exactly three vertices of a given cube?  
 (A) 2            (B) 4            (C) 6            (D) 8            (E) 10

28. A graph consists of 16 points and several connecting lines as shown in the diagram. An ant is at point A. With every move the ant can move from the point where it currently is, along one of the connecting lines, to an adjacent point.  
 At which of the points P, Q, R, S and T can the ant be after 2019 moves?



- (A) only at P, R or S, not at Q or T            (B) only at P, R, S or T, not at Q  
 (C) only at Q            (D) only at T            (E) At all of the points
29. The numbers  $a$ ,  $b$  and  $c$  are three-digit numbers and in each number the first digit is equal to the last one. Furthermore  $b = 2a + 1$  and  $c = 2b + 1$ . How many possible values are there for the number  $a$ ?  
 (A) 0            (B) 1            (C) 2            (D) 3            (E) more than 3
30. What is the minimum number of elements of the set  $\{10, 20, 30, 40, 50, 60, 70, 80, 90\}$  that have to be removed so that the product of the remaining elements of the set is a square number?  
 (A) 1            (B) 2            (C) 3            (D) 4            (E) 5

# Känguru der Mathematik 2019

## Level Student (Schulstufe 11, 12 and 13)

### Austria – 21. 3. 2019



#### - 3 Point Examples -

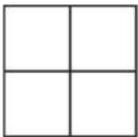
1. The flag of Kangoroland is a rectangle which is split into three equal rectangles as shown.

How big is the ratio of the side lengths of the white rectangle?

- (A) 1:2      (B) 2:3      (C) 2:5      (D) 3:7      (E) 4:9

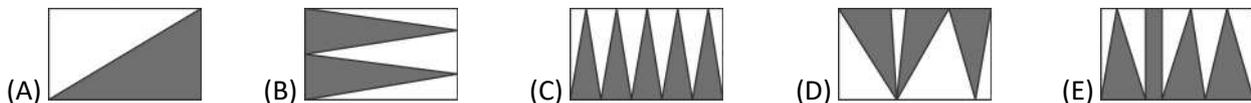


2. The numbers 1, 2, 3 and 4 are inserted into different cells of the  $2 \times 2$  table shown. Then the sums of the numbers in each row and column are determined. Two of these sums are 4 and 5. How big are the two remaining sums?

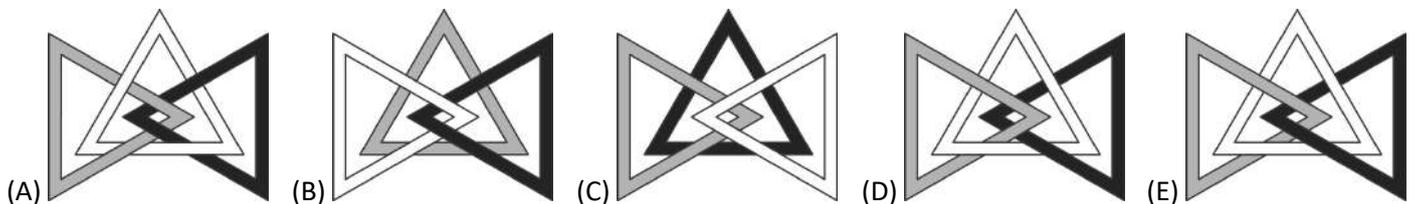
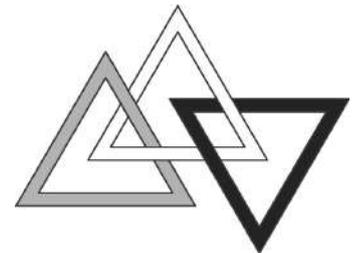


- (A) 6 and 6      (B) 3 and 5      (C) 4 and 5      (D) 4 and 6      (E) 5 and 6

3. A rectangle is coloured in five different ways as shown. In which picture is the grey area biggest?



4. Three triangles are connected to each other as shown. In which of the following pictures are the three triangles connected in the same way?

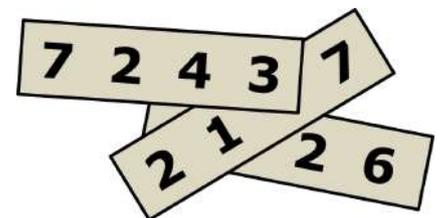


5. A pyramid has 23 triangular faces. How many edges does this pyramid have?

- (A) 23      (B) 24      (C) 46      (D) 48      (E) 69

6. Three four-digit numbers are written onto three separate pieces of paper as shown. The sum of the three numbers is 11126. Three of the digits in the picture are hidden. Which are the three hidden digits?

- (A) 1, 4 and 7      (B) 1, 5 and 7      (C) 3, 3 and 3      (D) 4, 5 and 6      (E) 4, 5 and 7



7. Reading from the left, what is the first digit of the smallest positive integer whose digit sum is 2019?

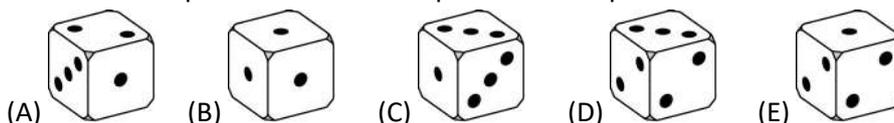
- (A) 2      (B) 3      (C) 4      (D) 5      (E) 6

8. How many of the numbers from  $2^{10}$  to  $2^{13}$  (including these two numbers) are divisible by  $2^{10}$ ?

- (A) 2      (B) 4      (C) 6      (D) 8      (E) 16

9. Each side of a die is marked with either 1, 2 or 3 dots so that the probability of rolling a 1 is equal to  $\frac{1}{2}$ , the probability of rolling a 2 is equal to  $\frac{1}{3}$  and the probability of rolling a 3 is equal to  $\frac{1}{6}$ .

Which of these pictures cannot be a picture of this particular die?



10. Every day the three kangaroos Alex, Bob and Carl go for a walk. If Alex does not wear a hat, Bob wears a hat. If Bob does not wear a hat, Carl wears a hat. Today Carl does not wear a hat. Which kangaroos can one say for sure are wearing a hat today?
- (A) only Alex and Bob                      (B) only Alex                      (C) Alex, Bob and Carl  
 (D) neither Alex nor Bob                      (E) only Bob

**- 4 Point Examples -**

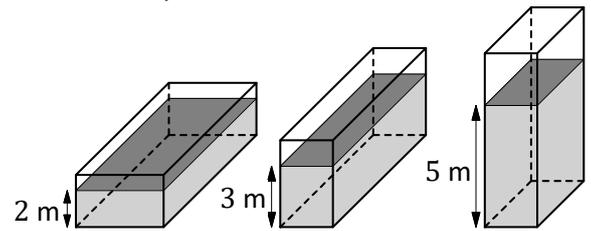
11. Which is the highest power of three that divides the number  $7! + 8! + 9!$  ?  
 (Hint: The expression  $n!$  is defined by  $n! = n \cdot (n-1) \cdot (n-2) \cdot \dots \cdot 3 \cdot 2 \cdot 1$ .)

- (A)  $3^2$               (B)  $3^4$               (C)  $3^5$               (D)  $3^6$               (E) a power of three greater than  $3^6$

12. In this school year the number of boys in my class has increased by 20% compared to the previous year and the number of girls has decreased by 20%. There is now one person more than before in this class. Which of the following numbers could be the current number of students in my class?

- (A) 22      (B) 26      (C) 29      (D) 31      (E) 34

13. A cuboid-shaped container that is not filled completely contains  $120 \text{ m}^3$  of water. The depth of the water is either 2 m or 3 m or 5 m, depending on which side the container is actually standing on (drawings not to scale).



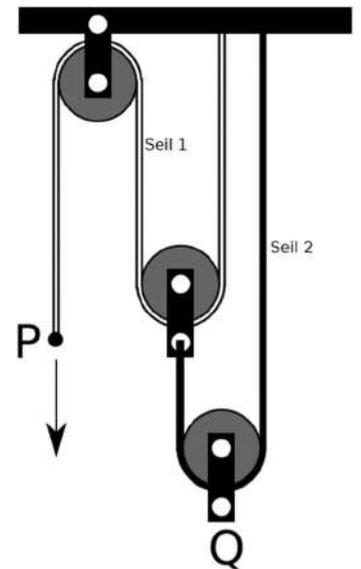
How big is the volume of the container?

- (A)  $160 \text{ m}^3$       (B)  $180 \text{ m}^3$       (C)  $200 \text{ m}^3$       (D)  $220 \text{ m}^3$       (E)  $240 \text{ m}^3$

14. Michael invents a new operation „ $\diamond$ “ for real numbers that is defined by  $x \diamond y = y - x$ . Which of the following statements is definitely true if the numbers  $a$ ,  $b$ , and  $c$  fulfill the condition  $(a \diamond b) \diamond c = a \diamond (b \diamond c)$  ?

- (A)  $a = b$       (B)  $b = c$       (C)  $a = c$       (D)  $a = 0$       (E)  $c = 0$

15. The system shown consists of three pulleys that are connected to each other via two ropes. P, the end of one rope, is pulled down by 24 cm.



By how many centimeters does point Q move upwards?

- (A) 24      (B) 12      (C) 8      (D) 6      (E)  $\frac{24}{5}$

16. A positive integer  $n$  is called good, if it's biggest factor (apart from  $n$  itself) is equal to  $n - 6$ . How many good positive integers are there?

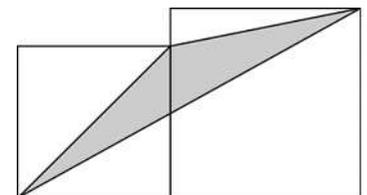
- (A) 1      (B) 2      (C) 3      (D) 6      (E) infinitely many

17. There are five balls in a box. Four of which contain chocolate, one contains one boiled sweet. Johann and Maria take it in turns to draw a ball from the box without replacing it. Whoever draws the boiled sweet wins. Johann starts.

How big is the probability that Maria wins?

- (A)  $\frac{2}{5}$       (B)  $\frac{3}{5}$       (C)  $\frac{1}{2}$       (D)  $\frac{5}{6}$       (E)  $\frac{1}{3}$

18. The diagram shows two adjoining squares with side lengths  $a$  and  $b$  (with  $a < b$ ). How big is the area of the grey triangle?

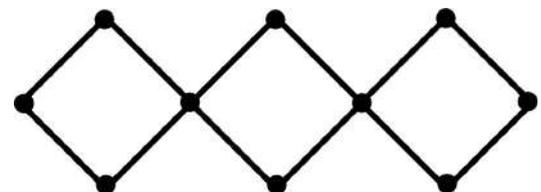


- (A)  $\sqrt{ab}$       (B)  $\frac{1}{2}a^2$       (C)  $\frac{1}{2}b^2$       (D)  $\frac{1}{4}(a^2 + b^2)$       (E)  $\frac{1}{2}(a^2 + b^2)$

19. What is the biggest integer smaller than  $\sqrt{20 + \sqrt{20 + \sqrt{20 + \sqrt{20 + \sqrt{20}}}}}$ ?

- (A) 4      (B) 5      (C) 6      (D) 20      (E) 25

20. The points of intersection of the network of bars shown are labelled with the numbers 1 to 10. The sums  $S$  of the four numbers on the vertices of each square are all the same.



What is the minimum value of  $S$ ?

- (A) 18      (B) 19      (C) 20      (D) 21      (E) 22

**- 5 Point Examples -**

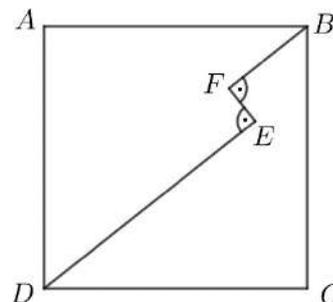
- 21.** Let  $a$  be the sum of all positive factors of 1024 and  $b$  be the product of all positive factors of 1024. (Hint: 1 and 1024 are also factors of 1024.) Then  
 (A)  $(a - 1)^5 = b$     (B)  $(a + 1)^5 = b$     (C)  $a^5 = b$     (D)  $a^5 - 1 = b$     (E)  $a^5 + 1 = b$
- 22.** Which is the set of all parameters  $a$  for which the equation  $2 - |x| = ax$  has exactly two solutions?  
 (A)  $] - \infty; -1]$     (B)  $] - 1; 1[$     (C)  $[1; +\infty[$     (D)  $\{0\}$     (E)  $\{-1; 1\}$
- 23.** In order to determine the result of the calculation  $\frac{a+b}{c}$  ( $a, b$  and  $c$  are positive integers), Sara inserts into a calculator  $a + b \div c =$  and obtains the result 11. Then she inserts  $b + a \div c =$  and is surprised that the result is now 14. She realises that the calculator follows the rules for the order of operations and does division before addition.

What is the actual result of the calculation  $\frac{a+b}{c}$ ?

- (A) 1    (B) 2    (C) 3    (D) 4    (E) 5
- 24.** Consider a cube. How many planes are there that go through at least three vertices of this cube?  
 (A) 6    (B) 8    (C) 12    (D) 16    (E) 20
- 25.** Four different straight lines go through the origin of the co-ordinate-system. They intersect the parabola  $y = x^2 - 2$  at eight points. What could be the product of the x-co-ordinates of these eight points?  
 (A) only 16    (B) only  $-16$     (C) only 8    (D) only  $-8$     (E) There is more than one possible value.

- 26.** For how many integers  $n$  is  $|n^2 - 2n - 3|$  a prime number?  
 (A) 1    (B) 2    (C) 3    (D) 4    (E) infinitely many

- 27.** A path  $DEFB$  with  $DE \perp EF$  and  $EF \perp FB$  lies within the square  $ABCD$  as shown. We know that  $DE = 5$ ,  $EF = 1$  and  $FB = 2$ . What is the side length of the square?

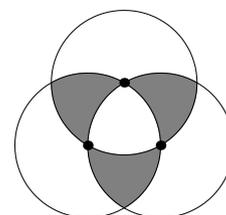


- (A)  $3\sqrt{2}$     (B)  $\frac{7\sqrt{2}}{2}$     (C)  $\frac{11}{2}$     (D)  $5\sqrt{2}$     (E) another value

- 28.** The sequence  $a_1, a_2, a_3, \dots$  starts with  $a_1 = 49$ . To work out  $a_{n+1}$  for  $n \geq 1$  you add 1 to the digit sum of  $a_n$  and square the result. So e.g.  $a_2 = (4 + 9 + 1)^2 = 196$ . Work out  $a_{2019}$ .

- (A) 121    (B) 25    (C) 64    (D) 400    (E) 49

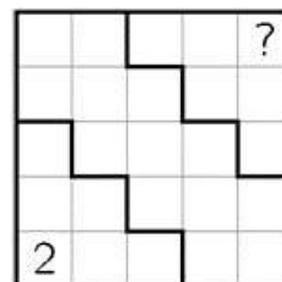
- 29.** Three circles with radius 2 are drawn in such a way that each time one of the points of intersection of two circles is identical with the centre of the third circle. How big is the area of the grey zone?



- (A)  $\pi$     (B)  $3\pi$     (C)  $\frac{\pi}{2}$     (D)  $2\pi$     (E)  $4\pi$

- 30.** numbers are to be placed into the square grid shown, so that each of the numbers 1, 2, 3, 4 and 5 appears exactly once in each row and in each column. Furthermore the sum of all numbers in the three black-bordered sections should always be the same. Which number has to be written into the top right cell?

- (A) 1    (B) 2    (C) 3    (D) 4    (E) 5



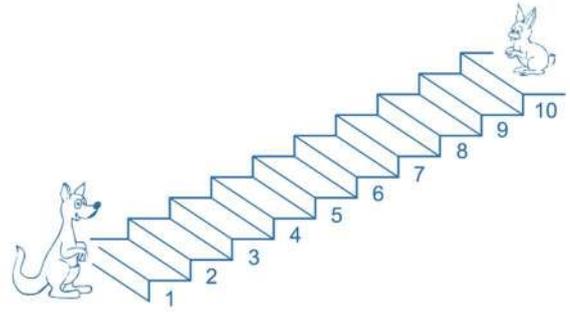
2019

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Felix	D	C	B	B	C	E	D	E	E	C	A	A	C	B	D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Écolier	E	C	D	D	A	B	D	B	B	C	D	E	B	A	D	D	E	C	B	C	B	B	B	E	-	-	-	-	-	
Benjamin	B	D	E	C	E	D	A	D	C	E	A	B	C	C	C	D	C	E	D	B	B	B	D	A	-	-	-	-	-	
Kadett	E	E	C	D	D	D	A	B	D	A	A	B	E	B	C	C	D	B	C	C	B	B	C	E	E	A	C	E	E	D
Junior	D	B	E	C	B	B	C	B	A	B	B	C	C	C	E	B	D	B	A	C	C	D	E	A	E	B	D	C	C	B
Student	A	E	E	D	C	B	B	D	C	E	D	B	E	D	D	C	A	B	A	C	B	B	E	E	A	D	E	C	D	C

Canguru de Matemática Brasil – Level P – 2020 – Second Application

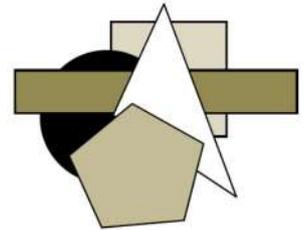
3 points

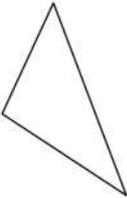
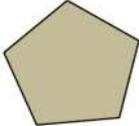
1. The kangaroo goes up three steps each time the rabbit goes down two steps. When the kangaroo is on step 9, on which step will the rabbit be?



- (A) 3                      (B) 4                      (C) 5                      (D) 6                      (E) 7

2. Julia has 5 pieces of plastic and has stacked these pieces on a table, as shown beside. What was the second piece she put on the table?



- (A)       (B)       (C)       (D)       (E) 

3. Marco's father took a picture of his son in front of the car shown beside. Which of the drawings below could represent this picture?



- (A)       (B)       (C) 
- (D)       (E) 

4. Every night the wizard Tilim makes the weather forecast for the king. When Tilim gets it right he gets 3 gold coins, but when he makes a mistake, he pays a fine of 2 gold coins. After making the prediction for 5 days, Tilim did the math and discovered that he neither won nor lost coins. How many times did he get the weather forecast right in those 5 days?



- (A) none      (B) 1      (C) 2      (D) 3      (E) 4

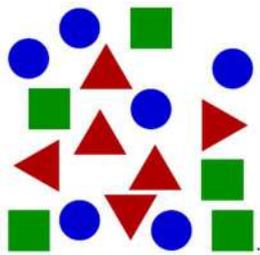
5. A magician takes animals out of his hat always in the same order, as shown below.



The pattern of the figure is repeated every five animals. What will be the fourteenth animal he will pull out of his hat?

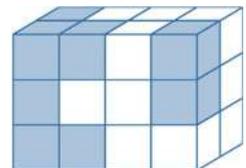
- (A)      (B)      (C)      (D)      (E)

6. Ana has the cards shown on the left. She chooses several of them to assemble the tower shown on the right. Which cards did she not use?



- (A)      (B)      (C)      (D)      (E)

7. Maria made a block using white cubes and colored cubes in equal amounts. How many of the white cubes cannot be seen in the picture?



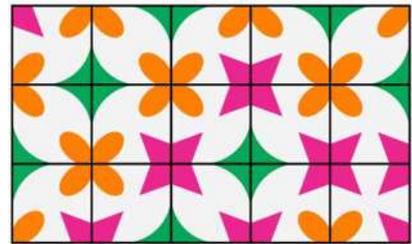
- (A) 1      (B) 2      (C) 3      (D) 4      (E) 5

8. Ana draws some shapes on a sheet. Her drawing has fewer squares than triangles. What could be her drawing?

- (A)      (B)      (C)      (D)      (E)

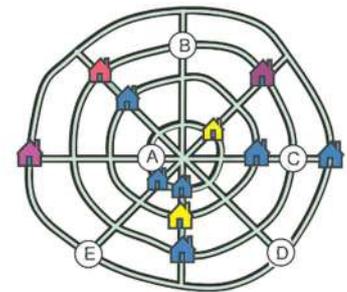
4 points

9. Which of the tiles below is **NOT** part of the wall next door?



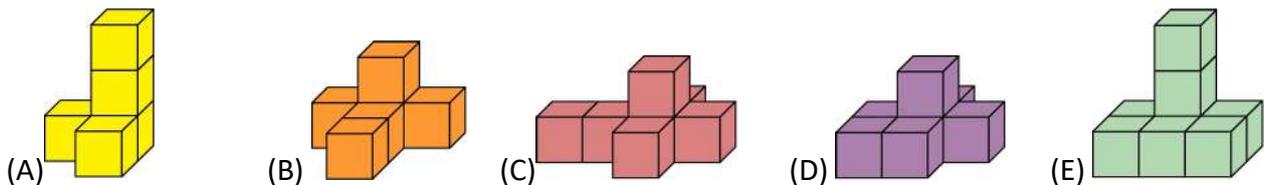
- (A) (B) (C) (D) (E)

10. A village of 12 houses has four straight streets and four circular streets. The map shows 11 houses. In each straight street there are three houses and in each circular street there are also three houses. Where should the 12th house be placed on this map?



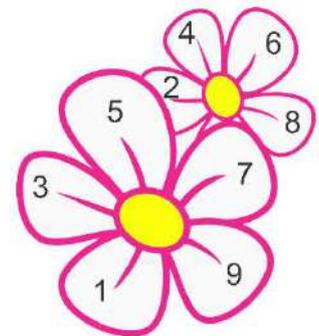
- (A) On A (B) On B (C) On C (D) On D (E) On E

11. Five blocks are built with equal cubes glued face to face. In which of them was the smallest number of cubes used?

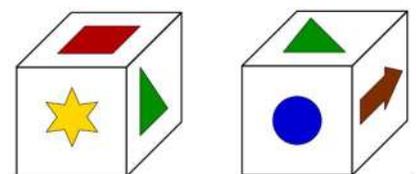


12. Numbers were written on the petals of two flowers, with a number on each petal. One of the petals is hidden. The sum of the numbers written on the back flower is twice the sum of the numbers written on the front flower. What is the number written on the hidden petal?

- (A) 5 (B) 12 (C) 25 (D) 30 (E) 40



13. Six figures were drawn, one on each side of a cube, as shown beside, in different positions. On the side that does not appear beside is this drawing: . What is the figure on the face opposite to it?



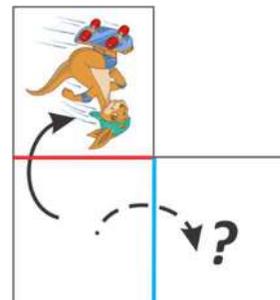
- (A) (B) (C) (D) (E)

14. Maria wants to write whole numbers in the squares of the figure, so that the sum of the numbers in three consecutive squares is always 10. She has already written a number. What number should she write on the gray square?



- (A) 1                      (B) 2                      (C) 3                      (D) 4                      (E) 8

15. Turning a card around on the top side, we see the photo of the kangaroo. Instead, if we turn the card around on the right side, what will appear?



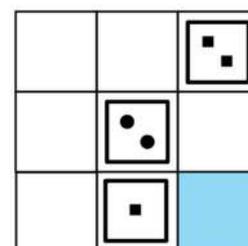
- (A) (B) (C) (D) (E)

16. Grandma has just baked 23 cupcakes and wants to give the same amount of them to each of her six grandchildren, eating what is left over. At least how many cupcakes will she have left to eat?

- (A) 1                      (B) 2                      (C) 3                      (D) 4                      (E) 5

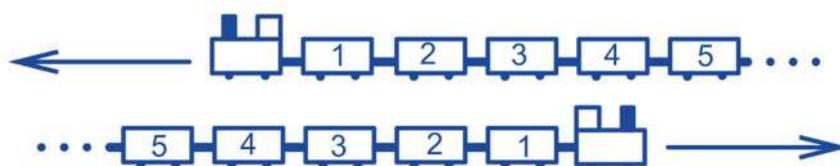
**5 points**

17. Tom has these nine cards: He places these cards on the board next to each other so that each horizontal line and each vertical line has three cards with the three different shapes and the three different amounts of drawings. He has already placed three cards, as shown in the picture. Which card should he place in the colored box?



- (A) (B) (C) (D) (E) (E)

18. Two equal trains, each with 31 numbered wagons, travel in opposite directions. When the wagon number 7 of a train is side by side with the wagon number 12 of the other train, which wagon is side by side with the wagon number 11?



- (A) 8                      (B) 10                      (C) 11                      (D) 12                      (E) 15

19. Tania bought 14 chocolates, 8 of them round and the rest square. Half were white chocolates and half were dark chocolates. Among the square chocolates, only two are not white. How many dark round chocolates did Tania buy?

- (A) 2                      (B) 3                      (C) 4                      (D) 5                      (E) 6

20. Six different numbers, chosen from integers 1 to 9, are written on the faces of a cube, one number per face. The sum of the numbers on each pair of opposite faces is always the same. Which of the following numbers could have been written on the opposite side with the number 8?

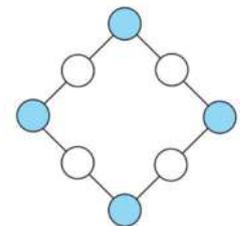


- (A) 3                      (B) 5                      (C) 6                      (D) 7                      (E) 9

21. In a classroom, there are two chairs for each table. Each of the boys in the class sits with a girl on the same table, but there are four girls who do not sit on tables with a boy. There are 14 little tables in the classroom. How many girls are in that class?

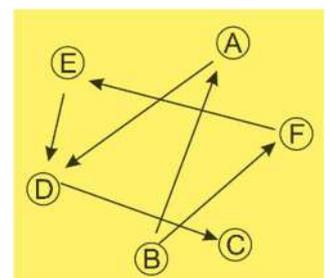
- (A) 6                      (B) 10                      (C) 12                      (D) 14                      (E) 16

22. Rita numbered the circles of the figure from 1 to 8, so that the sum of the three numbers on each of the four sides of the square equals 13. What is the sum of the four numbers written on the colored circles?



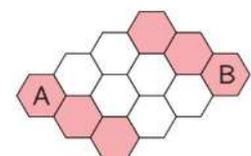
- (A) 12                      (B) 13                      (C) 14                      (D) 15                      (E) 16

23. In the figure, an arrow pointing from one person to another means that the first person is shorter than the second. For example, person B is shorter than person A. Which person is the tallest?



- (A) Person A    (B) Person B    (C) Person C    (D) Person D    (E) Person E

24. Maia the bee can only walk on colorful houses. How many ways can you color exactly three white houses with the same color so that Maia can walk from A to B?

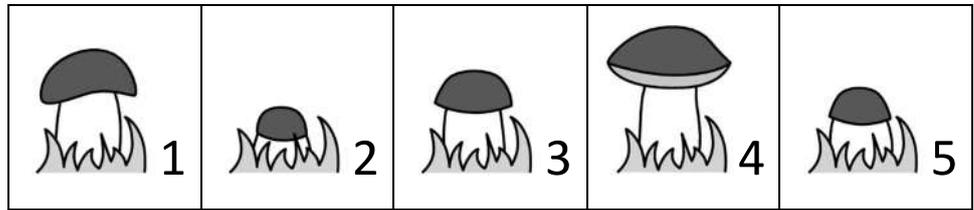


- (A) 15                      (B) 16                      (C) 17                      (D) 18                      (E) 20

Canguru de Matemática Brasil – Level E – 2020 – Second Application

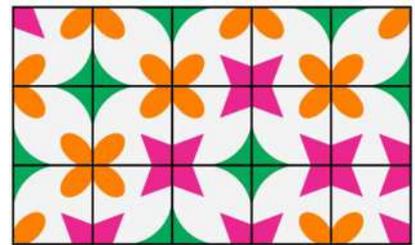
3 points

1. A mushroom grows up every day. For five days Maria took a picture of this mushroom, but she wrongly ordered the photos beside. What is the sequence of photos that correctly shows the mushroom growth, from left to right?



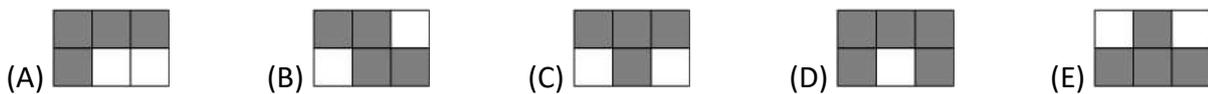
- (A) 2-5-3-1- 4      (B) 2-3-4-5-1      (C) 5-4-3-2-1      (D) 1-2-3-4-5      (E) 2-3-5-1-4

2. Which of the tiles below is **NOT** part of the wall next door?

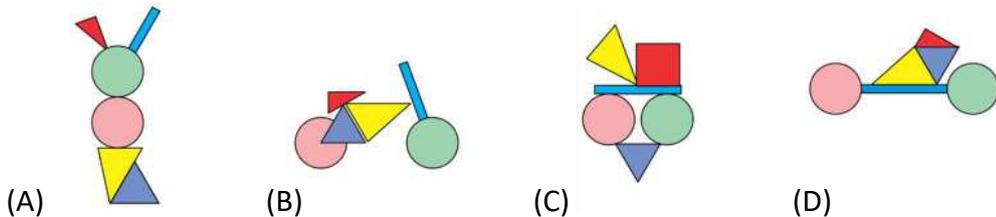
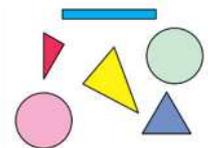


3. John paints the squares of the board next to it if the result of the calculation inside them is 24. How did the painting of the board look?

$28 - 4$	$4 \times 6$	$18 + 6$
$19 + 6$	$8 \times 3$	$29 - 6$



4. Which of the following pictures can you **NOT** do with all the pieces beside?

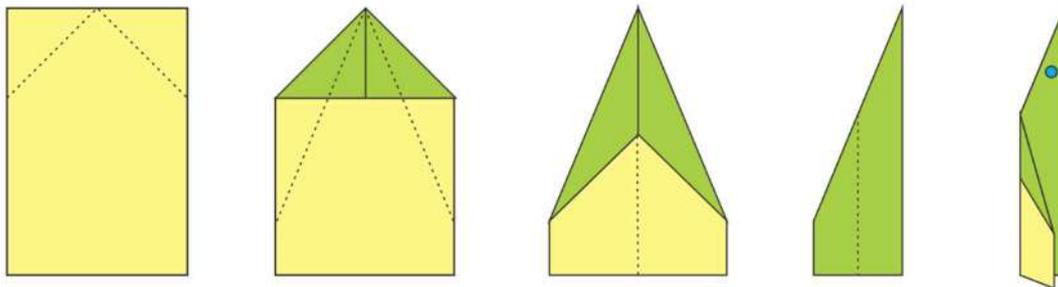


5. Eli drew a board on the floor with nine squares and wrote a number on each of them, starting from 1 and adding 3 units to each new number he wrote, until he filled the board. In the picture, three of the numbers that Eli wrote appear. What number below can be one of the numbers she wrote in the colored box?

1		
	4	
10		

- (A) 10                      (B) 14                      (C) 17                      (D) 20                      (E) 22

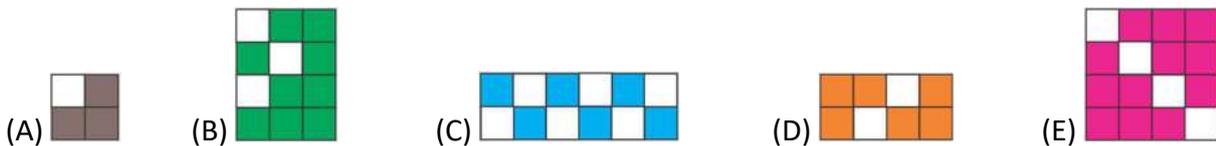
6. Paulo took a rectangular sheet of paper, yellow on one side and green on the other side and, with several folds shown in the dotted lines in the figure below, made a little paper plane. To give the airplane a charm, Paulo made a circular hole, marked on the last figure.



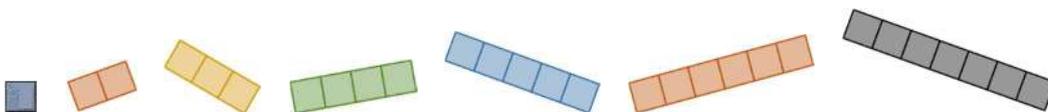
After playing a lot with the plane, Paulo unfolded the sheet and realized that there were several holes in it. How many holes did he count?

- (A) 2                      (B) 4                      (C) 6                      (D) 8                      (E) 16

7. Five children should paint three quarters of the total amount of the little squares on their trays. One of the children A, B, C, D or E was wrong. Which one?



8. Gaspar has these seven different pieces, formed by equal little squares.

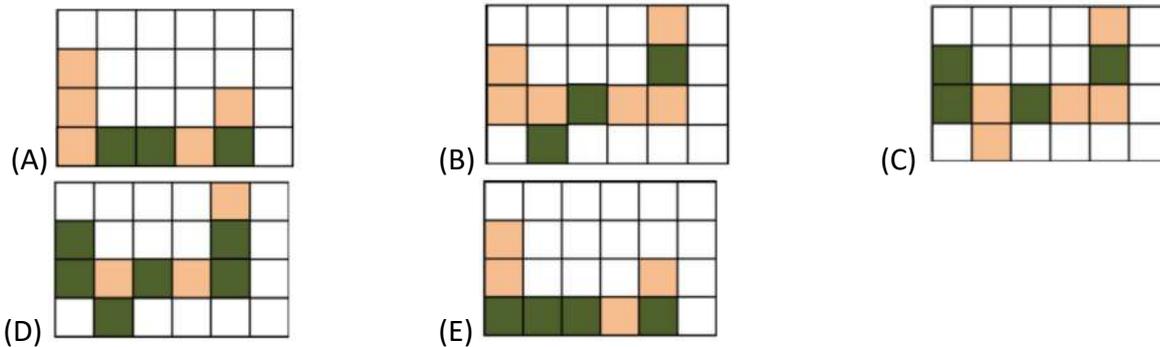
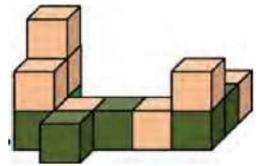


He uses all these pieces to assemble rectangles with different perimeters, that is, with different shapes. How many different perimeters can he find?

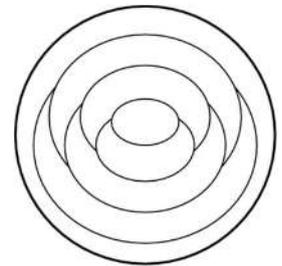
- (A) 2                      (B) 3                      (C) 4                      (D) 5                      (E) 6

4 points

9. Janaína made the construction on a grid, using some lighted colored cubes and others darker. Looking from above the construction, what can she see?

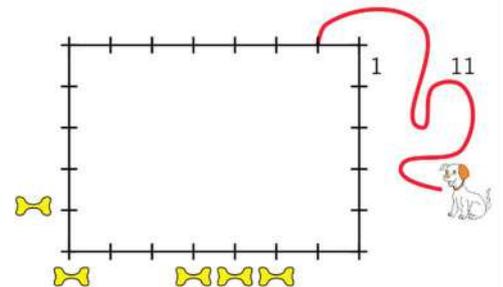


10. Cynthia paints each region of the figure in a single color: red, blue or yellow. She paints with different colors the regions that touch each other. In how many different ways can Cynthia paint the figure?



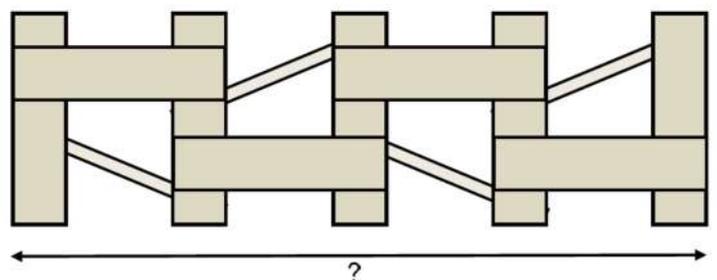
- (A) 2      (B) 3      (C) 4      (D) 5      (E) 6

11. Denis ties his dog, using an 11-meter rope, one meter away from a corner of about 7 meters by 5 meters, as illustrated. Denis places 5 bones near the fence, as shown in the picture. How many bones can the dog catch?



- (A) 1      (B) 2      (C) 3      (D) 4      (E) 5

12. Luana builds a fence using pieces of wood 2 meters long by half a meter wide, just like this one: . The picture beside shows this fence, after it is ready. How long is the fence, in meters?

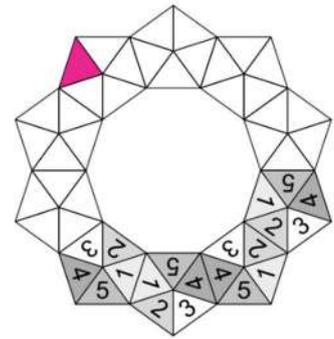


- (A) 6      (B) 6,5      (C) 7      (D) 7,5      (E) 8

13. Amelia built a crown using 10 copies of this piece

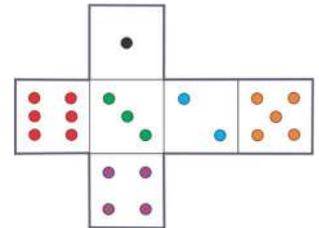


The parts were joined together so that the sides in contact had the same number, as shown in the picture, where four parts are visible. What is the number that appears in the colored triangle?



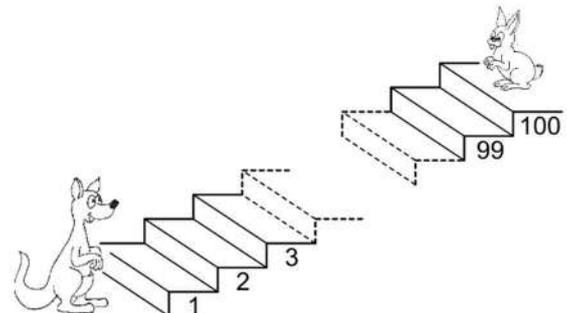
- (A) 1      (B) 2      (C) 3      (D) 4      (E) 5

14. Julia drew the picture on the side of a cardboard sheet, cut, folded and glued to form a cube. Which of the cubes below can be the one she did?



- (A)      (B)      (C)      (D)      (E)

15. Whenever the kangaroo goes up seven steps, the rabbit goes down three steps. When the kangaroo is on step number 56, on which step will the rabbit be?



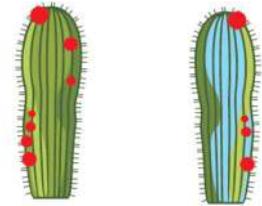
- (A) 73      (B) 76      (C) 79      (D) 82      (E) 85

16. Ana, Bia and Cris have, together, 100 reais. They go to the movies and each one pays their own entrance fee. Ana had twice as much as each of her friends before they paid the entrance fee. Now Ana has three times what the two friends have together. How much did the entrance to the movie cost?

- (A) R\$ 8,00      (B) R\$ 10,00      (C) RS 12,00      (D) R\$ 15,00      (E) R\$ 20,00

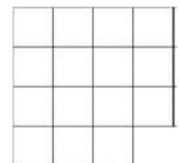
**5 points**

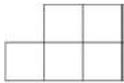
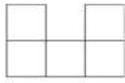
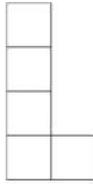
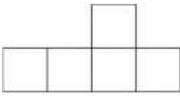
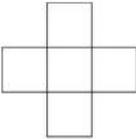
**17.** There are three flowers on the back of the left cactus. In total, the cactus on the right has six more flowers than the cactus on the left. How many flowers are on the back of the right cactus?



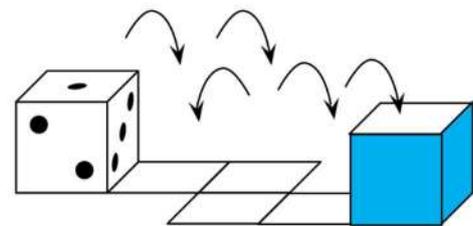
- (A) 9                      (B) 10                      (C) 11                      (D) 12                      (E) 14

**18.** The 4 x 4 grid without a little square, shown beside, was divided into three equal pieces. Which of the following figures represents one of these pieces?



- (A)       (B)       (C)       (D)       (E) 

**19.** The sum of the points on the opposite sides of a common dice is 7. This dice is placed in the first square as shown in the figure, and then rolled as shown in the figure, to the fifth square. When the dice reach the last square, what is the product of the numbers of points shown on the two colored vertical faces?

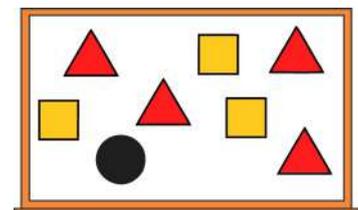


- (A) 10                      (B) 12                      (C) 15                      (D) 18                      (E) 24

**20.** Five friends decided to spend their vacations together. In a conversation, Adam said, "Yesterday was Wednesday." Beto said, "Tomorrow will be Friday". Carlos said: "The day before yesterday was Tuesday". David then said, "The day after tomorrow is Saturday". Finally, it was Eli's turn: "Today is Monday". One of them was wrong. Who was wrong?

- (A) Adam                      (B) Beto                      (C) Carlos                      (D) David                      (E) Eli

**21.** The teacher wrote the numbers 1 to 8 on the board. Then he covered the numbers with triangles, squares and a circle. The sum of the numbers covered with the triangles equals the sum of the numbers covered with the squares and the number covered with the circle is a quarter of that sum. What is the sum of the numbers covered with the triangles and the circle?



- (A) 18                      (B) 19                      (C) 20                      (D) 21                      (E) 22



**22.** Joana has several sheets of paper with the drawing of a parrot . She wants to paint only the head, tail and wing of the parrot, red, blue or green, and the head and tail may have the same color, but the wing may not have the same color as the head or tail. How many leaves can she paint, so that there are not two parrots painted the same way?

- (A) 3                      (B) 6                      (C) 9                      (D) 12                      (E) 15

**23.** Jonas and Elias went to the beach for their vacation, where they had ice cream every day. The ice cream they had, had two or three balls. On the last day of vacation, Jonas and Elias had 23 and 19 ice cream balls, respectively. At least how many days they were on vacation?

- (A) 6                      (B) 7                      (C) 8                      (D) 10                      (E) 11

**24.** The Kangaroo Hotel has 30 floors numbered from 1 to 30 and each floor has 20 rooms numbered from 1 to 20. The code to enter the room is formed by joining the floor number with the room number, in that order. But this code can be confusing, as shown in the picture. Note that the code 101 is not confusing, as it can only refer to floor 10 and room 1 and never to floor 1 and room 1, as it has the code 11. How many codes are confusing, including the one in the figure?

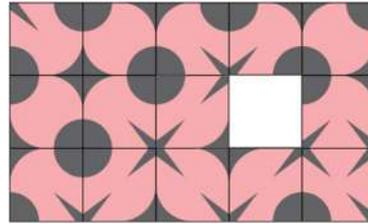
- (A) 2                      (B) 5                      (C) 9                      (D) 12                      (E) 18



Canguru de Matemática Brasil – Level B – 2020 – Second Application

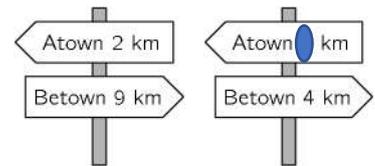
3 points

1. Which tile below completes the wall next to it?



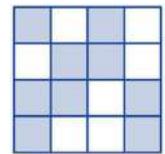
- (A)  (B)  (C)  (D)  (E) 

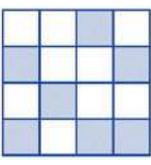
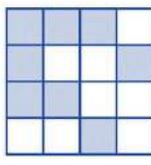
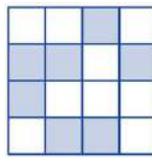
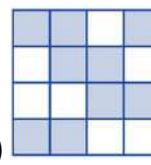
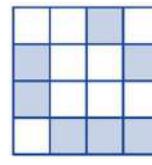
2. Amira is traveling from Atown to Betown and passes by two indicative signs along the road. One of them has a hidden number. What is this number?



- (A) 5 (B) 6 (C) 7 (D) 8 (E) 9

3. The board beside is formed by little white and dark squares. After a ninety-degree turn, how can this board appear?

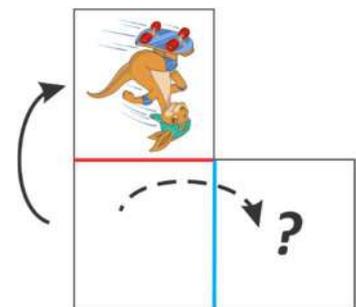


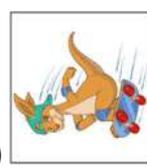
- (A)  (B)  (C)  (D)  (E) 

4. Ana starts lighting a candle every 10 minutes. Each candle lasts 40 minutes. After 55 minutes, how many candles will be lit?

- (A) 2 (B) 3 (C) 4 (D) 5 (E) 6

5. Turning a card around on the top side, we see the photo of the kangaroo. Instead, if we turn the card around on the right side, what will appear?



- (A)  (B)  (C)  (D)  (E) 

6. Bia has five coins as shown beside. She went to the grocery store to buy a fruit, using only three coins, without having to receive change. Among the prices of the following fruits, which one can she **NOT** buy?

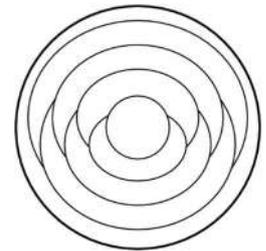


- (A) 1,30                      (B) 1,35                      (C) 1,40                      (D) 1,55                      (E) 1,75

7. In a garden, a bush has branches with seven leaves or branches with four leaves and a flower. Janaina counted the leaves and flowers and verified that there are 9 flowers and 120 leaves in the bush. How many branches does the bush have?

- (A) 14                      (B) 21                      (C) 28                      (D) 35                      (E) 42

8. Cynthia paints each region of the figure in a single color: red, blue or yellow. She paints the regions that touch each other with different colors. In how many different ways can she color the figure?

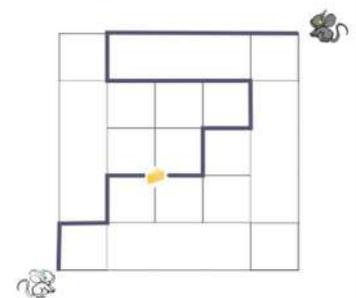


- (A) 2                      (B) 3                      (C) 4                      (D) 5                      (E) 6

9. Five boxes contain 2, 3, 4, 7 and 15 balls respectively. Peter wants to distribute the balls into the boxes so that any box has twice or half the number of balls in one of the remaining boxes. At least for how many balls should he change boxes?

- (A) 1                      (B) 2                      (C) 3                      (D) 4                      (E) 5

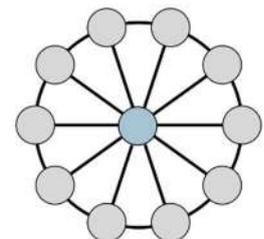
10. Two little mice, one white and one dark, leave, at the same time, towards the cheese, through different paths, as indicated in the picture, in which the little squares are equal. The two arrive at the same time to the cheese. If the dark mouse runs 4.5 meters per second, how many meters per second does the white mouse run?



- (A) 1                      (B) 1,5                      (C) 2                      (D) 2,5                      (E) 3

**4 points**

11. The circles of the figure should be numbered from 0 to 10, each with a different number. The five sums of the three numbers written on each diameter must be odd numbers. If one of these sums is the smallest possible, what will be the largest possible value of one of the remaining sums?



- (A) 13                      (B) 15                      (C) 17                      (D) 19                      (E) 21

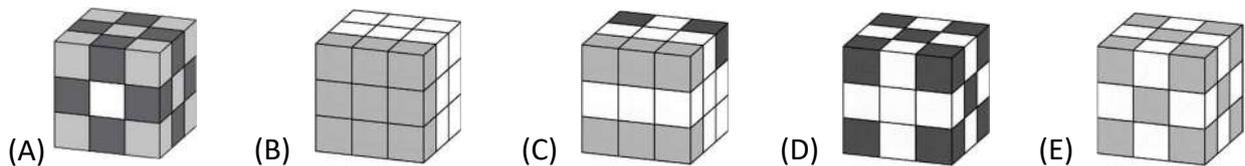
12. When the bat Elisa left its cave at night, the digital clock showed 10:20. When she came back in the morning and hung herself upside down, she looked at her watch and saw 10:20. How long did she stay out of the cave?

- (A) 2h 48m      (B) 2h 59m      (C) 3h 39m      (D) 3h 41m      (E) 3h 49m

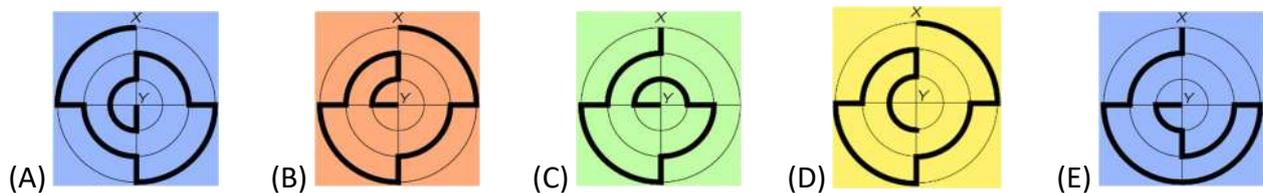
13. On a distant island, 2020 kangaroos, holding hands, form a large circle. These kangaroos are either brown and always tell the truth, or they are grey and only tell lies. Each one of them says the same thing: "One of my neighbors is brown and the other is gray". What is the number of brown kangaroos in this circle?

- (A) 0      (B) 1009      (C) 1010      (D) 2019      (E) 2020

14. Maria has exactly 9 white cubes, 9 light gray cubes and 9 dark gray cubes, all the same size. She glues all these cubes together to form a larger cube. Which of the cubes below is the one she made?



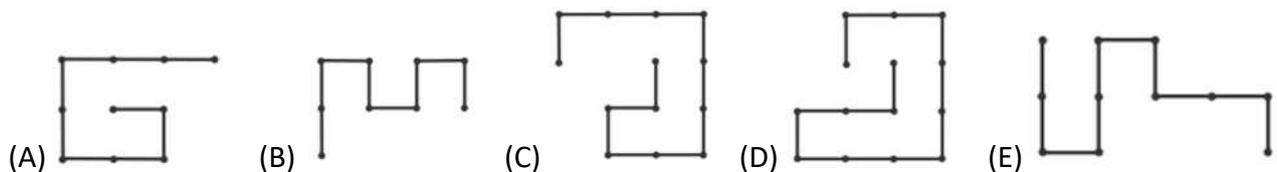
15. The following figures show five paths, indicated by the thickest lines, between the X and Y points. Which of these paths is the longest?



16. Mary numbered the sides of three cards from 1 to 6. Using these cards, she can compose three digit numbers, for example 135 or 234. But some numbers cannot be obtained, like 126. Which of the following numbers **CANNOT** be obtained?

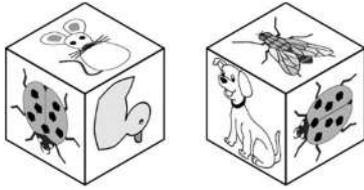
- (A) 134      (B) 146      (C) 235      (D) 245      (E) 256

17. Which of the following indeformable pieces of wire, when duplicated, allows to make a closed piece without crosses, with the two pieces joined by their ends?



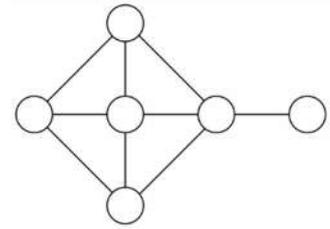


18. Amelia glues these six stickers on the faces of a cube: . The figure shows this cube in two different positions. Which adhesive is on the opposite side of the duck?



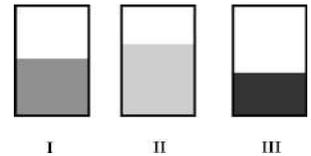
- (A) (B) (C) (D) (E)

19. Beatriz has five sisters with ages of 2, 3, 5, 8, 10 and 17. Beatriz writes these ages in the circles of the opposite diagram, so that the sum of the ages in the four corners of the square is equal to the sum of the ages in the four circles aligned horizontally. What is this sum?



- (A) 13 (B) 17 (C) 26 (D) 32 (E) There is more than one possible value.

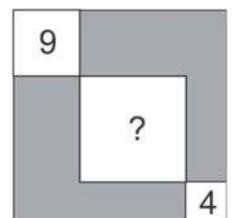
20. Maria puts 4 liters of water in vase I, 3 liters of water in vase II and 4 liters of water in vase III, represented on the side. Seen from the front, these three vases seem to have the same size. Which of the following images can represent the three vases, when seen from above?



- (A) (B) (C) (D) (E)

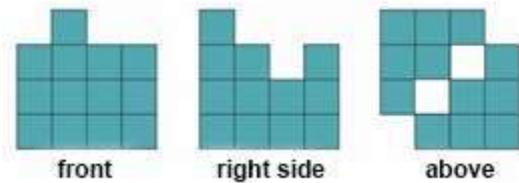
5 points

21. Inside the gray square there are three white squares and the numbers inside them indicate their areas. The white squares have sides parallel to the sides of the gray square. If the area of the gray square is 81, what is the area of the gray area not covered by the white squares?



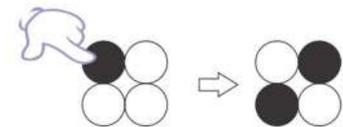
- (A) 25 (B) 43 (C) 52 (D) 68 (E) 81

22. John made a construction with wooden cubes of the same size, with the three views shown beside, using as many cubes as possible. Ana, John's sister, wants to remove all the cubes she can, without modifying these three views. At most, how many cubes can she remove?



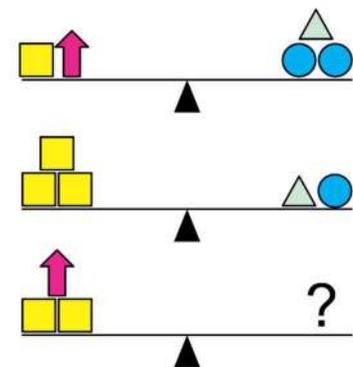
- (A) None                      (B) 12                      (C) 18                      (D) 22                      (E) 34

23. A panel is composed of 4 circles. When Lucy touches a circle, this circle and the others that touch this circle change their color from white to black or from black to white, as shown in the picture. Starting with all white circles, at least how many circles must Lucy touch, one after the other, so that all circles turn black?



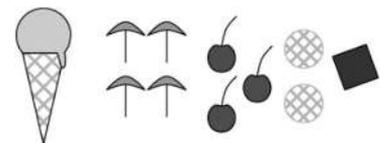
- (A) 2                      (B) 3                      (C) 4                      (D) 5                      (E) more than 5

24. Which set of weights below balances the third scale, in the picture beside?



- (A) (B) (C) (D) (E)

25. Ten people order an ice cream for each one. They ask for four vanilla ice creams, three chocolate ice creams, two lemon ice creams and one mango ice cream. As a topping, they ask for four umbrellas, three cherries, two wafers and a chocolate gum, one topping for each ice cream. Since they don't want two ice creams the same, which of the following combinations is possible?



- (A) Chocolat and chocolate gum.                      (B) Mango and cherry.                      (C) Lemmon and wafer.  
(D) Mango and wafer.                      (E) Lemmon and cherry.

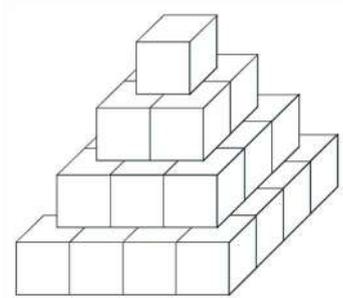
26. We say that a three-digit number is *balanced* if the middle digit is the arithmetic mean of the other two digits. How many balanced numbers are divisible by 18?

- (A) 2                      (B) 3                      (C) 6                      (D) 9                      (E) 18

27. Janaina bought three toys, spending all her money. For the first one she paid half of the money she had plus one Real, for the second one she paid half of what was left plus two Reais and for the third one she paid half of what was left plus three Reais. How much money did she have?

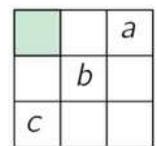
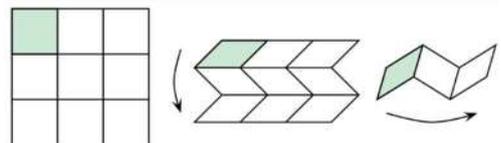
- (A) 34 Reais      (B) 36 Reais      (C) 45 Reais      (D) 65 Reais      (E) 100 Reais

28. Dirce built the sculpture on the side by gluing cubic boxes of half a meter on the side. Then she painted the sculpture minus the support base, with a special paint sold in cans. Each can allow to paint 4 square meters of surface. How many cans of paint did she have to buy?



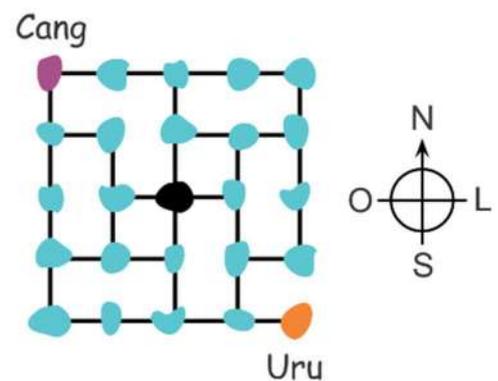
- (A) 3      (B) 4      (C) 5      (D) 6      (E) 7

29. Vania has a sheet of paper divided into nine equal squares. She wants to fold the sheet as shown in the picture, initially with horizontal folds and then with vertical folds, until she leaves the colored square on top of the layers. Vania wants to write the numbers from 1 to 9, one in each square, so that these numbers are in ascending order, starting with the number 1 at the top, after the folds are made above. On the open sheet, indicated at the side, which numbers should she write in place of  $a$ ,  $b$  and  $c$ ?



- (A)  $a = 9, b = 5, c = 3$     (B)  $a = 4, b = 6, c = 8$     (C)  $a = 7, b = 5, c = 3$   
 (D)  $a = 3, b = 5, c = 7$     (E)  $a = 6, b = 4, c = 7$

30. The figure shows a map with some islands and how they are connected by bridges. A navigator wants to pass through each of the islands exactly once. He started at Cang Island and wants to finish at Uru Island. He has just arrived at the black island in the center of the map. In which direction must he go now to be able to complete his route?



- (A) North.    (B) East.    (C) South.  
 (D) West.    (E) There is more than one possible choice.

Canguru de Matemática Brasil – Level C – 2020 – Second Application

3 points

1. What result of the following additions is **not** a prime number?

- (A)  $2 + 11$       (B)  $4 + 7$       (C)  $6 + 11$       (D)  $3 + 4$       (E)  $5 + 7$

2. With the numbers 1, 2, 3 and 4, we can write several fractions whose value is less than 1, for example,  $\frac{1}{3}$ . How many different values, beyond the example, can be obtained?

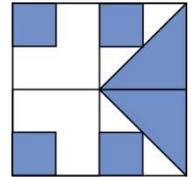
- (A) 3      (B) 4      (C) 5      (D) 6      (E) 8

3. Miguel decided to solve three math problems a day. Eight days later, Daniel started solving five problems a day, until the two of them tied in the amount of problems solved. How many problems each one solved until that day?

- (A) 12      (B) 20      (C) 60      (D) 80      (E) 120

4. One square was divided into four equal squares, containing other equal colored squares and equal colored triangles, as shown in the picture. What fraction of the original square does the colored part represent?

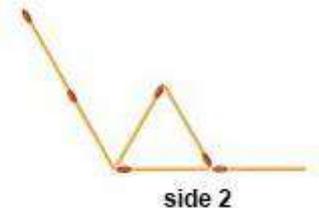
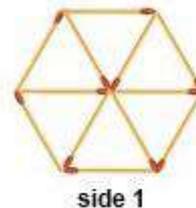
- (A)  $\frac{1}{3}$       (B)  $\frac{1}{2}$       (C)  $\frac{4}{9}$       (D)  $\frac{5}{8}$       (E)  $\frac{3}{4}$



5. Three soccer teams compete in a championship. Each team plays exactly once with each of the other teams. In each match, the victorious team wins 4 points, the loser loses 1 point, and in case of a tie, each team wins 2 points. Once the championship is over, what will be the largest possible sum of the points obtained by the three teams?

- (A) 8      (B) 9      (C) 10      (D) 11      (E) 12

6. The figure of side 1 is formed by six equal triangles, made with 12 sticks. How many matchsticks are needed to complete the figure of side 2, partially represented?



- (A) 18      (B) 24      (C) 32      (D) 36      (E) 48

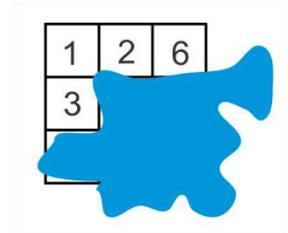
7. Carlos wants to square the sum of three chosen numbers from the list  $-5, -3, -1, 0, 2, 7$ . What is the smallest result he can get?

- (A) 0      (B) 1      (C) 4      (D) 9      (E) 16

8. When Julia goes from home to school, she can walk half-way and half-way she can go by bus. If she only walks, she will spend 45 minutes more. How much less time does it take her to go to school if she uses only the bus?

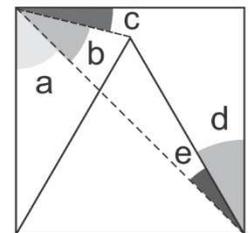
- (A) 25 minutos      (B) 45 minutos      (C) 1 hora      (D) 1 hora e meia      (E) 2 horas

9. Juca wrote a whole number greater than zero in each of the boxes on the  $3 \times 3$  board on the right, so that the sums of the numbers in each row and in each column are equal. The only thing Juca remembers is that there are no three numbers repeated. What number is written in the box of the center?



- (A) 1      (B) 2      (C) 4      (D) 5      (E) 6

10. In the figure, formed by a square and an equilateral triangle, the letters indicate the measurements of the angles. Which of the following equality is true?



- (A)  $a = d$     (B)  $b + c = d$     (C)  $a + c = d + e$     (D)  $a + b = d + e$     (E)  $e + d = a$

**4 points**

11. As soon as he left his city towards Caecá, Charles saw the sign on the left. When he came back from Caecá, he saw the sign on the right. At that point, how far was it to get to his city?

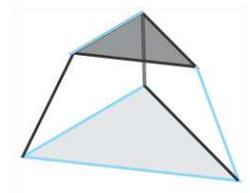


- (A) 12 km      (B) 21 km      (C) 29 km      (D) 41 km      (E) 52 km

12. Ana planned to walk an average of 5 km per day in March. In the first 10 days she walked an average of 4,4 km per day and in the following 6 days she walked an average of 3,5 km per day. What is the average daily distance she should walk on the remaining days in order to fulfill her plan?

- (A) 5,4 km      (B) 5,8 km      (C) 6 km      (D) 6,6 km      (E) 7 km

13. Which of the pictures below shows what you will see if you look from above the piece represented on the right?

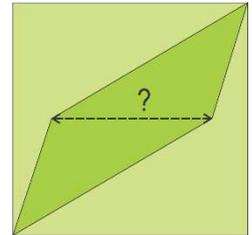


- (A)    (B)    (C)    (D)    (E)

14. In a class, students only swim or only dance or do both. Three eighths of the students in the class swim. There are exactly five students who do both, that is, they swim and dance. At least how many students are in class?

- (A) 16                      (B) 24                      (C) 32                      (D) 40                      (E) 48

15. The garden of Sonia's house is shaped like a 12-meter square and is divided into three lawns of the same area. The central lawn is shaped like a parallelogram, whose smaller diagonal is parallel to two sides of the square, as shown in the picture. What is the length of this diagonal, in meters?



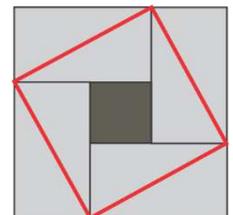
- (A) 7,2                      (B) 7,6                      (C) 8,0                      (D) 8,4                      (E) 8,8

16. Andrew bought 27 little cubes of the same color, each with three adjacent faces painted red and the other three of another color. He wants to use all these little cubes to build a bigger cube. What is the largest number of completely red faces that he can get for this cube?



- (A) 2                      (B) 3                      (C) 4                      (D) 5                      (E) 6

17. A square is formed by four identical rectangles and a central square, as in the figure. The area of the square is  $81 \text{ cm}^2$  and the square formed by the diagonals of these rectangles has an area equal to  $64 \text{ cm}^2$ . What is the area of the central square?

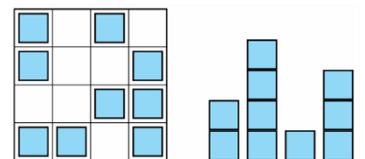


- (A)  $25 \text{ cm}^2$                       (B)  $27 \text{ cm}^2$                       (C)  $36 \text{ cm}^2$                       (D)  $47 \text{ cm}^2$                       (E)  $49 \text{ cm}^2$

18. A store announced a 30% discount on a sale. However, one day before this promotion, the store increased the prices of all its products by 20%. What was the real discount that this store gave on the day of the sale?

- (A) 10%                      (B) 12%                      (C) 15%                      (D) 16%                      (E) 20%

19. Irene made a "city" using identical wooden cubes. We have, beside, a view from above and a side view of this "city". We do not know which side of the "city" is being shown. What is the smallest amount of cubes Irene may have used to make its assembly?



- (A) 10                      (B) 12                      (C) 13                      (D) 14                      (E) 15

20. Amelia has a paper strip with five equal cells containing different drawings, according to the figure. She folds the strip in such a way that the cells overlap in five layers. Which of the sequences of layers, from top to bottom, is **not** possible to obtain?



- (A)  $\star, \square, \blacksquare, \circ, \bullet$                       (B)  $\star, \circ, \blacksquare, \square, \bullet$                       (C)  $\star, \blacksquare, \circ, \square, \bullet$                       (D)  $\star, \square, \bullet, \circ, \blacksquare$                       (E)  $\star, \bullet, \square, \blacksquare, \circ$

## 5 points

21. In each of the four corners of a swimming pool, 10 m wide by 25 meters long, there is a child. The swimming instructor is sitting almost in the middle of one of the edges of the pool. When he calls the children, they all choose the longest path along the edges to reach the instructor. What was the sum of the distances covered by the four children?

- (A) 90 m                      (B) 120 m                      (C) 140 m                      (D) 160 m                      (E) 210 m

22. Twelve colored cubes are lined side by side. There are three blue cubes, two yellow cubes, three red cubes, and four green cubes, but not in that order. There is a red cube at one end and a yellow one at the other. The red cubes are all together, and the green cubes are all together. The tenth cube from the left is blue. How many ways can the cubes be queued?

- (A) 2                      (B) 3                      (C) 6                      (D) 9                      (E) 12

23. Sofia has 52 isosceles triangles of  $1 \text{ cm}^2$  area. She wants to make a square using some of these triangles. What is the area of the largest square she can make?

- (A)  $32 \text{ cm}^2$                       (B)  $36 \text{ cm}^2$                       (C)  $42 \text{ cm}^2$                       (D)  $50 \text{ cm}^2$                       (E)  $52 \text{ cm}^2$

24. Let  $N$  be the smallest positive number such that half of  $N$  is divisible by 2, one-third of  $N$  is divisible by 3, one-quarter of  $N$  is divisible by 4, one-fifth of  $N$  is divisible by 5, one-sixth of  $N$  is divisible by 6, one-eighth of  $N$  is divisible by 8, and one-ninth of  $N$  is divisible by 9. The square root of  $N$  is a number of how many digits?

- (A) 3                      (B) 4                      (C) 5                      (D) 6                      (E) 7

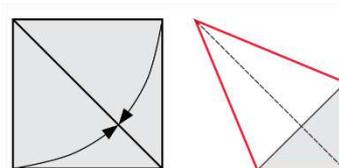
25. Jonas was traveling with his car and saw on the car display the following information: speed 90 km/h, distance travelled 116,0 km and time 21h00min. Jonas continued driving at the same speed and that same night he realized that the four-digit sequence showing the distance traveled was the same four-digit sequence showing the time. At what time did this happen?

- (A) 21h30min                      (B) 21h50min                      (C) 22h00min                      (D) 22h10min                      (E) 22h30min

26. Lady Josephine bought a pack of beans. The beans come mixed with impurities such as pebbles and sand, and the label reads that these impurities correspond to 8% of the contents of the package. Lady Josephine removes part of these impurities, which are reduced to 4% of the content of the package. What fraction of the total amount of impurities was removed from the package?

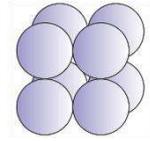
- (A)  $\frac{1}{2}$                       (B)  $\frac{25}{48}$                       (C)  $\frac{7}{12}$                       (D)  $\frac{5}{8}$                       (E)  $\frac{25}{36}$

27. Zilda took a square sheet of paper of side 1 and made two folds taking two consecutive sides of the sheet to a diagonal of it, as shown in the picture, obtaining a quadrilateral (highlighted outline). What is the area of this quadrilateral?



- (A)  $\frac{7}{10}$                       (B)  $2 - \sqrt{2}$                       (C)  $\frac{3}{5}$                       (D)  $\sqrt{2} - 1$                       (E)  $\frac{\sqrt{2}}{2}$

28. Cleuza assembled the  $2 \times 2 \times 2$  block formed by equal balls beside, using one drop of glue at each contact point between two balls, in a total of 12 drops. She then glued a few more spheres until she completed a  $4 \times 3 \times 2$  block. How many extra drops of glue did she get to use?



- (A) 12                      (B) 24                      (C) 34                      (D) 36                      (E) 44

29. Sonia writes three consecutive whole numbers, one on each side of a triangle. Then she writes on each vertex of the triangle the sum of the numbers written on the sides that touch this vertex and multiplies these three numbers, obtaining the product 504. What is the product of the three numbers written on the sides of the triangle?

- (A) 24                      (B) 60                      (C) 120                      (D) 210                      (E) 336

30. The statements below give the clues to identifying a four-digit N number.

2	7	4	1
---	---	---	---

 A digit is right, but it's in the wrong place.

4	1	3	2
---	---	---	---

 Two digits are right, but they are in the wrong places.

7	6	4	2
---	---	---	---

 None of the digits are right.

9	8	2	6
---	---	---	---

 One digit is correct and in the right place.

5	0	7	9
---	---	---	---

 Two digits are right, one is in the right place and the other is in the wrong place.

What is the digit of the hundreds of the number N?

- (A) 0                      (B) 1                      (C) 3                      (D) 5                      (E) 9

## Canguru de Matemática Brasil – Level J – 2020 – Second Application

### 3 points

1. When the results of the following additions are written in descending order, what sum will be in the middle?

- (A)  $1 + 2 + 345$     (B)  $12 + 3 + 45$     (C)  $1 + 23 + 45$     (D)  $12 + 34 + 5$     (E)  $1 + 234 + 5$

2. Who is the mother of the daughter of the mother of Lia's daughter?

- (A) Lia's sister.    (B) Lia.    (C) Lia's mother.    (D) Lia's niece.    (E) Lia's aunt.

3. When Cosme correctly wears his new shirt, as shown on the left figure, the horizontal stripes form seven closed arches around his body. This morning he buttoned his shirt in the wrong way, as shown on the right. How many open arches were there around Cosme's body this morning?



- (A) 0    (B) 1    (C) 2    (D) 3    (E) 4

4. Four integer numbers have sum  $S$  and product 9. What is the lowest possible value for  $S$ ?

- (A)  $-18$     (B)  $-12$     (C)  $-8$     (D) 0    (E) 6

5. Maria has ten pieces of paper. Some are square and the others are triangles. She cuts each square along one of its diagonals. She then counts the total number of vertices of the pieces she has now and gets 48. How many squares did she have before making the cuts?

- (A) 3    (B) 4    (C) 5    (D) 6    (E) 7

6. In the addition beside, different letters represent different numbers and equal letters represent equal numbers. The resulting sum is a number of four digits, B being different from zero. What is the sum of the numbers of this number?

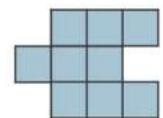
$$\begin{array}{r}
 A \\
 + AB \\
 ABA \\
 \hline
 BEBA
 \end{array}$$

- (A) AA    (B) BB    (C) AB    (D) BE    (E) EA

7. The figures for the year 2020 are repeated twice each and are different. How many times does this happen since the year 1000 until now?

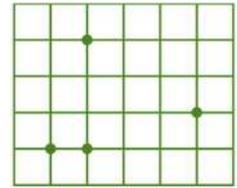
- (A) 11    (B) 17    (C) 20    (D) 24    (E) 29

8. There are several figures that can be formed by nine squares of 1 cm side by side (see an example beside) and one of them has the biggest perimeter. What is this perimeter?



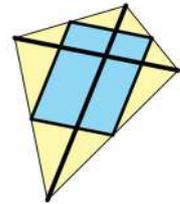
- (A) 12 cm    (B) 14 cm    (C) 16 cm    (D) 18 cm    (E) 20 cm

9. Four points were marked on a grid of 1 cm side squares. Of the possible triangular regions that can be obtained with vertices in three of these points, one has the largest area. What is this area, in  $\text{cm}^2$ ?



- (A) 2,5      (B) 3,5      (C) 4,5      (D) 5,5      (E) 6,5

10. Martinho made a bicolor kite with six pieces of a thin strip of bamboo. Two pieces were used for the diagonals, which are perpendicular. The other four pieces were used to connect the middle points on the sides of the kite, as shown in the picture. What is the ratio between the blue and yellow parts of the kite?



- A)  $\frac{2}{3}$       (B)  $\frac{3}{2}$       (C)  $\frac{3}{4}$       (D)  $\frac{4}{3}$       (E) 1

**4 points**

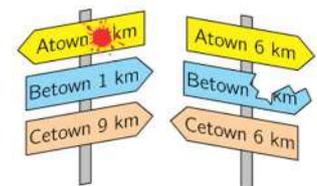
11. Adam, Breno and Carlos live in the same apartment and bought a treadmill for exercise. Nobody uses the treadmill on Wednesdays and Sundays and there is no day the three of them use the treadmill. Adam uses the treadmill 4 times a week and Breno 5 times a week. There are 4 consecutive days when Adam uses the treadmill on the first day, he does not use it on the second day and Breno does not use it on the fourth day. Carlos uses the treadmill on one day of the week. Which day?

- (A) Friday      (B) Saturday      (C) Tuesday      (D) Thursday      (E) Monday

12. Integers  $a$ ,  $b$ ,  $c$  and  $d$  satisfy the equality  $2ab = 3cd$ . Which of the following numbers can be the  $abcd$  product?

- (A) 50      (B) 100      (C) 150      (D) 200      (E) 250

13. The shortest way from Atown to Cetown is through Betown. Going back by this road from Cetown to Atown, we first find the signposts on the left side of the road. Further on we find the road signs on the right side of the road. How far is it from Betown to Atown?

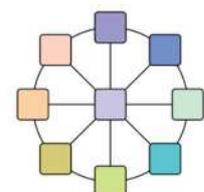


- (A) 1 km      (B) 2 km      (C) 3 km      (D) 4 km      (E) 5 km

14. Two isosceles triangles not similar have at least one side of 20 cm and have equal perimeters. If one of them has a side of 8 cm, which of the following measures can be the measure of one side of the other triangle?

- (A) 8 cm      (B) 10 cm      (C) 12 cm      (D) 14 cm      (E) 16 cm

15. Toninho wants to write strictly positive and consecutive whole numbers, in the nine places of the figure, so that the sum of the three numbers in each diameter is equal to 24. What is the largest possible sum for all the nine numbers?

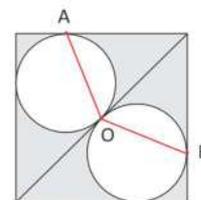


- (A) 81      (B) 90      (C) 99      (D) 108      (E) 117

16. Marta observed that the number 2020 has the following property: the number formed by the two digits on the left is equal to the number formed by the two digits on the right. How many four-digit numbers, including 2020, have this same property?

- (A) 49                      (B) 50                      (C) 81                      (D) 90                      (E) 99

17. Two circles are tangent to each other and also to two sides of a square. What is the measure of the  $A\hat{O}B$  angle, determined by three of these points of tangency, as shown in the figure?



- (A)  $110^\circ$                       (B)  $112^\circ$                       (C)  $120^\circ$                       (D)  $128^\circ$                       (E)  $135^\circ$

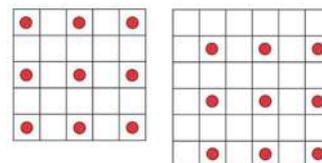
18. Roberto and Maria leave at the same time from the same point of a long circular track, he on foot and she by bike. Maria completes a lap 24 minutes before Roberto and waits for him while having an ice cream. When he reaches this point, Maria leaves with her bike in the opposite direction and Roberto continues walking without stopping in the same direction. Then they meet 5 minutes later. Assuming the speeds are kept constant, how long does it take for Roberto to take a ride on the track?

- (A) 30 min                      (B) 29 min                      (C) 28 min                      (D) 27 min                      (E) 26 min

19. Let  $17x + 51y = 102$ . If  $x$  e  $y$  are strictly positive integers, what is the value of  $x - 3y$ ?

- (A)  $-3$                       (B) 0                      (C) 3                      (D) 12                      (E) undetermined

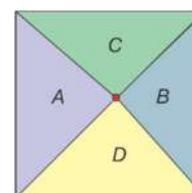
20. Ana plays with  $n \times n$  boards by placing a token in each of the cells with no common points with other cells containing tokens. In the picture beside we see how to place as many chips as possible on  $5 \times 5$  and  $6 \times 6$  boards. In this way, how many chips can Ana possibly put on a  $2020 \times 2020$  board?



- (A) 2020                      (B) 4039                      (C)  $674^2$                       (D)  $1010^2$                       (E)  $2020^2$

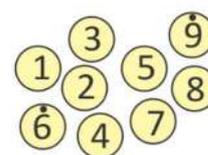
**5 points**

21. The next window is a square of area  $1 \text{ m}^2$  and is composed of four triangles, which areas, indicated in the figure, follow the ratios  $3A = 4B$  and  $2C = 3D$ . A fly is placed exactly at the point where these four triangles touch each other. The fly flies directly to the side closest to the window. How much does it fly?



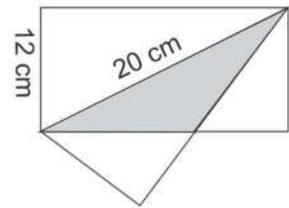
- (A) 40 cm                      (B) 30 cm                      (C) 25 cm                      (D) 20 cm                      (E) 10 cm

22. Julia puts the nine chips on the right in a box. She then takes one chip at a time, without looking, and notes down its digit, obtaining, at the end, a number of nine different digits. What is the probability that the number written by Julia is divisible by 45?



- (A)  $\frac{1}{9}$                       (B)  $\frac{2}{9}$                       (C)  $\frac{1}{3}$                       (D)  $\frac{4}{9}$                       (E)  $\frac{8}{9}$

23. A rectangular sheet with one side of 12 cm is folded along its 20 cm diagonal. What is the overlapping area of the folded parts, indicated in gray in the picture beside?

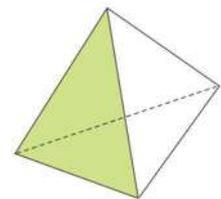


- (A)  $24 \text{ cm}^2$       (B)  $36 \text{ cm}^2$       (C)  $48 \text{ cm}^2$       (D)  $50 \text{ cm}^2$       (E)  $75 \text{ cm}^2$

24. Carlos always tells the truth on alternate days. On the other days, he tells only lies. Today he made exactly four of the five statements that follow. Which one was not made today by him?

- (A) The number of male and female friends I have is a prime number.  
 (B) The number of male friends I have is equal to the number of female friends I have.  
 (C) My name is Carlos.  
 (D) Three of my male friends are older than me.  
 (E) I always tell the truth.

25. Julia wrote four positive integers, one at each vertex of a triangular base pyramid. She calculated the sum of the numbers written on the vertices of one face and the product of the numbers written on the vertices of other two faces, obtaining 15, 20 and 30, respectively. What is the highest possible value of the product of the four numbers?



- (A) 40      (B) 50      (C) 60      (D) 90      (E) 120

26. Pedro assembled a cube using 64 little white equal cubes and then he painted the cube red. Then he dismantled the cube and reassembled it so that all its faces were white and painted the cube red again. How many white faces of little cubes remained white?

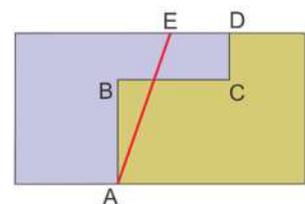
- (A) 0      (B) 72      (C) 109      (D) 144      (E) 192

27. Ana wants to write positive whole numbers, one in each of the squares beside, so that the sums of the four numbers in each row and the four numbers in each column are equal. She has already written some numbers, as shown. She wants to write the missing numbers so that the sum of these six numbers is as small as possible. What is this sum?

1		6	3
	2	2	8
	7		4
		7	

- (A) 32      (B) 24      (C) 20      (D) 18      (E) 12

28. A large rectangular plot is divided into two lots that are separated from each other by an ABCD fence, as shown in the picture beside. The AB, BC and CD parts of this fence are parallel to the sides of the rectangle and have lengths of 30 m, 24 m and 10 m, respectively. The owners of these lands have combined to knock down the fence and make a new straight AE fence, without changing the area of each of the lands. How far from point D should the E end of the fence be?



- (A) 8 m      (B) 10 m      (C) 12 m      (D) 14 m      (E) 16 m

29. The number  $K = 9999 \dots 9$  is formed by  $n$  digits 9. What is the sum of the digits of the number  $K^3$  ?

(A)  $n + 17$

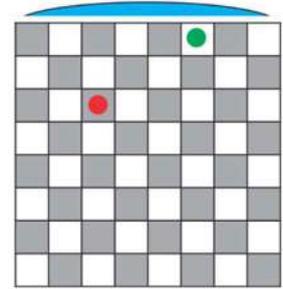
(B)  $\underbrace{999 \dots 9}_{3n \text{ 9's}}$

(C)  $\underbrace{999 \dots 9}_{n \text{ 9's}}$

(D)  $18n$

(E)  $10^{6n} - 1$

30. On the 8 x 8 board beside, in how many ways can you place two chips, one green and one red, in different colored cells, so that the chips are not in the same row or in the same column of the board?



(A) 112

(B) 672

(C) 768

(D) 1344

(E) 1536

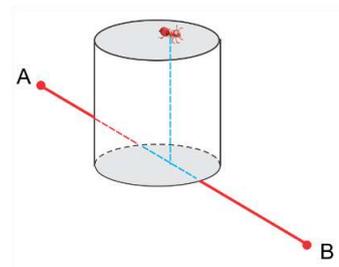
## Canguru de Matemática Brasil – LEVEL 5 – 2020 – Second Application

### 3 points

1. What is the last digit of the multiplication  $1 \times 3 \times 5 \times 7 \times 9^2 \times 7 \times 5 \times 3 \times 1$  result?

- (A) 1                      (B) 3                      (C) 5                      (D) 7                      (E) 9

2. An ant walked 6 m every day to go from point A to point B in a straight line. One day Johnny put a straight cylinder of one meter high in that way. Now the ant walks on the same straight line or above it, having to go up and down the cylinder, as shown in the picture. How much does she have to walk now to go from A to B?



- (A) 8 m                      (B) 9 m                      (C)  $6 + \pi$  m                      (D)  $12 - \pi$  m                      (E) 10 m

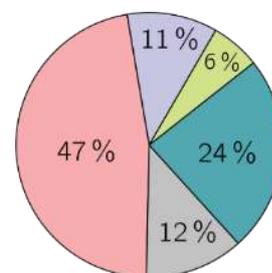
3. How many integers are there between  $2020,9^2$  and  $2018,9 \times 2022,9$  ?

- (A) 0                      (B) 1                      (C) 2                      (D) 3                      (E) 4

4. What is the value of  $\frac{1010^3 - 2020^3 + 3030^3}{1010^3}$  ?

- (A) 10                      (B) 20                      (C) 30                      (D) 40                      (E) 50

5. The pie chart beside refers to the number of inhabitants of the five zones of a city. The central zone has the same population as the north, west and east zones together and the south zone has half of the inhabitants of the west zone. What is the percentage difference between the inhabitants of the north and east zones?



- (A) 6%                      (B) 11%                      (C) 12%                      (D) 13%                      (E) 18%

6. Being  $a, b$  e  $c$  integers numbers such that  $1 \leq a = b \leq c$  and  $abc = 2020^2$ , what is the highest possible value of  $a$ ?

- (A) 36                      (B) 40                      (C) 44                      (D) 101                      (E) 202

7. Which of the following numbers is divisible by 3, whatever the integer  $n$ ?

- (A)  $5n + 1$                       (B)  $n^2$                       (C)  $(n - 3)^2$                       (D)  $n^2 - 1$                       (E)  $n^3 - n$

8. If a dozen bananas nanicas cost the same as a dozen bananas prata and  $y$  bananas nanicas cost  $x$  reais, how many reais are  $z$  bananas prata?

- (A)  $xyz$                       (B)  $\frac{5}{6}xyz$                       (C)  $\frac{6xz}{5y}$                       (D)  $\frac{5yz}{6x}$                       (E)  $\frac{6yz}{5x}$

9. Two equal dice have two red faces, two blue and two green each. If we roll the two dice simultaneously, what is the probability that the result will be two faces with different colors?

- (A)  $\frac{1}{12}$       (B)  $\frac{1}{9}$       (C)  $\frac{1}{6}$       (D)  $\frac{2}{9}$       (E)  $\frac{2}{3}$

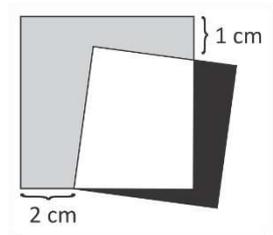
10. In the addition on the right, different letters represent different numbers. Assuming the account is correct, what is the highest possible value for the sum  $C + A + N$ ?



- (A) 15      (B) 18      (C) 19      (D) 21      (E) 24

**4 points**

11. A gray square with an area of  $36 \text{ cm}^2$  and a black square with an area of  $25 \text{ cm}^2$  are superimposed, as shown beside. What is the perimeter of the overlapping region, represented by the white quadrilateral, which has a vertex on the side of the gray square?

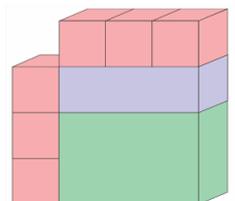


- (A) It is not determined. (B) 11 cm      (C) 16 cm      (D) 18 cm      (E) 20 cm

12. Two thousand and twenty coins are on a table, with "head" facing up. With each movement you must turn exactly three of these coins. What is the smallest number of moves you must make so that all the coins on the table have "tails" facing up?

- (A) 672      (B) 673      (C) 674      (D) 675  
(E) It is not possible to make all the "tails" face up.

13. Zilda will use six equal cubes and two different rectangular blocks to form the structure beside with eight faces. Before gluing the pieces, she will paint each one entirely and calculated that she will need 18 liters of paint (the color does not matter). How many liters of paint would she use if she painted the whole structure only after gluing the parts?



- (A) 8,4      (B) 9,6      (C) 11,5      (D) 12,8      (E) 16,0

14. Let  $a, b$  and  $c$  be real numbers not null such that  $(a - a^{-1})^2 + (b - b^{-1})^2 + (c - c^{-1})^2 = 0$ . What number below can **NOT** be the value of  $a + b + c$ ?

- (A)  $-3$       (B)  $-1$       (C)  $0$       (D)  $1$       (E)  $3$

15. The last two digits of a 2020 number are 9 and 9. At most, how many digits does the square of that number have?

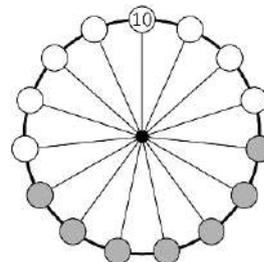


- (A) 2018      (B) 2020      (C) 4018      (D) 4019      (E) 4040

16. The sequence  $f_n$  is given by  $f_1 = 1, f_2 = 2$  e  $f_n = f_{n-1} \cdot f_{n+1}$  for  $n \geq 2$ . How many of the first 2020 elements of this sequence are even numbers?

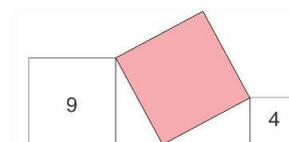
- (A) 673                      (B) 674                      (C) 1 010                      (D) 1 346                      (E) 1 347

17. Matias wrote 15 numbers on the wheel represented beside. Only one of them is visible, the 10 on top of the wheel. The sum of the numbers in any seven consecutive positions, such as the gray positions in the figure, does not vary. When seven numbers in consecutive positions are summed up, which of the following results is possible?



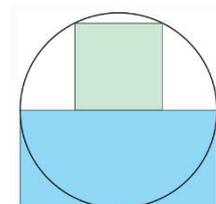
- (A) 49                      (B) 70                      (C) 75                      (D) 105                      (E) 150

18. A large square touches another two squares, as shown in the picture. The numbers inside the smaller squares indicate their areas. What is the area of the largest square?



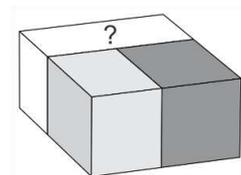
- (A) 10                      (B) 11                      (C) 12                      (D) 13                      (E) 14

19. A circle is tangent to one side of a rectangle and passes through two of its vertices, as shown beside. A square of  $20 \text{ cm}^2$  area has one side over the side of the rectangle and two vertices over the circle, as shown in the figure. What is the area of the rectangle?



- (A)  $40 \text{ cm}^2$                       (B)  $45 \text{ cm}^2$                       (C)  $50 \text{ cm}^2$                       (D)  $55 \text{ cm}^2$                       (E)  $60 \text{ cm}^2$

20. Two rectangular blocks and a cube are joined to form a larger rectangular block, which volume is  $280 \text{ cm}^3$ . The cube, in dark gray in the picture, has volume equal to  $125 \text{ cm}^3$  and the smaller rectangular block has volume equal to  $75 \text{ cm}^3$ . What is the area of the face marked with the question mark?

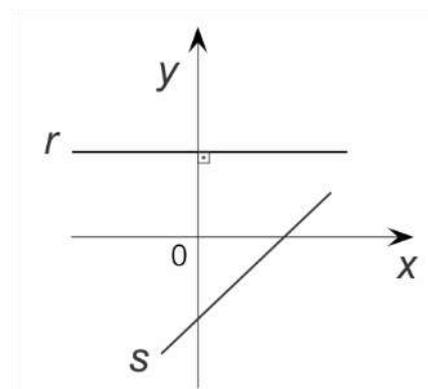


- (A)  $16 \text{ cm}^2$                       (B)  $18 \text{ cm}^2$                       (C)  $20 \text{ cm}^2$                       (D)  $24 \text{ cm}^2$                       (E)  $56 \text{ cm}^2$

**5 points**

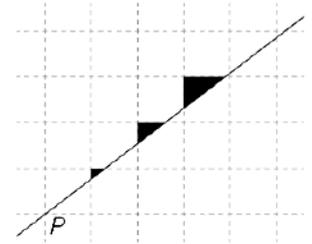
21. The figure shows the lines  $r$  and  $s$ , which equations are, respectively,  $y = ax + b$  e  $y = cx + d$ . Which of the following statements is true?

- (A)  $ab + cd < 0$                       (B)  $a + b + c + d < 0$                       (C)  $ac + bd \geq 0$   
 (D)  $a + b + c + d > 0$                       (E)  $abcd > 0$



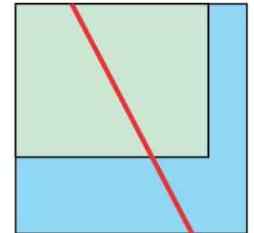
22. A little kangaroo draws a line passing through point P of the grid and then paints three triangles in black as shown in the picture. The areas of these triangles are proportional to which numbers?

- (A) 1 : 4 : 9      (B) 1 : 2 : 9      (C) 1 : 3 : 9      (D) 1 : 2 : 3      (E) 2 : 3 : 4



23. A rectangular garden was 50 m long and 40 m wide. An artificial lake was built next to it, so that the whole set forms a 60 m square. Then a fence was stretched, separating both the garden and the lake in two parts with equal areas, as shown in the picture. How long is this fence?

- (A) 60 m      (B)  $30\sqrt{5}$  m      (C)  $60\sqrt{2}$  m      (D) 85 m      (E)  $60\sqrt{3}$  m



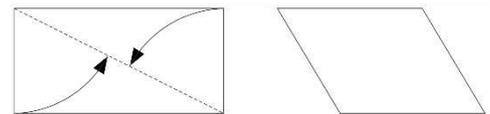
24. A positive integer  $N$  is divisible by all integers from 2 to 11 except two of these numbers. Among the pairs of integers (6,7), (7,8), (8,9), (9,10) e (10,11), how many could be this exception?

- (A) 1      (B) 2      (C) 3      (D) 4      (E) 5

25. At the Sunday fair, in the morning Ana wanted to buy three types of fruit among 12 options and one type of vegetable, among the six types available. In the afternoon some products were sold out and Bela wanted to buy two kinds of fruits and two kinds of vegetables, among the remaining ones. Since the number of possible choices for Bela was a quarter of the number of possible choices for Ana, how many products were sold out in the afternoon?

- (A) 1      (B) 2      (C) 3      (D) 4      (E) 5

26. Vilma took a sheet of paper measuring 10 cm x 20 cm and made two folds, taking the two smaller sides of the sheet to a diagonal of it. She gets a parallelogram, as shown in the picture. What is the area of this quadrilateral, in  $\text{cm}^2$ ?



- (A)  $\frac{100\sqrt{5}}{3}$       (B)  $50\sqrt{5}$       (C)  $100(\sqrt{5} - 1)$       (D)  $50(5 - \sqrt{5})$       (E)  $50(5 + \sqrt{5})$

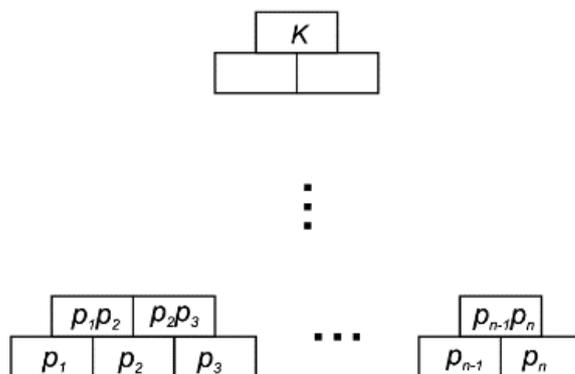
27. The submerged volume of an iceberg in the form of a cube corresponds to 96,4% of the volume of the iceberg. If the outside of the water has the same three edges, what is the percentage of the surface area in contact with the air in relation to the total surface area of the iceberg?

- (A) 9%      (B) 12%      (C) 15%      (D) 18%      (E) 21%

28. Maria writes all the positive divisors of 2020, one on each card and puts all these cards in a box. Then she closes her eyes and starts taking these cards out of the box, one by one. How many cards must she take out of the box to make sure that among the cards taken there are two with numbers  $a$  and  $b$  such that  $a$  is not a divisor of  $b$  and  $b$  is not a divisor of  $a$ ?

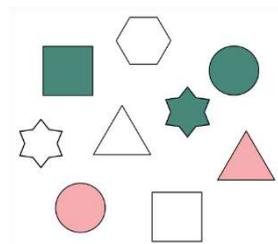
- (A) 5                      (B) 6                      (C) 7                      (D) 8                      (E) 9

29. There are  $n$  different prime numbers  $p_1, p_2, \dots, p_n$  written from left to right on the last line below the table shown beside. The product of two neighboring numbers in the same line is written in the upper two boxes. The number  $K = p_1^{\alpha_1} \cdot p_2^{\alpha_2} \dots p_n^{\alpha_n}$  is written in the last house above. In a table like this, in which  $\alpha_2 = 9$ , how many numbers are divisible by number  $p_4$ ?



- (A) 4                      (B) 16                      (C) 24                      (D) 28                      (E) 36

30. Adam and Bruna try to find out which is Carla's favorite figure, amongst the figures beside. Adam knows that Carla told Bruna what the shape of the figure was. Bruna knows that Carla told Adam what the color the figure was. The following conversation takes place. Adam: "I don't know what Carla's favorite figure is and I know that Bruna doesn't know either". Bruna: "At first I didn't know what Carla's favorite figure was, but now I know". Adam: "Now I know too". What is Carla's favorite figure?



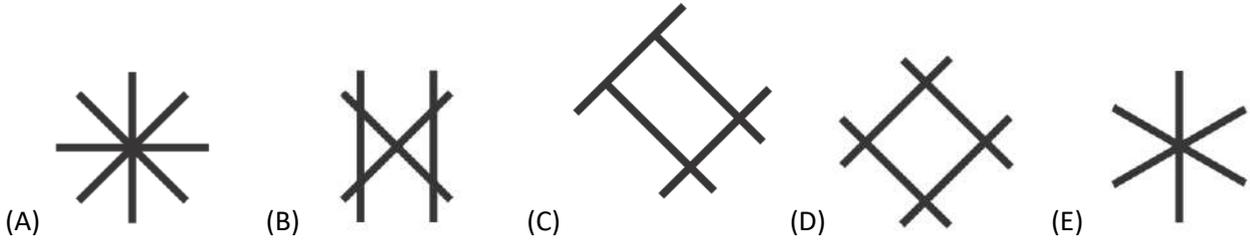
- (A)                       (B)                       (C)                       (D)                       (E) 

# 2020

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
<b>Felix</b>	B	C	E	C	A	C	B	D	E	D	A	D	B	B	D	E	E	A	D	A	E	E	C	B	-	-	-	-	-	-
<b>Écolier</b>	A	D	C	C	E	D	C	B	B	E	E	B	A	A	B	E	D	A	D	E	C	D	C	E	-	-	-	-	-	-
<b>Benjamin</b>	E	C	D	C	D	C	B	E	A	B	E	D	A	A	A	D	B	E	D	A	C	B	C	D	E	C	A	B	C	C
<b>Kadett</b>	E	B	C	B	E	D	B	B	C	E	D	C	C	A	C	E	D	D	E	A	E	D	D	A	D	B	B	C	B	A
<b>Junior</b>	C	D	B	B	D	B	E	E	D	E	A	C	D	D	A	D	E	A	B	D	A	A	E	C	E	E	B	C	D	E
<b>Student</b>	C	A	E	B	D	D	E	C	E	D	B	C	C	C	E	B	B	D	C	A	A	A	B	B	C	D	A	B	D	E

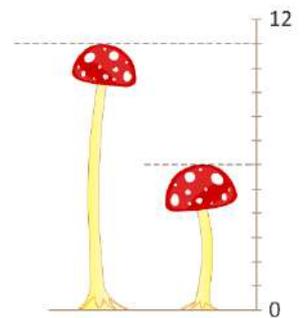
**3 points problems**

1. A kangaroo laid out 3 sticks like this  to make a shape. It is not allowed to break or to bend the sticks. Which shape could the kangaroo make?

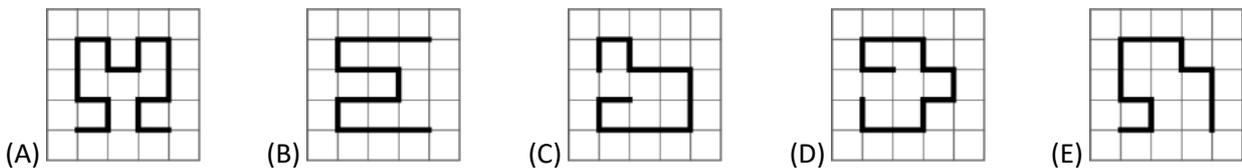


2. The picture shows 2 mushrooms. What is the difference between their heights?

- (A) 4      (B) 5      (C) 6      (D) 11      (E) 17

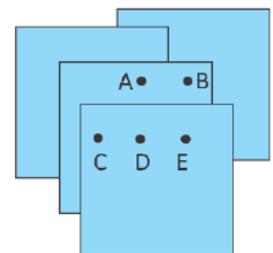


3. Which of the paths shown in the pictures is the longest?



4. Four identical pieces of paper are placed as shown. Michael wants to punch a hole that goes through all four pieces. At which point should Michael punch the hole?

- (A) A      (B) B      (C) C      (D) D      (E) E



5. Ella puts on this t-shirt and stands in front of a mirror. Which of these images does she see in the mirror?

- (A) 1S0S    (B) SOS1    (C) OS1S    (D) 120S    (E) 1S02



6. The pink tower is taller than the red tower but shorter than the green tower. The silver tower is taller than the green tower. Which tower is the tallest?

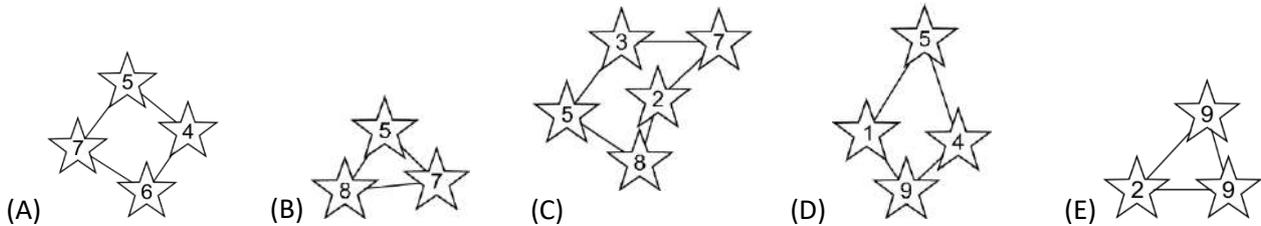
- (A) pink tower    (B) green tower    (C) red tower    (D) silver tower    (E) impossible to decide

7. These children are standing in a line. Some are facing forwards and others are facing backwards. How many children are holding another child's hand with their right hand?



- (A) 2                      (B) 3                      (C) 4                      (D) 5                      (E) 6

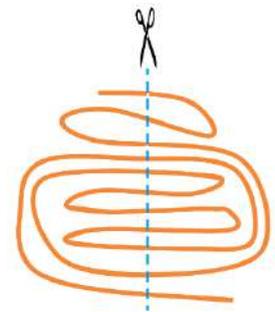
8. In the Kangaroo constellation, all stars have a number greater than 3 and their sum is 20. Which is the Kangaroo constellation?



**4 points problems**

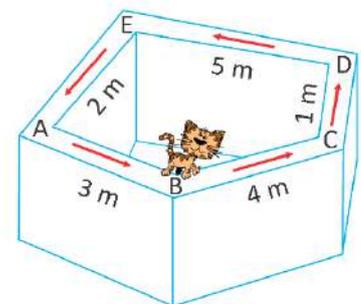
9. Edmund cut a ribbon as shown in the picture. How many pieces of the ribbon did he finish with?

- (A) 9                      (B) 10                      (C) 11                      (D) 12                      (E) 13



10. Rose the cat walks along the wall. She starts at point B and follows the direction of the arrows shown in the picture. The cat walks a total of 20 metres. Where does she end up?

- (A) A                      (B) B                      (C) C                      (D) D                      (E) E



11. Julie and Angela played "kangball", a ball game. Each goal in their game scores 2 points. Julie scored 5 goals and Angela scored 9 goals. How many more points than Julie did Angela score?

- (A) 4                      (B) 6                      (C) 8                      (D) 10                      (E) 12

12. Julia has two pots with flowers, as shown. She keeps the flowers exactly where they are. She buys more flowers and puts them in the pots. After that, each pot has the same number of each type of flower. What is the smallest number of flowers she needs to buy?



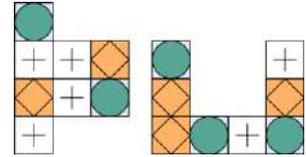
- (A) 3                      (B) 4                      (C) 5                      (D) 8                      (E) 10

13. Tom encodes words using the board shown. For example, the word PIZZA has the code A2A4C1C1B2. What word did Tom encode as B3B2C4D2?

1	B	K	Z	E
2	P	A	F	H
3	S	M	R	W
4	I	N	T	L
	A	B	C	D

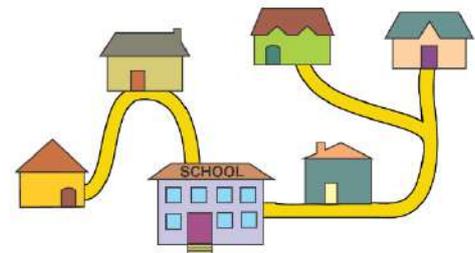
- (A) MAZE      (B) MASK      (C) MILK      (D) MATE      (E) MATH

14. Which figure can be made from the 2 pieces shown on the right?



- (A)      (B)      (C)      (D)      (E)

15. The picture shows the five houses of five friends and their school. The school is the largest building in the picture. To go to school, Doris and Ali walk past Leo's house. Eva walks past Chole's house. Which is Eva's house?



- (A)      (B)      (C)      (D)      (E)

16. The kangaroo had two branches for lunch. Each branch had 10 leaves. The kangaroo ate some leaves from one branch. Then, from the second branch, it ate as many leaves as were left on the first branch. How many leaves in total were left on the two branches?

- (A) 5      (B) 6      (C) 8      (D) 10      (E) 15

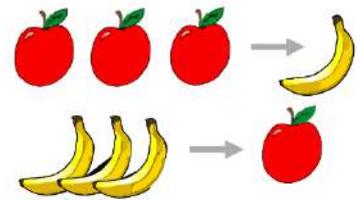
### 5 points problems

17. Mara built the square by using 4 of the following 5 shapes. Which shape was not used?

☆	☆	◇	→
☆	◇	◇	→
☆	○	◇	→
☆	○	○	○

- (A)      (B)      (C)      (D)      (E)

18. Every time the witch has 3 apples she turns them in to 1 banana. Every time she has 3 bananas she turns them in to 1 apple. What will she finish with if she starts with 4 apples and 5 bananas?

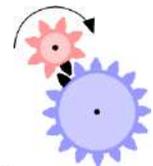


- (A)
- (B)
- (C)
- (D)
- (E)

19. The cards 2 3 4 5 6 are placed into 2 boxes. The sums of the numbers in each box are the same. Which number must be in the box with the number 4?

- (A) 2
- (B) 3
- (C) 5
- (D) 6
- (E) impossible to determine

20. The picture beside shows two cogs, each with a black tooth. Where will the black teeth be after the small cog has made one full turn?

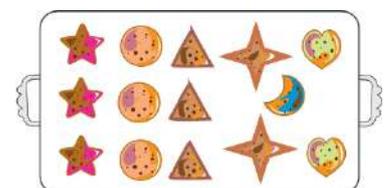


- (A)
- (B)
- (C)
- (D)
- (E)

21. 3 girls and 2 boys were dancing. They danced in pairs so that each girl danced with each boy for exactly 1 minute. At any time, there was only one pair on the dance floor. For how many minutes did they dance?

- (A) 5
- (B) 6
- (C) 8
- (D) 9
- (E) 10

22. Each participant in a cooking contest baked one tray of cookies like the one shown beside. What is the smallest number of trays of cookies needed to make the following plate?

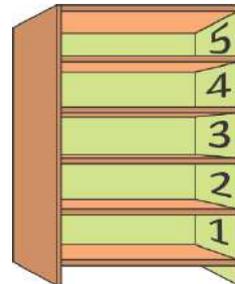


- (A) 1
- (B) 2
- (C) 3
- (D) 4
- (E) 5

**23.** Kangie eats only apples on Monday, Wednesday and Friday. On Tuesdays and Thursdays he eats only mangoes. He eats either 2 apples or 3 mangoes a day. On Saturdays and Sundays he eats nothing. How many pieces of fruit does Kangie eat in two weeks?

- (A) 12                      (B) 16                      (C) 18                      (D) 20                      (E) 24

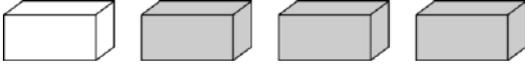
**24.** Stan has five toys: a ball, a set of blocks, a game, a puzzle and a car. He puts each toy on a different shelf of the bookcase. The ball is higher than the blocks and lower than the car. The game is directly above the ball. On which shelf can the puzzle not be placed?

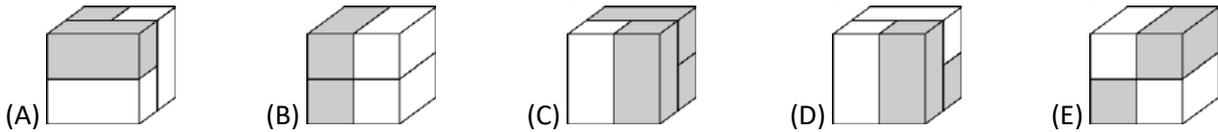


- (A) 1                      (B) 2                      (C) 3                      (D) 4                      (E) 5

KSF 2021 – Ecolier (E)

3 points problems

1. Erik has 4 bricks of the same size: . Which of the cubes shown below can he make with his 4 bricks?

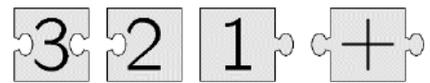


2. How many fish will have their heads pointing towards the ring when we straighten the line?

- (A) 3 (B) 5 (C) 6 (D) 7 (E) 8

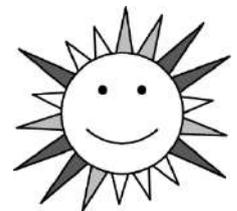


3. When you put the 4 puzzle pieces together correctly, they form a rectangle with a calculation on it. What is the result of this calculation?

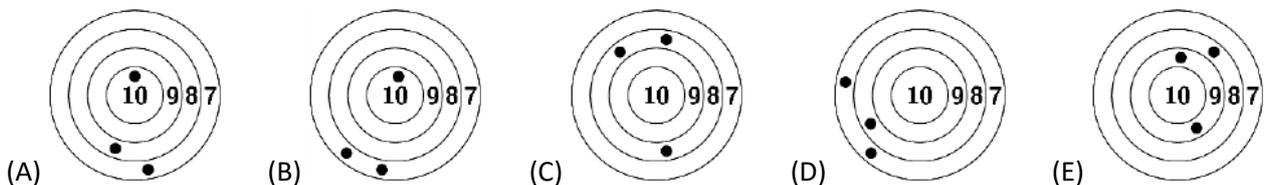


- (A) 6 (B) 15 (C) 18 (D) 24 (E) 33

4. Alaya draws a picture of the sun. Which of the following answers is part of her picture?

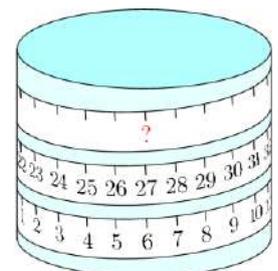


5. Five boys competed in a shooting challenge. Ricky scored the most points. Which target was Ricky's?



6. A measuring tape is wrapped around a cylinder. Which number should be at the place shown by the question mark?

- (A) 33 (B) 42 (C) 48 (D) 53 (E) 69

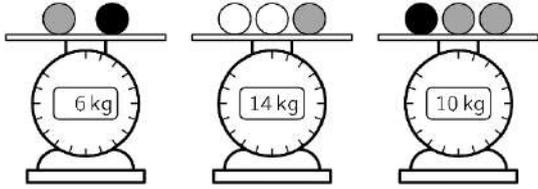


7. Denise fired a silver and a gold rocket at the same time. The rockets exploded into 20 stars in total. The gold rocket exploded into 6 more stars than the silver one. How many stars did the gold rocket explode into?

- (A) 9                      (B) 10                      (C) 12                      (D) 13                      (E) 15

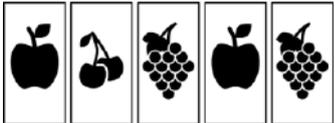
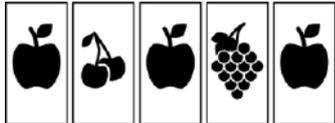
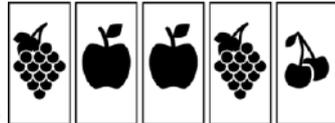
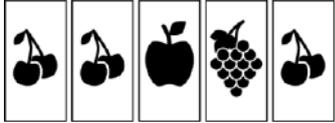
8. Rosana has some balls of 3 different colours. Balls of the same colour have the same weight. What is the weight of each white ball ?

- (A) 3            (B) 4            (C) 5            (D) 6            (E) 7

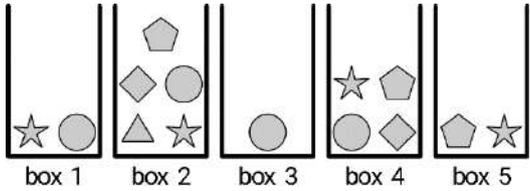


**4 points problems**

9. Nisa has 3 different types of cards in a game: apple , cherry  and grapes . She chooses 2 cards from the set and swaps their places. She wants to arrange the cards so that all the cards with the same fruit on are next to each other. For which set is this **NOT** possible?

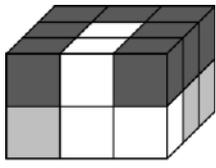
- (A)  (B)  (C)   
 (D)  (E) 

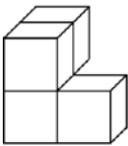
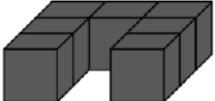
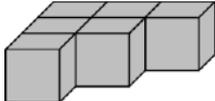
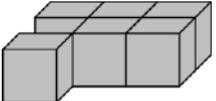
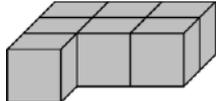
10. Sofie wants to pick 5 different shapes from the boxes. She can only pick 1 shape from each box. Which shape must she pick from box 4?



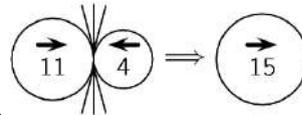
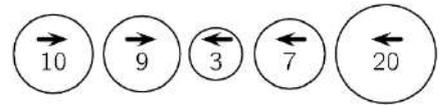
- (A)             (B)             (C)             (D)             (E) 

11. 18 cubes are coloured white or grey or black and are arranged as shown. The figures below show the white and the black parts. Which of the following is the grey part?



- (A)             (B)             (C)             (D)             (E) 

12. The 5 balls shown begin to move simultaneously in the directions indicated by their arrows. When two balls going in opposite directions collide, the bigger ball swallows the smaller one and increases its value by the value of the smaller ball. The bigger ball continues to move in its



original direction, as shown in the following example. What is the final result of the collisions of the 5 balls shown?

- (A) (B) (C) (D) (E)

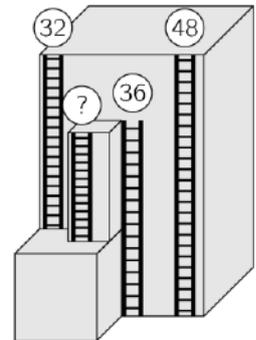
13. In an ice cream shop there is some money in a drawer. After 6 ice creams were sold, there were 70 euros left in the drawer. After a total of 16 ice creams were sold, there were 120 euros left in the drawer. How many euros were there in the drawer at the start?

- (A) 20 (B) 30 (C) 40 (D) 50 (E) 60

14. The Koala ate some leaves from 3 branches. Each branch had 20 leaves. The Koala ate a few leaves from the first branch and then ate as many leaves from the second branch as were left on the first branch. Then it ate 2 leaves from the third branch. How many leaves in total were left on the 3 branches?

- (A) 20 (B) 22 (C) 28 (D) 32 (E) 38

15. On a tall building there are 4 fire escape ladders, as shown. The heights of 3 ladders are at their tops. What is the height of the shortest ladder?



- (A) 12 (B) 14 (C) 16 (D) 20 (E) 22

16. Nora plays with 3 cups on the kitchen table. She takes the left-hand cup, flips it over, and puts it to the right of the other cups. The picture shows the first move. What do the cups look like after 10 moves?



- (A) (B) (C) (D) (E)

**5 points problems**

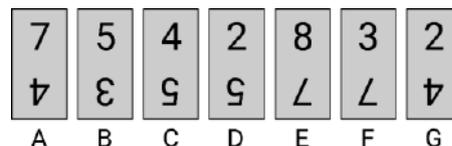
17. Eva has the 5 stickers shown: , , , , . She stuck one of them on each of the 5 squares of this board 

1	2	3	4	5
---	---	---	---	---

 so that  is not on square 5,  is on square 1, and  is adjacent to  and . On which square did Eva stick  ?

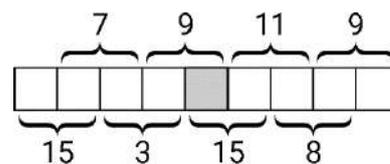
- (A) 1                      (B) 2                      (C) 3                      (D) 4                      (E) 5

18. 7 cards are arranged as shown. Each card has 2 numbers on with 1 of them written upside down. The teacher wants to rearrange the cards so that the sum of the numbers in the top row is the same as the sum of the numbers in the bottom row. She can do this by turning one of the cards upside down. Which card must she turn?



- (A) A                      (B) B                      (C) D                      (D) F                      (E) G

19. The numbers 1 to 9 are placed in the squares shown with a number in each square. The sums of all pairs of neighbouring numbers are shown. Which number is placed in the shaded square?



- (A) 4                      (B) 5                      (C) 6                      (D) 7                      (E) 8

20. Mia throws darts at balloons worth 3, 9, 13, 14 and 18 points. She scores 30 points in total. Which balloon does Mia *definitely* hit?

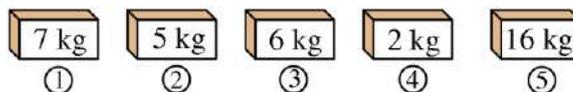


- (A) 3                      (B) 9                      (C) 13                      (D) 14                      (E) 18

21. A box has fewer than 50 cookies in. The cookies can be divided evenly between 2, 3, or 4 children. However, they cannot be divided evenly between 7 children because 6 more cookies would be needed. How many cookies are there in the box?

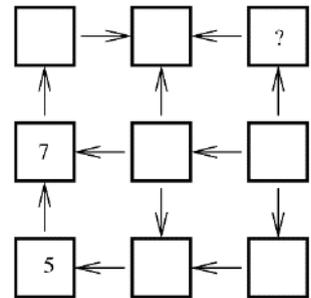
- (A) 12                      (B) 24                      (C) 30                      (D) 36                      (E) 48

22. Each of the 5 boxes contains either apples or bananas, but not both. The total weight of all the bananas is 3 times the weight of all the apples. Which boxes contain apples?



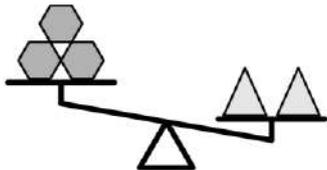
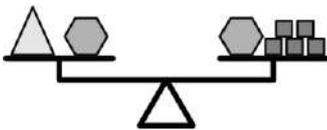
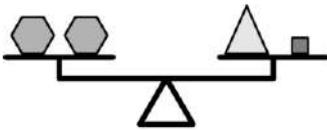
- (A) 1 and 2                      (B) 2 and 3                      (C) 2 and 4                      (D) 3 and 4                      (E) 1 and 4

23. Elena wants to write the numbers from 1 to 9 in the squares shown. The arrows always point from a smaller number to a larger one. She has already written 5 and 7. Which number should she write instead of the question mark?



- (A) 2            (B) 3            (C) 4            (D) 6            (E) 8

24. Martin placed 3 different types of objects, hexagons , squares and triangles , on sets of scales, as shown.



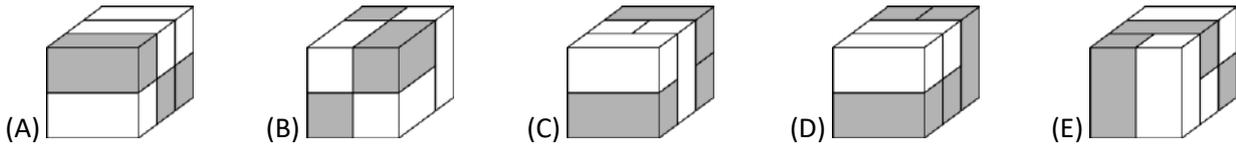
What does he need to put on the left-hand side on the third set of scales for these scales to balance?

- (A) 1 square            (B) 2 squares            (C) 1 hexagon            (D) 1 triangle            (E) 2 triangles

KSF 2021 – Benjamin (B)

3 points problems

1. Which of the following solid shapes can be made with these 6 bricks?



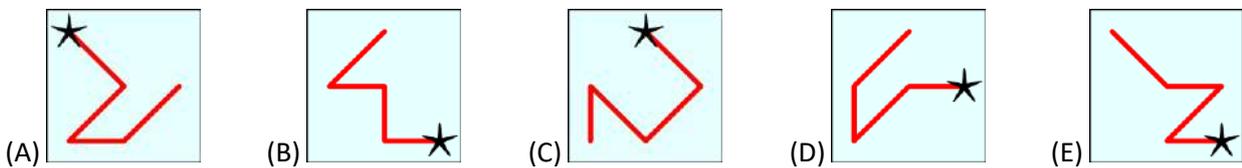
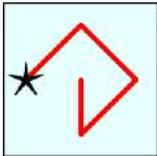
2. In how many places in the picture are two children holding each other with their left hands?

- (A) 1 (B) 2 (C) 3 (D) 4 (E) 5

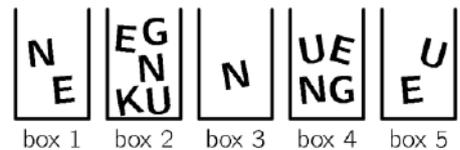


3. In the square you can see the digits from 1 to 9. A number is created by starting at the star, following the line and writing down the digits along the line while passing. For example, the line shown represents the number 42685. Which of the following lines represents the largest number?

1	2	3
4	5	6
7	8	9



4. Sofie wants to write the word KENGU by using letters from the boxes. She can only take one letter from each box. What letter must Sofie take from box 4?



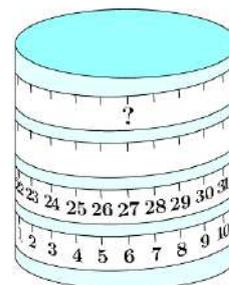
- (A) K (B) E (C) N (D) G (E) U

5. When the 5 pieces are fitted together correctly, the result is a rectangle with a calculation written on it. What is the answer to this calculation?

- (A) 22 (B) 32 (C) 41 (D) 122 (E) 203

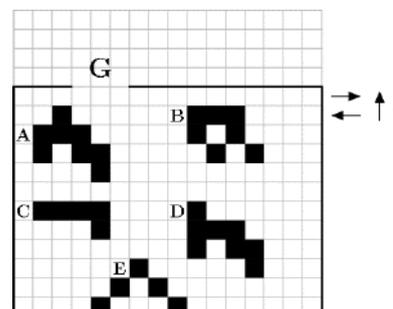
6. A measuring tape is wound around a cylinder. What number should be at the place shown by the question mark?

- (A) 53      (B) 60      (C) 69      (D) 77      (E) 81



7. The 5 figures on the grid can only move in the directions indicated by the black arrows. Which figure can leave through gate G?

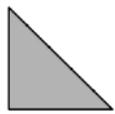
- (A) A      (B) B      (C) C      (D) D      (E) E

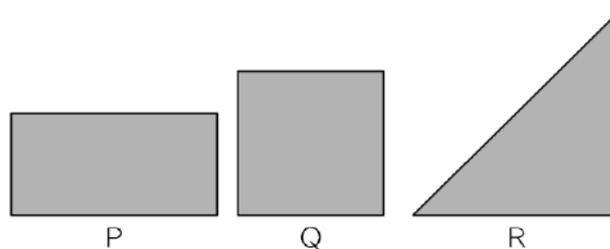


8. Carin is going to paint the walls in her room green. The green paint is too dark, so she mixes it with white paint. She tries different mixtures. Which of the following mixtures will give the darkest green colour?

- (A) 1 part green + 3 parts white      (B) 2 parts green + 6 parts white      (C) 3 parts green + 9 parts white  
 (D) 4 parts green + 12 parts white      (E) They will all be equally dark

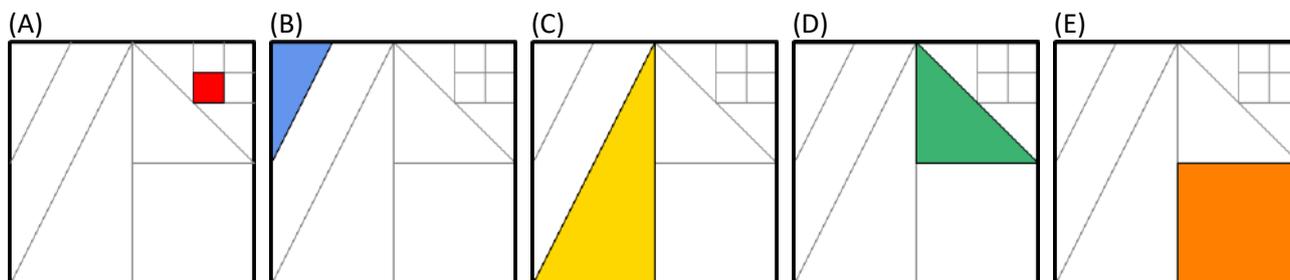
9. Mary had a piece of paper. She folded it exactly in half. Then she folded it exactly in half again.

She got this shape . Which of the shapes P, Q or R could have been the shape of her original piece of paper?



- (A) only P      (B) only Q      (C) only R      (D) only P or Q      (E) any of P, Q or R

10. There is a square with line segments drawn inside it. The line segments are drawn either from the vertices or the midpoints of other line segments. We coloured  $\frac{1}{8}$  of the large square. Which one is our coloring?

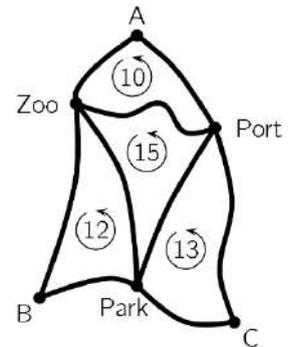


### 4 points problems

11. The number 5021972970 is written on a sheet of paper. Julian cuts the sheet twice, so he gets 3 numbers. What is the smallest sum he can get by adding these 3 numbers?

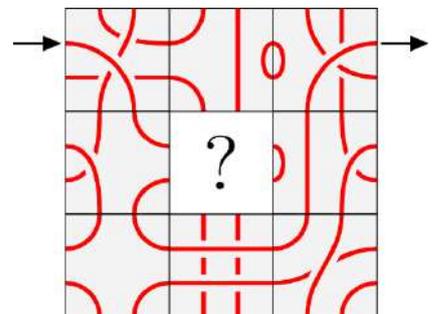
- (A) 3244                      (B) 3444                      (C) 5172                      (D) 5217                      (E) 5444

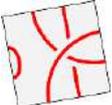
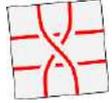
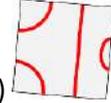
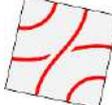
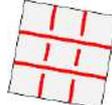
12. The map shows three bus stations at points A, B and C. A tour from station A to the Zoo and the Port and back to A is 10 km long. A tour from station B to the Park and the Zoo and back to B is 12 km long. A tour from station C to the Port and the Park and back to C is 13 km long. Also, A tour from the Zoo to the Park and the Port and back to the Zoo is 15 km long. How long is the shortest tour from A to B to C and back to A?



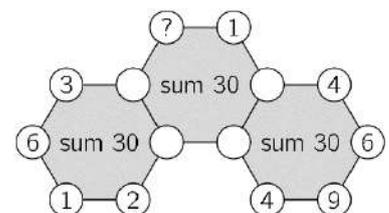
- (A) 18 km                      (B) 20 km                      (C) 25 km                      (D) 35 km                      (E) 50 km

13. Rosa wants to start at the arrow, follow the line, and get out at the other arrow. Which piece is it NOT possible to put in the middle to obtain that?



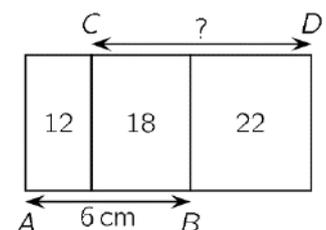
- (A)                       (B)                       (C)                       (D)                       (E) 

14. The diagram shows 3 hexagons with numbers at their vertices, but some numbers are invisible. The sum of the 6 numbers around each hexagon is 30. What is the number on the vertex marked with a question mark?

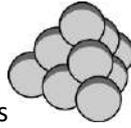


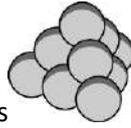
- (A) 3                      (B) 4                      (C) 5                      (D) 6                      (E) 7

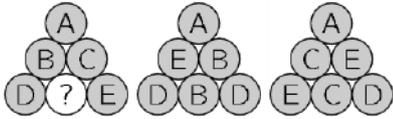
15. 3 rectangles of the same height are positioned as shown. The numbers within the rectangles indicate their areas in  $\text{cm}^2$ . If  $AB = 6 \text{ cm}$ , how long is the distance  $CD$ ?



- (A) 7 cm                      (B) 7,5 cm                      (C) 8 cm                      (D) 8.2 cm                      (E) 8.5 cm



16. A triangular pyramid is built with 10 identical balls, like this . Each ball has one of the letters A, B, C, D and E on it. There are 2 balls marked with each letter. The picture shows 3 side views of the pyramid. What is the letter on the ball with the question mark?

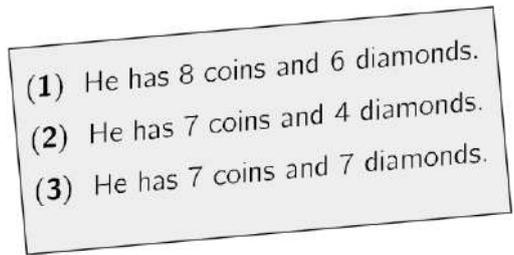


- (A) A                      (B) B                      (C) C                      (D) D                      (E) E

17. Ronja had four white tokens and Wanja had four grey tokens. They played a game in which they took turns to place one of their tokens to create two piles. Ronja placed her first token first. Which pair of piles could they not create?



18. Three pirates were asked how many coins and how many diamonds their friend Graybeard had. Each of the three told the truth to one question but told a lie to the other. Their answers are written on the piece of paper pictured. What is the total number of coins and diamonds that Graybeard has?

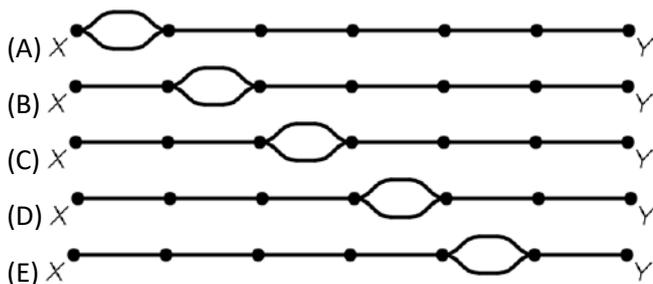


- (A) 11                      (B) 12                      (C) 13                      (D) 14                      (E) 15

19. There were 20 apples and 20 pears in a box. Carl randomly took 20 pieces of fruit from the box and Luca took the rest. Which of the following statements is always true?

- (A) Carl got at least one pear.  
 (B) Carl got as many apples as pears.  
 (C) Carl got as many pears as Luca.  
 (D) Carl got as many pears as Luca got apples.  
 (E) Carl got as many apples as Luca.

20. In a railway line between the cities X and Y, the trains can meet, traveling in opposite directions, only in one of its stretches, in which the line is double. The trains take 180 minutes to go from X to Y and 60 minutes to go from Y to X, at constant speeds. On this line, a train can start from X at the same instant that a train starts from Y, without them colliding during the trip. Which of the following figures represents the line?



**5 points problems**

21. Ann, Bob, Carina, Dan and Ed are sitting at a round table. Ann is not next to Bob, Dan is next to Ed and Bob is not next to Dan. Which two people are sitting next to Carina?

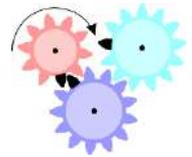
- (A) Ann and Bob (B) Bob and Dan (C) Dan and Ed (D) Ed and Ann (E) It is not possible to be certain

22. Maurice asked the canteen chef for the recipe for his pancakes. Maurice has 6 eggs, 400g flour, 0,5 liters of milk and 200g butter. What is the largest number of pancakes he can make using this recipe?

Ingredients for 100 pancakes	
25 eggs	4 l milk
5 kg flour	1 kg butter

- (A) 6 (B) 8 (C) 10 (D) 12 (E) 15

23. The picture shows 3 gears with a black gear tooth on each. Which picture shows the correct position of the black teeth after the small gear has turned a full turn clockwise?

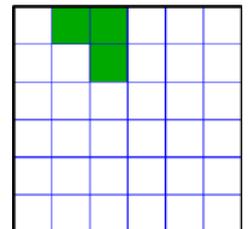


- (A) (B) (C) (D) (E)

24. An apple and an orange weigh as much as a pear and a peach. An apple and a pear weigh less than an orange and a peach, and a pear and an orange weigh less than an apple and a peach. Which of the pieces of fruit is the heaviest?

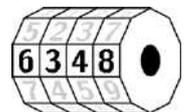
- (A) apple (B) orange (C) peach (D) pear (E) impossible to determine

25. What is the smallest number of shaded squares that can be added to the diagram to create a design, including the grid, with 4 axes of symmetry?



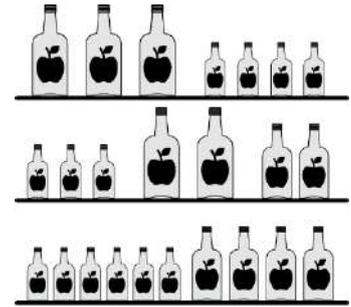
- (A) 1 (B) 9 (C) 12 (D) 13 (E) 21

26. My little brother has a 4-digit bike lock with the digits 0 to 9 on each part of the lock as shown. He started on the correct combination and turned each part the same amount in the same direction and now the lock shows the combination 6348. Which of the following CAN NOT be the correct combination of my brother's lock?



- (A) (B) (C) (D) (E)

27. Each shelf holds a total of 64 deciliters of apple juice. The bottles have three different sizes: large, medium and small. How many deciliters of apple juice does a medium bottle contain?



- (A) 3            (B) 6            (C) 8            (D) 10            (E) 14

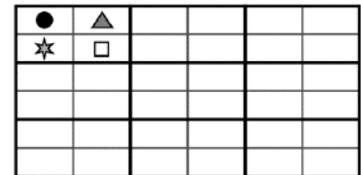
28. A large cube has side-length 7cm. On each of its 6 faces, the two diagonals are drawn in red. The large cube is then cut into small cubes with side-length 1cm. How many small cubes will have at least one red line drawn on it?

- (A) 54            (B) 62            (C) 70            (D) 78            (E) 86

29. In a group of 10 elves and trolls, each were given a token with a different number from 1 to 10 written upon it. They were each asked what number was on their token and all answered with a number from 1 to 10. The sum of the answers was 36. Each troll told a lie and each elf told the truth. What is the smallest number of trolls there could be in the group?"

- (A) 1            (B) 3            (C) 4            (D) 5            (E) 7

30. There are rectangular cards divided into 4 equal cells with different shapes  $\square$ ,  $\star$ ,  $\bullet$ ,  $\blacktriangle$  drawn in each cell. Cards can be placed side by side only if the same shapes appear in adjacent cells on their common side. 9 cards are used to form a rectangle as shown in the figure. Which of the following cards was definitely NOT used to form this rectangle?



- (A) 

$\square$	$\star$
$\bullet$	$\blacktriangle$

      (B) 

$\square$	$\bullet$
$\blacktriangle$	$\star$

      (C) 

$\star$	$\square$
$\blacktriangle$	$\bullet$

      (D) 

$\square$	$\star$
$\blacktriangle$	$\bullet$

      (E) 

$\square$	$\bullet$
$\star$	$\blacktriangle$

KSF 2021 – Cadet (C)

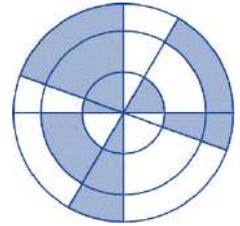
3 points problems

1. Which of the following symbols for signs of the Zodiac has an axis of symmetry?

- (A)  Sagittarius    (B)  Scorpio    (C)  Leo    (D)  Cancer    (E)  Capricorn

2. The figure shows three concentric circles with four lines passing through their common centre. What percentage of the figure is shaded?

- (A) 30%    (B) 35%    (C) 40%    (D) 45%    (E) 50%



3. What is the value of  $\frac{20 \cdot 21}{2+0+2+1}$ ?

- (A) 42    (B) 64    (C) 80    (D) 84    (E) 105

4. How many four-digit numbers have the property that their digits, from left to right, are consecutive and in ascending order?

- (A) 5    (B) 6    (C) 7    (D) 8    (E) 9

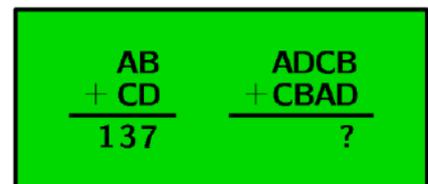
5. When the 5 pieces  are fitted together correctly, the result is a rectangle with a calculation written on it. What is the answer to this calculation?

- (A) -100    (B) -8    (C) -1    (D) 199    (E) 208

6. Each of the five vases shown has the same height and each has a volume of 1 litre. Half a litre of water is poured into each vase. In which vase would the level of the water be the highest?

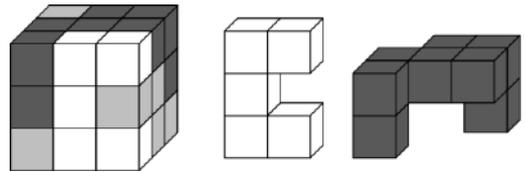
- (A)     (B)     (C)     (D)     (E) 

7. A student correctly added the two two-digit numbers on the left of the board and got the answer 137. What answer will he get if he adds the two four-digit numbers on the right of the board?



- (A) 13 737    (B) 13 837    (C) 14 747    (D) 23 737    (E) 137 137

8. A cube  $3 \times 3 \times 3$  is made from  $1 \times 1 \times 1$  white, grey and black cubes, as shown in the first diagram. The other two diagrams show the white part and the black part of the cube. Which of the following diagrams shows the grey part?



- (A) (B) (C) (D) (E)

9. A bike lock has four wheels numbered with the digits 0 to 9 in order. Each of the four wheels is rotated by  $180^\circ$  from the code shown in the first diagram to get the correct code. What is the correct code for the bike lock?



- (A) (B) (C) (D) (E)

10. Byron is 5cm taller than Aaron, but 10cm shorter than Caron. Darren is 10cm taller than Caron, but 5cm shorter than Erin. Which of the following statements is true?

- (A) Aaron and Erin are equal heights (B) Aaron is 10cm taller than Erin (C) Aaron is 10cm shorter than Erin  
(D) Aaron is 30cm taller than Erin (E) Aaron is 30cm shorter than Erin

#### 4 points problems

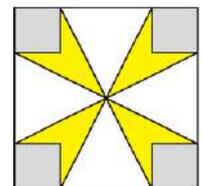
11. A rectangular chocolate bar is made of equal squares. Neil breaks off two complete strips of squares and eats the 12 squares he obtains. Later, Jack breaks off one complete strip of squares from the same bar and eats the 9 squares he obtains. How many squares of chocolate are left in the bar?

- (A) 72 (B) 63 (C) 54 (D) 45 (E) 36

12. A jar one fifth filled with water weighs 560 g. The same jar four fifths filled with water weighs 740 g. What is the weight of the empty jar?

- (A) 60 g (B) 112 g (C) 180 g (D) 300 g (E) 500 g

13. The area of the large square is  $16 \text{ cm}^2$  and the area of each small square is  $1 \text{ cm}^2$ . What is the total area of the central flower in  $\text{cm}^2$ ?



- (A) 3 (B)  $\frac{7}{2}$  (C) 4 (D)  $\frac{11}{2}$  (E) 6

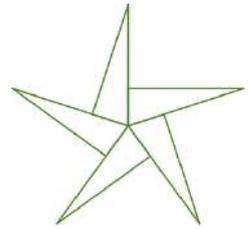
14. Costa is building a new fence in his garden. He uses 25 planks of wood, each of which are 30 cm long. He arranges these planks so that there is the same slight overlap between any two adjacent planks.



The total length of Costa's new fence is 6.9 metres. What is the length in centimetres of the overlap between any pair of adjacent planks?

- (A) 2,4                      (B) 2,5                      (C) 3                      (D) 4,8                      (E) 5

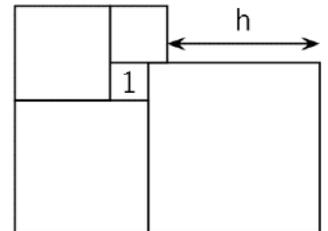
15. Five identical right-angled triangles can be arranged so that their larger acute angles touch to form the star shown in the diagram. It is also possible to form a different star by arranging more of these triangles so that their smaller acute angles touch. How many triangles are needed to form the second star?



- (A) 10                      (B) 12                      (C) 18                      (D) 20                      (E) 24

16. Five squares are positioned as shown. The small square indicated has area 1. What is the value of  $h$ ?

- (A) 3 m                      (B) 3.5 m                      (C) 4 m                      (D) 4.2 m                      (E) 4.5 m

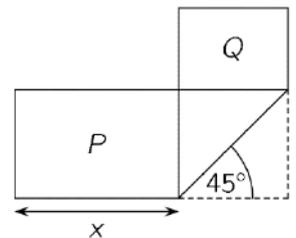


17. There are 20 questions in a quiz. Each correct answer scores 7 points, each wrong answer scores  $-4$  points, and each question left blank scores 0 points. Eric took the quiz and scored 100 points. How many questions did he leave blank?

- (A) 0                      (B) 1                      (C) 2                      (D) 3                      (E) 4

18. A rectangular strip of paper of dimensions  $4\text{cm} \times 13\text{cm}$  is folded as shown in the diagram. 2 rectangles are formed with areas  $P$  and  $Q$  where  $P=2Q$ . What is the value of  $x$ ?

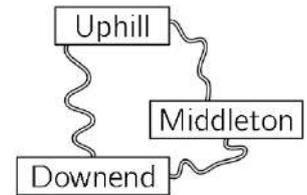
- (A) 5 cm                      (B) 5,5 cm                      (C) 6 cm                      (D) 6,5 cm                      (E)  $4\sqrt{2}$  cm



19. A box of fruit contains twice as many apples as pears. Christy and Lily divided them up so that Christy had twice as many pieces of fruit as Lily. Which one of the following statements is always true?

- (A) Christy took at least one pear.                      (B) Christy took twice as many apples as pears.  
 (C) Christy took twice as many apples as Lily.                      (D) Christy took as many apples as Lily got pears.  
 (E) Christy took as many pears as Lily got apples.

20. Three villages are connected by paths as shown. From Downend to Uphill, the detour via Middleton is 1km longer than the direct path. From Downend to Middleton, the detour via Uphill is 5km longer than the direct path. From Uphill to Middleton, the detour via Downend is 7km longer than the direct path. How long is the shortest of the three direct paths between the villages?



- (A) 1 km                      (B) 2 km                      (C) 3 km                      (D) 4 km                      (E) 5 km

**5 points problems**

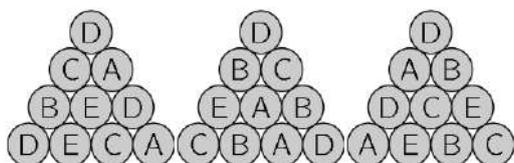
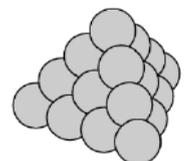
21. 5 friends talk about their collected astro-pins planets: , moons:  or stars: . Xenia says: "I have an even number of pins", Zach: "Half of my pins are planets", Sue: "I don't have any moons", Paul: "I have more moons than stars" and Yvonne: "I have more stars than planets". Below are the collections of the 5 friends. Which set of pins belongs to Yvonne?

- (A)                       (B)                       (C)   
 (D)                       (E) 

22. In a particular fraction the numerator and denominator are both positive. The numerator of this fraction is increased by 40%. By what percentage should its denominator be decreased so that the new fraction is double the original fraction?

- (A) 10%                      (B) 20%                      (C) 30%                      (D) 40%                      (E) 50%

23. A triangular pyramid is built with 20 cannon balls, as shown. Each cannon ball is labelled with one of A, B, C, D or E. There are 4 cannon balls with each type of label. The picture shows the labels on the cannon balls on 3 of the faces of the pyramid. What is the label on the hidden cannon ball in the middle of the fourth face?



- (A) A                      (B) B                      (C) C                      (D) D                      (E) E

24. The 6-digit number 2ABCDE is multiplied by 3 and the result is the 6-digit number ABCDE2. What is the sum of the digits of this number?

- (A) 24                      (B) 27                      (C) 30                      (D) 33                      (E) 36

25. A box contains only green, red, blue and yellow counters. There is always at least one green counter amongst any 27 counters chosen from the box; always at least one red counter amongst any 25 counters chosen; always at least one blue amongst any 22 counters chosen and always at least one yellow amongst any 17 counters chosen. What is the largest number of counters that could be in the box?

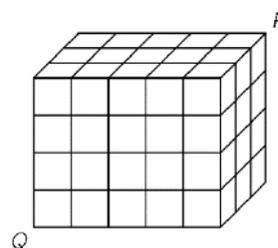
- (A) 27                      (B) 29                      (C) 51                      (D) 87                      (E) 91

26. 2021 coloured kangaroos are arranged in a row and are numbered from 1 to 2021. Each kangaroo is coloured either red, grey or blue. Amongst any three consecutive kangaroos, there are always kangaroos of all three colours. Bruce guesses the colours of five kangaroos. These are his guesses: Kangaroo 2 is grey; Kangaroo 20 is blue; Kangaroo 202 is red; Kangaroo 1002 is blue; Kangaroo 2021 is grey. Only one of his guesses is wrong. What is the number of the kangaroo whose colour he guessed incorrectly?

- (A) 2                      (B) 20                      (C) 202                      (D) 1002                      (E) 2021

27. A  $3 \times 4 \times 5$  cuboid consists of 60 identical small cubes. A termite eats its way along the diagonal from  $P$  to  $Q$ . This diagonal does not intersect the edges of any small cube inside the cuboid. How many of the small cubes does it pass through on its journey?

- (A) 8                      (B) 9                      (C) 10                      (D) 11                      (E) 12



28. In a town there are 21 knights who always tell the truth and 2000 knaves who always lie. A wizard divided 2020 of these 2021 people into 1010 pairs. Every person in a pair described the other person as either a knight or a knave. As a result, 2000 people were called knights and 20 people were called knaves. How many pairs of two knaves were there?

- (A) 980                      (B) 985                      (C) 990                      (D) 995                      (E) 1000

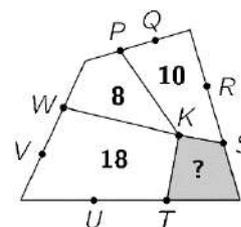
29. In a tournament each of the 6 teams plays one match against every other team. In each round of matches, 3 take place simultaneously. A TV station has already decided which match it will broadcast for each round, as shown in the diagram. In which round will team D play against team F?

1	2	3	4	5
A-B	C-D	A-E	E-F	A-C

- (A) 1                      (B) 2                      (C) 3                      (D) 4                      (E) 5

30. The diagram shows a quadrilateral divided into 4 smaller quadrilaterals with a common vertex  $K$ . The other labelled points divide the sides of the large quadrilateral into three equal parts. The numbers indicate the areas of the corresponding small quadrilaterals. What is the area of the shaded quadrilateral?

- (A) 4                      (B) 5                      (C) 6                      (D) 6.5                      (E) 7



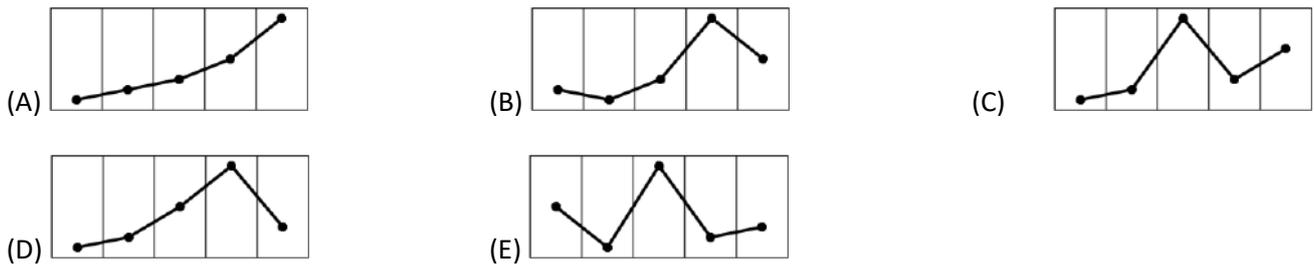
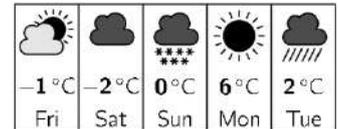
## KSF 2021 – Junior (J)

### 3 points problems

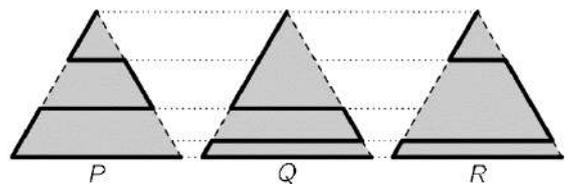
1. Each year, the third Thursday in March is named Kangaroo Day. The dates of Kangaroo Day for the next few years are shown below, with one error. Which date is wrong?

- (A) 17/3/2022      (B) 16/3/2023      (C) 14/3/2024      (D) 20/3/2025      (E) 19/3/2026

2. Jenny looks at her weather app that shows the predicted weather and maximum temperatures for the next five days. Which of the following represents the corresponding graph of maximum temperatures?

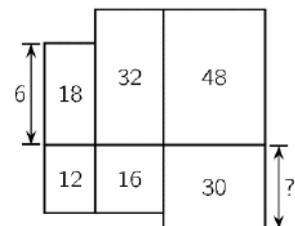


3. A park is shaped like an equilateral triangle. A cat wants to walk along one of the three indicated paths (thicker lines) from the upper corner to the lower right corner. The lengths of the paths are P, Q and R, as shown. Which of the following statements about the lengths of the paths is true?



- (A)  $P < Q < R$       (B)  $P < R < Q$       (C)  $P < Q = R$       (D)  $P = R < Q$       (E)  $P = Q = R$

4. Six rectangles are arranged as shown. The top left-hand rectangle has height 6 cm. The numbers within the rectangles indicate their areas in  $\text{cm}^2$ . What is the height of the bottom right-hand rectangle?



- (A) 4 cm      (B) 5 cm      (C) 6 cm      (D) 7.5 cm      (E) 10 cm

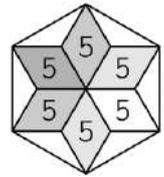
5. The halftime score of a handball match was **9:14**, thus the visiting team was leading by five goals. As a consequence of coach instructions received at halftime, the home team dominated in the second half and scored twice as many goals as their opponents. The home team won the match by one goal. What was the final score of the match?

- (A) **20:19**      (B) **21:20**      (C) **22:21**      (D) **23:22**      (E) **24:23**

6. In a jazz band, Giuseppe plays the saxophone, Sergio plays the trumpet and Eliana sings. They are all the same age. There are 3 more members of the jazz band, who are 19, 20 and 21 years old, respectively. The average age of the jazz band is 21. How old is Eliana?

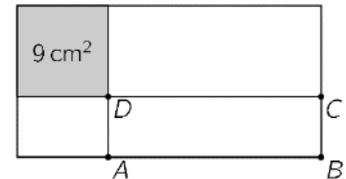
- (A) 20      (B) 21      (C) 22      (D) 23      (E) 24

7. Six congruent rhombuses, each of area  $5 \text{ cm}^2$ , form a star. The tips of the star are joined to draw a regular hexagon, as shown. What is the area of the hexagon?



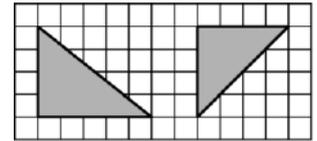
- (A)  $36 \text{ cm}^2$       (B)  $40 \text{ cm}^2$       (C)  $45 \text{ cm}^2$       (D)  $48 \text{ cm}^2$       (E)  $60 \text{ cm}^2$

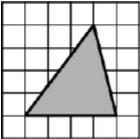
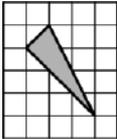
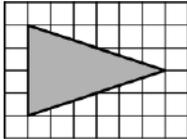
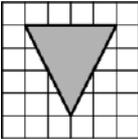
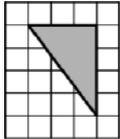
8. A rectangle with perimeter 30 cm is divided into four parts by a vertical line and a horizontal line. One of the parts is a square of area  $9 \text{ cm}^2$ , as shown in the figure. What is the perimeter of rectangle  $ABCD$ ?



- (A) 14 cm      (B) 16 cm      (C) 18 cm      (D) 21 cm      (E) 24 cm

9. Ally drew 3 triangles on a grid. Exactly 2 of them have the same area, exactly 2 of them are isosceles, and exactly 2 are right-angled triangles. 2 of the triangles are shown. Which could be the third one?



- (A)       (B)       (C)       (D)       (E) 

10. The little kangaroo has chosen a special number. She gets the same result when she subtracts  $\frac{1}{10}$  from her number as she does when she multiplies it by  $\frac{1}{10}$ . What is her number?

- (A)  $\frac{1}{100}$       (B)  $\frac{1}{11}$       (C)  $\frac{1}{10}$       (D)  $\frac{11}{100}$       (E)  $\frac{1}{9}$

#### 4 points problems

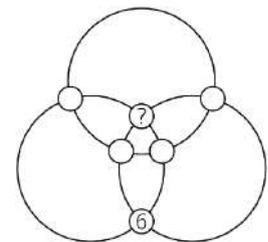
11. Tom had ten sparklers of the same size. He lit one first. When only a tenth of it remained, he lit the second one. When only a tenth of that remained, he lit the third one, and so on. Sparklers burn at the same speed along their entire length. One sparkler will burn in 2 minutes. How long did it take for all 10 sparklers to burn down?

- (A) 18 min 20 sec      (B) 18 min 12 sec      (C) 18 min      (D) 17 min      (E) 16 min 40 sec

12. Ahmad walks up 8 steps going up either 1 or 2 steps at a time. There is a hole on the 6th step, so he cannot use this step. In how many different ways can Ahmad reach the top step?

- (A) 6      (B) 7      (C) 8      (D) 9      (E) 10

13. The numbers from 1 to 6 are placed in the circles at the intersections of 3 rings. The position of number 6 is shown. The sums of the numbers on each ring are the same. What number is placed in the circle with the question mark?



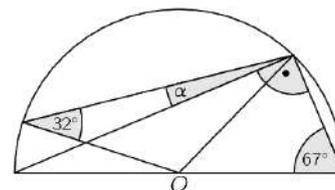
- (A) 1      (B) 2      (C) 3      (D) 4      (E) 5

14. 2021 has a remainder of 5 when divided by 6, by 7, by 8, and by 9. How many positive integers, less than 2021, have this property?

- (A) 4      (B) 3      (C) 2      (D) 1      (E) none

15. The figure shows a semicircle with center  $O$ . Two of the angles are given. What is the size, in degrees, of the angle  $\alpha$  ?

- (A)  $9^\circ$       (B)  $11^\circ$       (C)  $16^\circ$       (D)  $17,5^\circ$       (E)  $18^\circ$



16. In a team competition, there are 5 teams waiting to start. Each team consists of either only boys or only girls. The number of team members are 9, 15, 17, 19 and 21. After all members of the first team have started, the number of girls not started yet is 3 times the number of boys not started yet. How many members are on the team that has already started?

- (A) 9      (B) 15      (C) 17      (D) 19      (E) 21

17. Five cars participated in a race, starting in the order shown.



Whenever a car overtook another car, a point was awarded. The cars reached the finish line in the following order:



What is the smallest number of points in total that could have been awarded?

- (A) 10      (B) 9      (C) 8      (D) 7      (E) 6

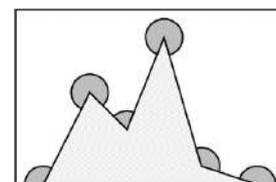
18. A  $3 \times 3$  square initially has the number 0 in each of its cells. In one step all four numbers in one  $2 \times 2$  sub-square such as the shaded one, for example, are then increased by 1. This operation is repeated several times to obtain the arrangement on the right. Unfortunately, some numbers in this arrangement are hidden. What number is in the square with the question mark?

0	0	0		18	
0	0	0		47	
0	0	0	13		?

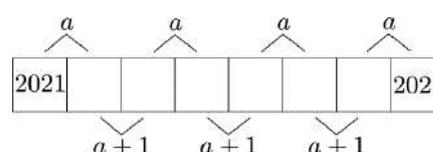
- (A) 14      (B) 15      (C) 16      (D) 17      (E) 19

19. What is the sum of the six marked angles in the picture?

- (A)  $360^\circ$       (B)  $900^\circ$       (C)  $1080^\circ$       (D)  $1120^\circ$       (E)  $1440^\circ$



20. There are eight boxes in the strip shown. Numbers in adjacent boxes have sum  $a$  or  $a+1$  as shown. The numbers in the first box and the eighth box are both 2021. What is the value of  $a$ ?

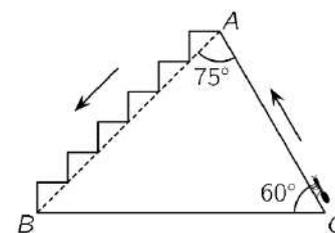


- (A) 4041      (B) 4042      (C) 4043      (D) 4044      (E) 4045

### 5 points problems

21. An ant climbs from  $C$  to  $A$  on path  $CA$  and descends from  $A$  to  $B$  on the stairs, as shown in the diagram. What is the ratio of the lengths of the ascending and descending paths?

- (A) 1      (B)  $\frac{1}{2}$       (C)  $\frac{1}{3}$       (D)  $\frac{\sqrt{2}}{2}$       (E)  $\frac{\sqrt{3}}{3}$



22. The numbers  $a$ ,  $b$  and  $c$  satisfy  $a + b + c = 0$  and  $abc = 78$ . What is the value of  $(a+b)(b+c)(c+a)$ ?

- (A) -156                      (B) -78                      (C) -39                      (D) 78                      (E) 156

23. Let  $N$  be the smallest positive integer whose sum of its digits is 2021. What is the sum of the digits of  $N + 2021$ ?

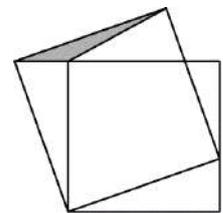
- (A) 10                      (B) 12                      (C) 19                      (D) 28                      (E) 2021

24. Three boys played a "Word" game in which they each wrote down 10 words. Each boy scored three points if neither of the other boys had the same word. Each boy scored one point if only one of the other boys had the same word. No points were awarded for words which all three boys had. When they added up their scores, they found that they each had different score. Sam had 19 points, which was the smallest score, and James had the highest score. How many points did James score?

- (A) 20                      (B) 21                      (C) 23                      (D) 24                      (E) 25

25. The smaller square in the picture has area 16 and the grey triangle has area 1. What is the area of the larger square, in  $\text{cm}^2$ ?

- (A) 17                      (B) 18                      (C) 19                      (D) 20                      (E) 21



26. Each of the numbers  $a$  and  $b$  is a square of an integer. The difference  $a - b$  is a prime number. Which of the following could be number  $b$ ?

- (A) 100                      (B) 144                      (C) 256                      (D) 900                      (E) 10 000

27. In the  $4 \times 4$  table some cells must be painted black. The numbers next to and below the table show how many cells in that row or column must be black. In how many ways can this table be painted?

- (A) 1                      (B) 2                      (C) 3                      (D) 5                      (E) more than 5

				2
				0
				2
				1
2	0	2	1	

28. How many five-digit positive numbers have the product of their digits equal to 1000?

- (A) 10                      (B) 20                      (C) 30                      (D) 40                      (E) 60

29. Christina has eight coins whose weights in grams are different positive integers. When Christina puts any two coins on one side of a balance scales and any two on the other side of the balance scales, the side containing the heaviest of the four coins is always the heavier side. What is the smallest possible weight of the heaviest coin?

- (A) 8 g                      (B) 12 g                      (C) 34 g                      (D) 128 g                      (E) 256 g

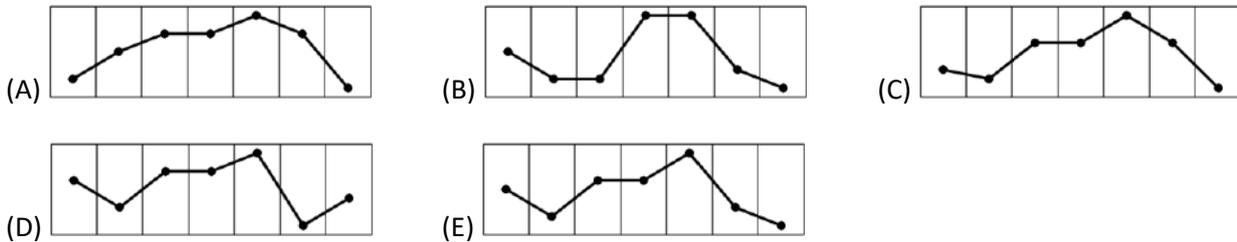
30. 2021 balls are arranged in a row and are numbered from 1 to 2021. Each ball is coloured in one of four colours: green, red, yellow or blue. Among any five consecutive balls there is exactly one red, one yellow and one blue ball. After any red ball the next ball is yellow. The balls numbered 2, 20 and 202 are green. What colour is the ball numbered 2021?

- (A) green                      (B) red                      (C) yellow                      (D) blue                      (E) not determined

3 points problems

1. Paula's weather app shows a diagram of the predicted weather and maximum temperatures for the next seven days, as shown. Which of the following represents the corresponding graph of maximum temperatures?

-1 °C	-4 °C	0 °C	0 °C	3 °C	-3 °C	-5 °C
Fri	Sat	Sun	Mon	Tue	Wed	Thu



2. How many integers are in the interval  $(20 - \sqrt{21}; 20 + \sqrt{21})$ ?

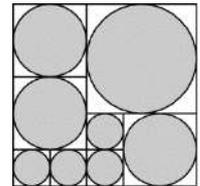
- (A) 9                      (B) 10                      (C) 11                      (D) 12                      (E) 13

3. A cube with edge 1 is cut into two identical cuboids. What is the surface area of one of these cuboids?

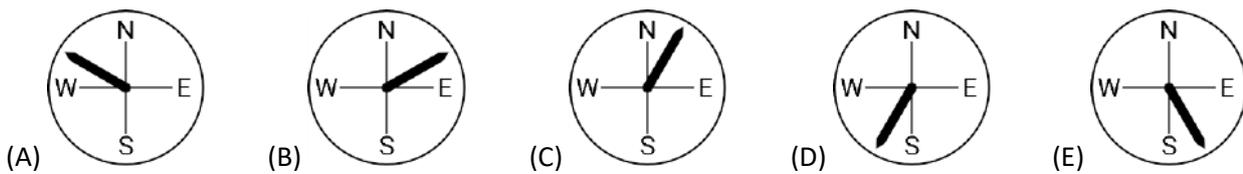
- (A)  $\frac{3}{2}$                       (B) 2                      (C) 3                      (D) 4                      (E) 5

4. A large square is divided into smaller squares, as shown. A shaded circle is inscribed inside each of the smaller squares. What proportion of the area of the large square is shaded?

- (A)  $\frac{8\pi}{9}$                       (B)  $\frac{13\pi}{16}$                       (C)  $\frac{3}{\pi}$                       (D)  $\frac{3}{4}$                       (E)  $\frac{\pi}{4}$



5. After the storm last night, the flagpole on our school building is leaning over. Looking from northwest, its tip is to the right of its bottom point. Looking from the east, its tip is also to the right of its bottom point. In which direction could the flagpole be leaning over?



6. A rectangular sheet of paper has length  $x$  and width  $y$  where  $x > y$ . The rectangle may be folded to form the curved surface of a circular cylinder in two different ways. What is the ratio of the volume of the longer cylinder to the volume of the shorter cylinder?

- (A)  $y^2 : x^2$                       (B)  $y : x$                       (C) 1 : 1                      (D)  $x : y$                       (E)  $x^2 : y^2$

7. Let  $x = \frac{\pi}{4}$ . Which of the following numbers is the largest?

- (A)  $x^4$                       (B)  $x^2$                       (C)  $x$                       (D)  $\sqrt{x}$                       (E)  $\sqrt[4]{x}$

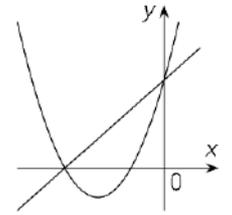
8. How many 3-digit-numbers formed using only the digits 1, 3 and 5 are divisible by 5? You may use digits more than once.

- (A) 3                      (B) 6                      (C) 9                      (D) 18                      (E) 27

9. What is the area of the triangle whose vertices are  $(p, q), (3p, q)$  e  $(2p, 3q)$ , where  $p, q > 0$ ?

- (A)  $\frac{pq}{2}$                       (B)  $pq$                       (C)  $2pq$                       (D)  $3pq$                       (E)  $4pq$

10. The parabola in the figure has an equation of the form  $y = ax^2 + bx + c$  for some distinct real numbers  $a, b$  and  $c$ . Which of the following equations could be an equation of the line in the figure?



- (A)  $y = bx + c$                       (B)  $y = cx + b$                       (C)  $y = ax + b$                       (D)  $y = ax + c$                       (E)  $y = cx + a$

**4 points problems**

11. What fraction of all the divisors of  $7!$  is odd?

- (A)  $\frac{1}{2}$                       (B)  $\frac{1}{3}$                       (C)  $\frac{1}{4}$                       (D)  $\frac{1}{5}$                       (E)  $\frac{1}{6}$

12. If  $A = ]0, 1[ \cup ]2, 3[$  and  $B = ]1, 2[ \cup ]3, 4[$ , what is the set of all numbers of the form  $a + b$  with  $a \in A$  and  $b \in B$ ?

- (A)  $]1, 7[$                       (B)  $]1, 5[ \cup ]5, 7[$                       (C)  $]1, 3[ \cup ]3, 7[$                       (D)  $]1, 3[ \cup ]3, 5[ \cup ]5, 7[$                       (E)  $\emptyset$

13. How many three-digit natural numbers have the property that when their digits are written in reverse order, the result is a three-digit number which is 99 more than the original number?

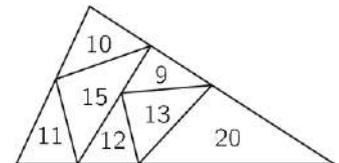
- (A) 8                      (B) 64                      (C) 72                      (D) 80                      (E) 81

14. The first 1000 positive integers are written in a row in some order and all sums of any three adjacent numbers are calculated. What is the greatest number of odd sums that can be obtained?

- (A) 997                      (B) 996                      (C) 995                      (D) 994                      (E) 993

15. A large triangle is divided into smaller triangles as shown. The number inside each small triangle indicates its perimeter. What is the perimeter of the large triangle?

- (A) 30                      (B) 31                      (C) 34                      (D) 39                      (E) 41



16. An infinite list of numbers has the property that, for each positive integer  $n$ , the average of the first  $n$  terms is  $n$ . How many terms are there less than 2021?

- (A) 44                      (B) 504                      (C) 1010                      (D) 1427                      (E) 2018

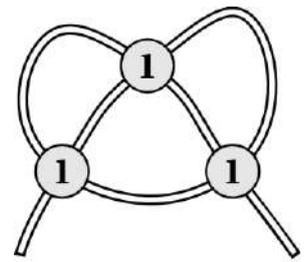
17. In the  $5 \times 5$  square shown the sum of the numbers in each row and in each column is the same. There is a number in every cell, but some of the numbers are not shown. What is the number in the cell marked with a question mark?

	16		22	
20		21		2
	25		1	
24		5		6
	4		?	

- (A) 8                      (B) 10                      (C) 12                      (D) 18                      (E) 23

18. A piece of string is lying on the table. It is partially covered by three coins as seen in the figure. Under each coin the string is equally likely to pass over itself

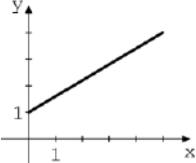
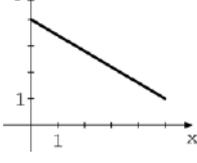
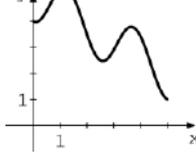
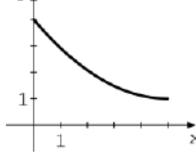
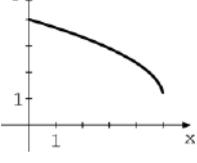
like this:  or like this: . What is the probability that the string is knotted after its ends are pulled?



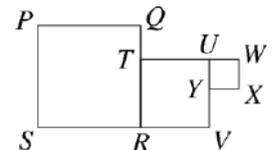
- (A)  $\frac{1}{2}$                       (B)  $\frac{1}{4}$                       (C)  $\frac{1}{8}$                       (D)  $\frac{3}{4}$                       (E)  $\frac{3}{8}$

19. A naughty pup grabs the end of a roll of toilet paper and walks away at a constant speed. Which of the functions below best describes the thickness  $y$  of the roll as a function of the unrolled part  $x$ ?



- (A)                       (B)                       (C)                       (D)                       (E) 

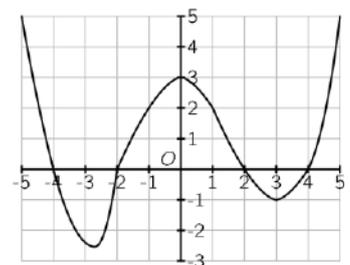
20. The diagram shows three squares,  $PQRS$ ,  $TUVR$  and  $UWXY$ . They are placed together, edge to edge. Points  $P$ ,  $T$  and  $X$  lie on the same straight line. The area of  $PQRS$  is 36 and the area of  $TUVR$  is 16. What is the area of triangle  $PXV$ ?



- (A)  $\frac{44}{3}$                       (B)  $\frac{46}{3}$                       (C) 16                      (D)  $\frac{53}{3}$                       (E) 18

### 5 points problems

21. The figure shows the graph of a function  $f: [-5, 5] \rightarrow \mathbb{R}$ . How many distinct solutions does the equation  $f(f(x)) = 0$  have?



- (A) 2                      (B) 4                      (C) 6                      (D) 7                      (E) 8

22. The numbers 1, 2, 7, 9, 10, 15 and 19 are written down on a blackboard. Two players alternately delete one number each until only one number remains on the blackboard. The sum of the numbers deleted by one of the players is twice the sum of the numbers deleted by the other player. What is the number that remains?

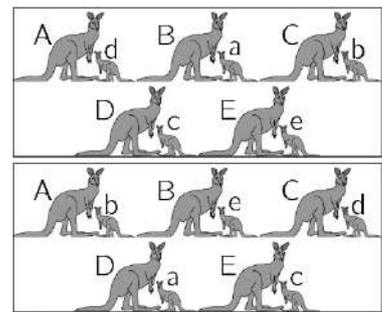
- (A) 7                      (B) 9                      (C) 10                      (D) 15                      (E) 19

23. The function  $f$  is such that  $f(x+y) = f(x) \cdot f(y)$  and  $f(1) = 2$ .

What is the value of  $\frac{f(2)}{f(1)} + \frac{f(3)}{f(2)} + \dots + \frac{f(2021)}{f(2020)}$ ?

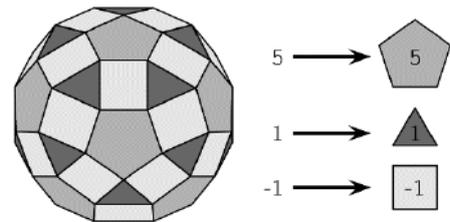
- (A) 0                      (B)  $\frac{1}{2}$                       (C) 2                      (D) 2020                      (E) none of the previous

24. Five kangaroos named **A, B, C, D** and **E** have one child each, named **a, b, c, d** and **e**, not necessarily in that order. In the first group photo shown exactly 2 of the children are standing next to their mothers. In the second group photo exactly 3 of the children are standing next to their mothers. Whose child is **a**?



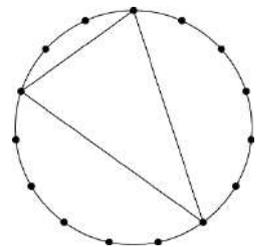
- (A) A      (B) B      (C) C      (D) D      (E) E

25. The solid shown in the diagram has 12 regular pentagonal faces, the other faces being either equilateral triangles or squares. Each pentagonal face is surrounded by 5 square faces and each triangular face is surrounded by 3 square faces. John writes 1 on each triangular face, 5 on each pentagonal face and  $-1$  on each square. What is the total of the numbers written on the solid?



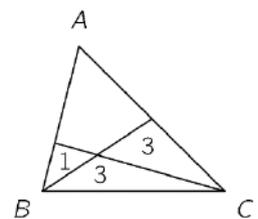
- A) 20      (B) 50      (C) 60      (D) 80      (E) 120

26. On a circle 15 points are equally spaced. We can form triangles by joining any 3 of these. Congruent triangles, by rotation or reflection, are counted as only one triangle. How many different triangles can be drawn?



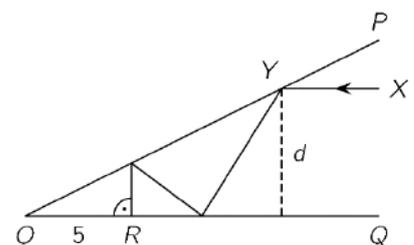
- (A) 19      (B) 23      (C) 46      (D) 91      (E) 455

27. A triangle  $ABC$  is divided into four parts by two straight lines, as shown. The areas of the smaller triangles are 1, 3 and 3. What is the area of the original triangle?



- (A) 12      (B) 12.5      (C) 13      (D) 13.5      (E) 14

28. Two plane mirrors  $OP$  and  $OQ$  are inclined at an acute angle (diagram is not to scale). A ray of light  $XY$  parallel to  $OQ$  strikes mirror  $OP$  at  $Y$ . The ray is reflected and hits mirror  $OQ$ , is reflected again and hits mirror  $OP$  and is reflected for a third time and strikes mirror  $OQ$  at right angles at  $R$  as shown. If  $OR = 5$  cm, what is the distance  $d$  of the ray  $XY$  from the mirror  $OQ$ ?



- (A) 4 cm      (B) 4.5 cm      (C) 5 cm      (D) 5.5 cm      (E) 6 cm

29. Let  $M(k)$  be the maximum value of  $|4x^2 - 4x + k|$  for  $x$  in the interval  $[-1, 1]$ , where  $k$  can be any real number. What is the minimum possible value of  $M(k)$ ?

- (A) 4      (B)  $\frac{9}{2}$       (C) 5      (D)  $\frac{11}{2}$       (E) 8

30. A certain game is won when one player gets 3 points ahead. Two players A and B are playing the game and at a particular point, A is 1 point ahead. Each player has an equal probability of winning each point. What is the probability that A wins the game?

- (A)  $\frac{1}{2}$       (B)  $\frac{2}{3}$       (C)  $\frac{3}{4}$       (D)  $\frac{4}{5}$       (E)  $\frac{5}{6}$

# 2021

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
<b>Felix</b>	E	B	A	D	A	D	E	B	D	D	C	D	E	A	B	D	D	A	D	C	B	C	E	C	-	-	-	-	-	-
<b>Écolier</b>	C	C	B	B	E	C	D	C	A	E	E	C	C	E	D	B	D	E	D	A	D	E	D	A	-	-	-	-	-	-
<b>Benjamin</b>	D	A	E	D	B	C	B	E	E	D	B	B	D	B	C	A	E	C	D	B	A	B	A	C	E	C	D	B	B	E
<b>Kadett</b>	A	E	D	B	A	A	B	E	B	E	D	E	C	B	D	C	B	C	E	C	E	C	D	B	B	B	C	D	A	C
<b>Junior</b>	C	B	B	B	B	C	C	C	D	E	B	C	A	A	A	E	E	C	C	E	E	B	A	E	B	D	D	D	C	D
<b>Student</b>	E	A	D	E	A	B	E	C	C	D	D	D	D	A	C	C	B	B	E	C	E	B	E	D	B	A	A	C	B	B

# KÄNGURU DER MATHEMATIK 2022

17. 3. 2022

Level: Felix, Grades 1 – 2

Name:	
School:	
Class:	

Time: 60 min.

15 starting points

each correct answer to questions 1. – 5.:

3 points

each correct answer to questions 6. – 10.:

4 points

each correct answer to questions 11. – 15.:

5 points

each question left unanswered:

0 points

each incorrect answer: minus  $\frac{1}{4}$  of the points for the question



Please write the letter (A, B, C, D, E) of the correct answer in the square under the question number (1 to 15). Write clearly and carefully!

1	2	3	4	5

6	7	8	9	10

11	12	13	14	15

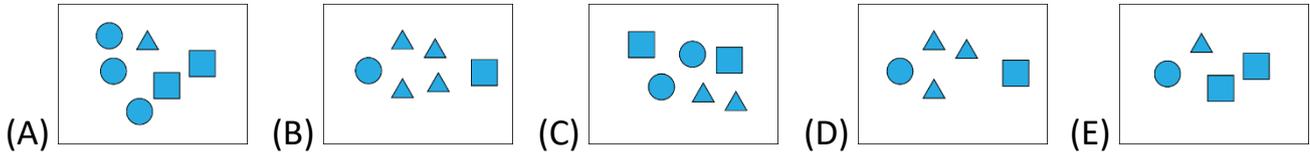


Information über den Känguruwettbewerb:

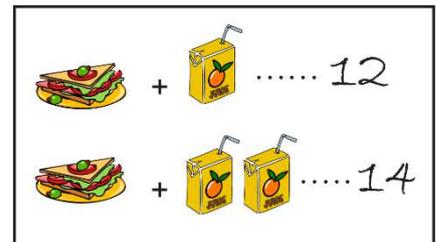
[www.kaenguru.at](http://www.kaenguru.at)

- 3 Point Examples -

1. In which box are the most triangles?



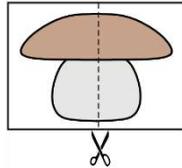
2. A sandwich and a juice cost 12 Euros together.  
A sandwich and two juices cost 14 Euros together.



How many Euros does one juice cost?

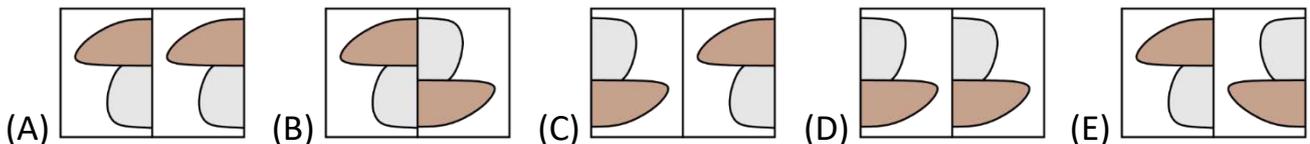
- (A) 1                      (B) 2                      (C) 3                      (D) 4                      (E) 5

3. Anna cuts the picture of a mushroom in two halves.



She then arranges the two pieces together to form a new picture.

What could this new picture look like?



4. In the four squares of a row there always have to be exactly two coins.

In the four squares below each other there also always have to be exactly two coins.

○	○		B
A	○	C	○
○		D	
E		○	○

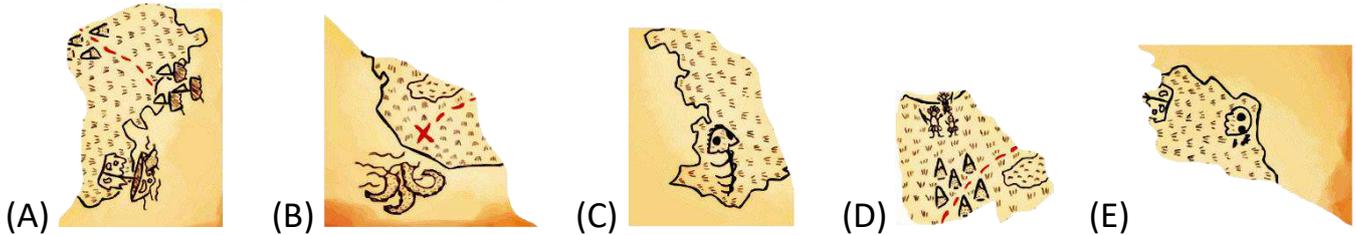
On which square does one more coin have to be placed?

- (A) square A              (B) square B              (C) square C              (D) square D              (E) square E

5. A monkey has torn off a piece of Captain Jack's map.



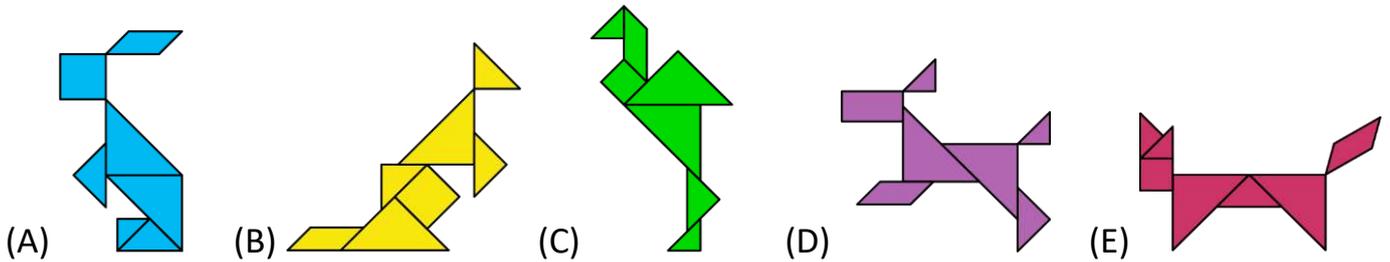
What does the piece the monkey has torn off look like?



- 4 Point Examples -

6. These five animals are made up from different shapes. There is one shape which is only used on one animal.

On which animal is this shape used?



7. There is an animal asleep in each of the five baskets.

The koala and the fox sleep in baskets with the same pattern and the same shape. The kangaroo and the rabbit sleep in baskets with the same pattern.

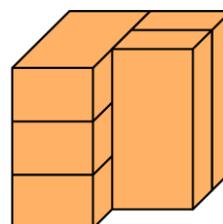


In which basket does the mouse sleep?

(A) Basket 1      (B) Basket 2      (C) Basket 3      (D) Basket 4      (E) Basket 5

8. The picture shows one object made up of 5 identical building blocks.

How many building blocks touch exactly 3 others?

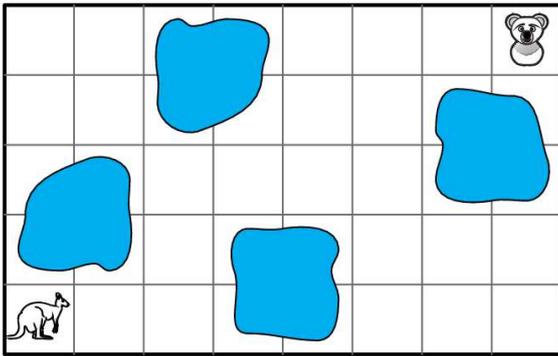


(A) 1      (B) 2      (C) 3      (D) 4      (E) 5

9. The kangaroo wants to visit the koala.

On its way it is not allowed to jump through a square with water.

Each arrow shows one jump on to a neighbouring field.



Which path is the kangaroo allowed to take?

- (A) → → ↑ ↑ ↑ ↑ → → → → →
- (B) → → ↑ ↑ → → → → → ↑ ↑
- (C) → → ↑ ↑ → → ↑ ↑ → → →
- (D) → → ↑ ↑ → → ↑ ↑ ← ← ←
- (E) → → ↑ ↑ ↑ → → ↑ → → →

10. Carl writes down a five-digit number.

He then places a shape on each of the five digits (see picture).

He places different shapes on different digits.

He places the same shape on the same digits.

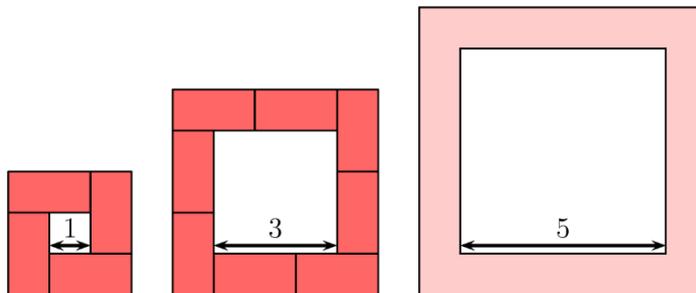


Which number did Carl hide?

- (A) 34426
- (B) 34526
- (C) 34423
- (D) 34424
- (E) 32446

- 5 Point Examples -

11. Katrin forms a path around each square. For that she uses stones like this .



How many such stones does she need for a path around the square with side length 5?

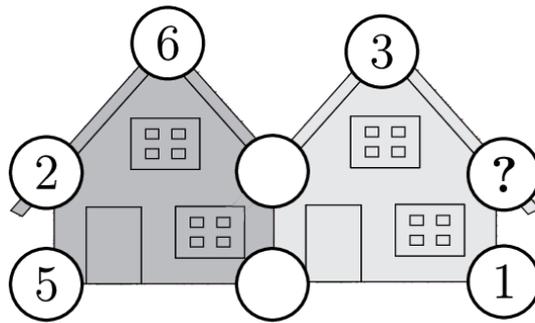
- (A) 10
- (B) 11
- (C) 12
- (D) 14
- (E) 16

12. Below you see five pieces of lawn.

Which one has the smallest area of grass?

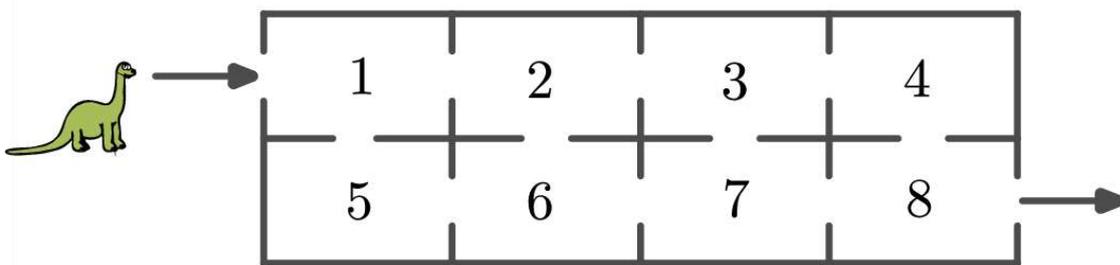


13. The numbers in the five circles around each house add up to 20. Some numbers are missing.



Which number does the question mark stand for?

- (A) 3                      (B) 4                      (C) 7                      (D) 9                      (E) 14
14. Dino walks from the entrance to the exit.  
He is only allowed to go through each room once.  
The rooms have numbers (see diagram).  
Dino adds up all the numbers of the rooms he walks through.



What is the biggest result he can get this way?

- (A) 27                      (B) 29                      (C) 32                      (D) 34                      (E) 36
15. The three zebras Runa, Zara and Biba take part in a competition.  
The winner is the zebra with the most stripes.

Runa has 15 stripes.

Zara has 3 stripes more than Runa.

Runa has 5 stripes less than Biba.

How many stripes does the winner have?

- (A) 16                      (B) 18                      (C) 20                      (D) 21                      (E) 22

# KÄNGURU DER MATHEMATIK 2022

## 17. 3. 2022

**Level: Écolier, Grades 3 - 4**

Name:	
School:	
Class:	

Time: 60 min.

24 starting points

each correct answer to questions 1. – 8.: 3 points  
each correct answer to questions 9. – 16.: 4 points  
each correct answer to questions 17. – 24.: 5 points  
each questions left unanswered: 0 points  
each incorrect answer: minus  $\frac{1}{4}$  of the points for the question



**Please write the letter (A, B, C, D, E) of the correct answer in the square under the question number (1 bis 24). Write clearly and carefully!**

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>

<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>13</b>	<b>14</b>	<b>15</b>	<b>16</b>

<b>17</b>	<b>18</b>	<b>19</b>	<b>20</b>	<b>21</b>	<b>22</b>	<b>23</b>	<b>24</b>



Information über den Känguruwettbewerb: [www.kaenguru.at](http://www.kaenguru.at)  
Wenn du mehr in dieser Richtung machen möchtest,  
gibt es die Österreichische Mathematikolympiade;  
Infos unter: [www.oemo.at](http://www.oemo.at)

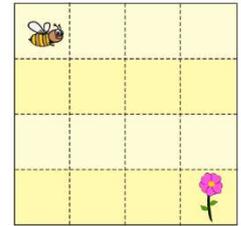
- 3 Point Examples -

1. The bee wants to get to the flower.

Each arrow indicates a move to one neighbouring square.

Which path can the bee fly to get to the flower?

- (A)  $\downarrow \rightarrow \rightarrow \downarrow \downarrow \downarrow$       (B)  $\downarrow \downarrow \rightarrow \downarrow \downarrow \rightarrow$       (C)  $\rightarrow \downarrow \rightarrow \downarrow \rightarrow \rightarrow$   
(D)  $\rightarrow \rightarrow \downarrow \downarrow \downarrow \downarrow$       (E)  $\rightarrow \downarrow \rightarrow \downarrow \downarrow \rightarrow$



2. For every birthday Maria gets as many teddies as she is years old on that day.

For her first birthday she got 1 teddy.

For her second birthday she got 2 teddies and so on.

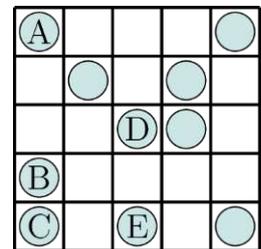
How many teddies in total has Maria got on the day after her sixth birthday?

- (A) 19      (B) 20      (C) 21      (D) 22      (E) 23

3. One of the five coins A, B, C, D or E shall be placed in an empty square so that there are exactly two coins in each row and in each column.

Which coin should be moved?

- (A) A      (B) B      (C) C      (D) D      (E) E



4. Which two numbers can be placed instead of the  $\square$  in the calculation  $2022 + \square = 2020 + \square$  so that it is correct?

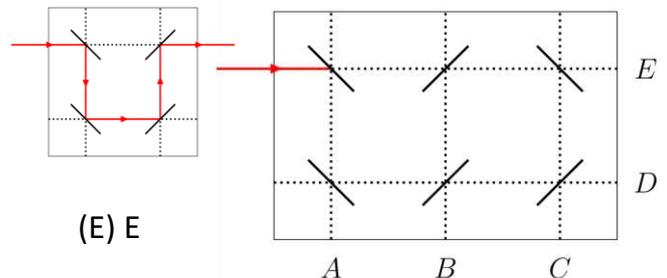
- (A) 3 and 5      (B) 4 and 1      (C) 3 and 4      (D) 7 and 2      (E) 9 and 8

5. If a laser beam hits a mirror it changes its direction (see small diagram).

Each mirror has mirrored sides on both sides.

At which letter does the laser beam end?

- (A) A      (B) B      (C) C      (D) D      (E) E



6. Kengu jumps on the number line to the right (see diagram).

He first makes one big jump and then two little jumps in a row and keeps repeating the same thing over and over again.

He starts at 0 and ends at 16.

How many jumps does Kengu make in total?

- (A) 4      (B) 7      (C) 8      (D) 9      (E) 12



7. In the diagram on the right two neighbouring squares are never allowed to have the same number.

Which puzzle piece has to be placed in the gap so that this rule is followed?

- (A) 

4
1 2 3

      (B) 

1
3 4 2

      (C) 

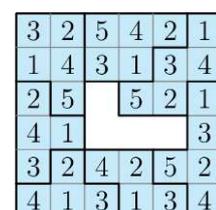
2
4 1 3

      (D) 

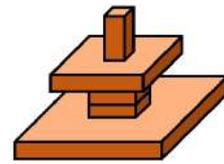
2
3 1 4

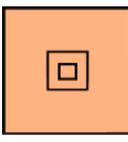
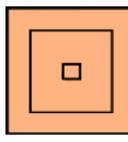
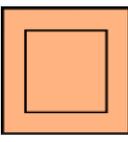
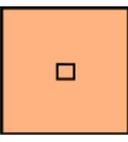
      (E) 

3
2 1 4



8. John uses some building blocks to form a work of art.  
What does John see when he looks at his work of art from above?



- (A)  (B)  (C)  (D)  (E) 

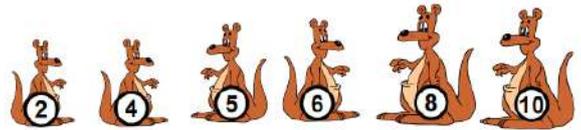
- 4 Point Examples -

9. Five cars are labelled with the numbers 1 to 5. They drive in the direction of the arrow.



First the last car overtakes the two cars in front of it.  
Then the now second to last car overtakes the two in front of it.  
In the end the car that is now in the middle overtakes the two in front of it.  
In which order do the cars now drive?

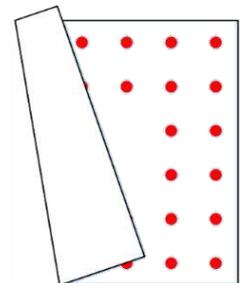
- (A) 1, 2, 3, 4, 5    (B) 2, 1, 3, 5, 4    (C) 2, 1, 5, 3, 4    (D) 3, 1, 4, 2, 5    (E) 4, 1, 2, 5, 3
10. The members of a family of kangaroos are 2, 4, 5, 6, 8 and 10 years old.  
Four of them are 22 years old when added together.  
How old are the other two kangaroos?



- (A) 2 and 8    (B) 4 and 5    (C) 5 and 8    (D) 6 and 8    (E) 6 and 10
11. Mosif has filled a table with numbers (see diagram).  
When he adds the numbers in each row and in each column together, the result should always be the same. He has however, made a mistake.  
In order to get the same result every time he has to change one single number.  
Which number does Mosif have to change?

9	1	5
3	7	6
4	7	4

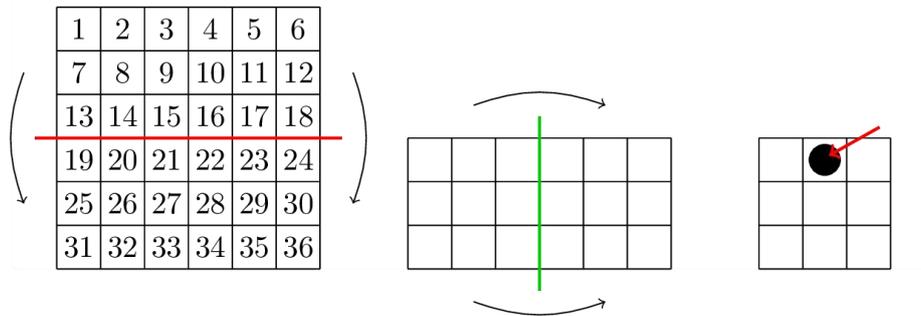
- (A) 1    (B) 3    (C) one of the two 4s    (D) 5    (E) one of the two 7s
12. Aladdin's carpet has the shape of a square.  
Along each edge there are two rows of dots (see diagram).  
The number of points is the same along each edge.  
How many dots in total does the carpet have?



- (A) 32    (B) 36    (C) 40    (D) 44    (E) 48
13. In a classroom the children sit in rows.  
In each row there are the same amount of children.  
In Robert's row there are 2 children to the left of him and 3 children to the right of him.  
In front of Robert there are 2 rows, behind him just one.  
How many children in total are in this class?

- (A) 8    (B) 15    (C) 18    (D) 20    (E) 24

14. Johanna folds a piece of paper with the numbers 1 to 36 in half twice (see diagrams).



Then she stabs a hole through all four layers at the same time (see diagram on the right). Which four numbers does she pierce in doing so?

- (A) 8, 11, 26, 29                      (B) 14, 16, 21, 23                      (C) 14, 17, 20, 23
- (D) 15, 16, 21, 22                      (E) 15, 17, 20, 22

15. Three football teams are taking part in a tournament.

Each team plays each other team once.

For a win the team scores 3 points, the other team 0 points.

For a draw both teams get 1 point each.

Which number of points is impossible, for any team to reach at the end of this tournament?

- (A) 1                      (B) 2                      (C) 4                      (D) 5                      (E) 6

16. Jan sends five postcards to his friends during his holiday.

The card for Michael does **not** have ducks.

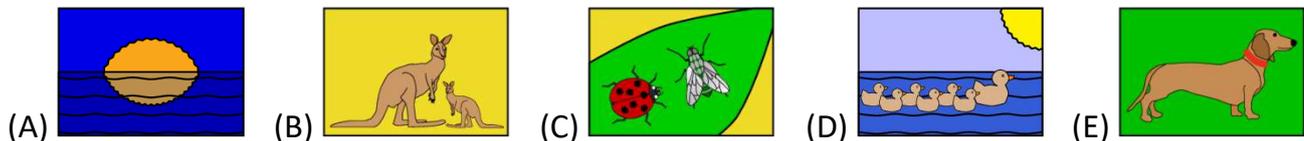
The card for Lexi shows a dog.

The card for Clara shows the sun.

The card for Heidi shows kangaroos.

The card for Paula shows exactly two animals.

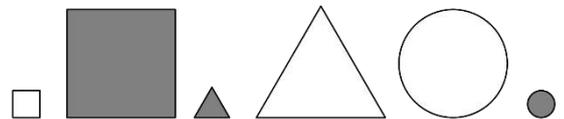
Which card does Jan send to Michael?



- 5 Point Examples -

17. Wanda chooses some of the following shapes.

She says: „I have chosen exactly 2 grey, 2 big and 2 round shapes.“



What is the minimum number of shapes Wanda has chosen?

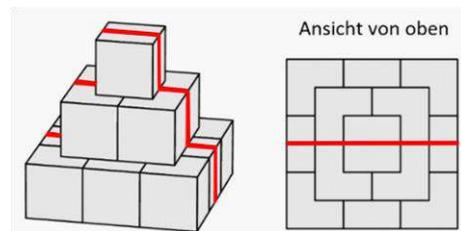
- (A) 2                      (B) 3                      (C) 4                      (D) 5                      (E) 6

18. The little caterpillar rolls up to go to sleep.

What could it look like then?

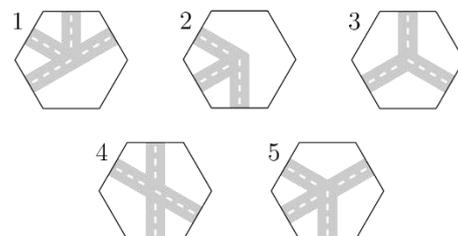
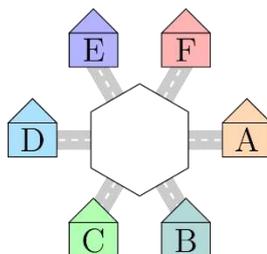


19. A pyramid is built from cubes (see diagram).  
 All cubes have side length 10 cm.  
 An ant crawls along the line drawn across the pyramid (see diagram).  
 How long is the path taken by the ant?



- (A) 30 cm    (B) 60 cm    (C) 70 cm    (D) 80 cm    (E) 90 cm

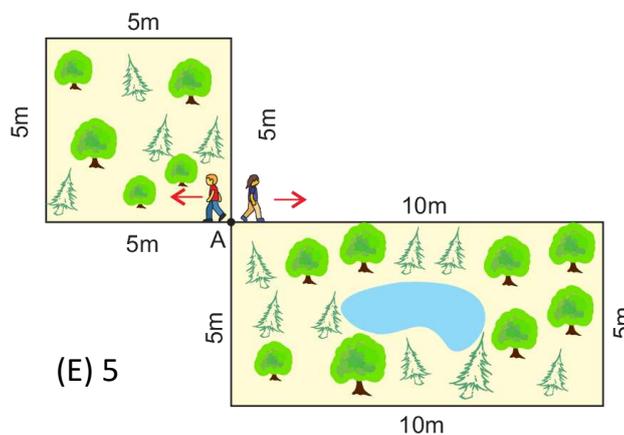
20. A road leads away from each of the six houses (see diagram).  
 A hexagon showing the roads in the middle is however, missing.



- Which hexagons fit in the middle so that one can travel from A to B and to E, but **not** to D?

- (A) 1 and 2    (B) 1 and 4    (C) 1 and 5    (D) 2 and 3    (E) 4 and 5

21. Ahmed and Sara move from point A in the direction shown with the same speed.  
 Ahmed walks around the square garden and Sara walks around the rectangular garden.  
 How many rounds does Ahmed have to walk to meet Sara in point A again for the first time?

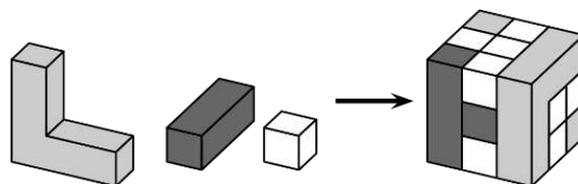


- (A) 1    (B) 2    (C) 3    (D) 4    (E) 5

22. Five girls eat plums.  
 Laura eats 2 plums more than Sophie.  
 Bettina eats 3 plums less than Laura.  
 Clara eats one plum more than Bettina and 3 less than Alice.  
 Which two of the girls eat the same amount of plums?

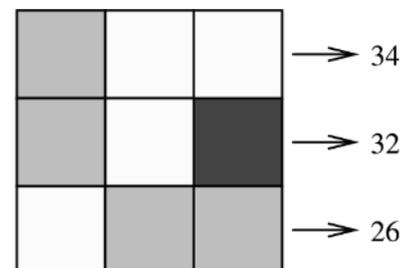
- (A) Alice and Bettina    (B) Alice and Laura    (C) Alice and Sophie  
 (D) Clara and Laura    (E) Clara and Sophie

23. The big cube is made up of three different kinds of building blocks (see diagram).  
 How many of the little white cubes are needed for this big cube?



- (A) 8    (B) 11    (C) 13    (D) 16    (E) 19

24. Under cards with the same colour, the same number is always found. If the three hidden numbers in one row are added, one obtains the number to the right of the row.  
 Which number is hidden under the black card?



- (A) 6    (B) 8    (C) 10    (D) 12    (E) 14

# KÄNGURU DER MATHEMATIK 2022

## 17. 3. 2022

**Level: Benjamin, Grades 5 - 6**

Name:	
School:	
Class:	

Time: 60 min.

24 starting points

each correct answer to questions 1. – 8.: 3 points

each correct answer to questions 9. – 16.: 4 points

each correct answer to questions 17. – 24.: 5 points

each questions left unanswered: 0 points

each incorrect answer: minus  $\frac{1}{4}$  of the points for the question



**Please write the letter (A, B, C, D, E) of the correct answer in the square under the question number (1 bis 24). Write clearly and carefully!**

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>

<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>13</b>	<b>14</b>	<b>15</b>	<b>16</b>

<b>17</b>	<b>18</b>	<b>19</b>	<b>20</b>	<b>21</b>	<b>22</b>	<b>23</b>	<b>24</b>



Information über den Känguruwettbewerb: [www.kaenguru.at](http://www.kaenguru.at)  
Wenn du mehr in dieser Richtung machen möchtest,  
gibt es die Österreichische Mathematikolympiade;  
Infos unter: [www.oemo.at](http://www.oemo.at)

# Känguru der Mathematik 2022

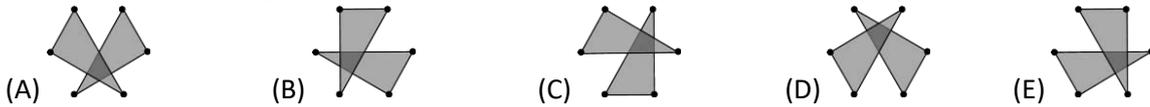
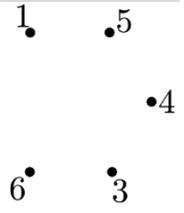
## Level Benjamin (Schulstufe 5 and 6)

### Austria – 17. 3. 2022

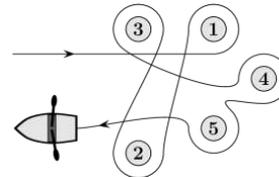


#### - 3 Point Examples -

1. Six points are placed and numbered as shown on the right. Two triangles are drawn: one by connecting the even numbered points, and one by connecting the odd numbered points. Which of the following shapes is the result?

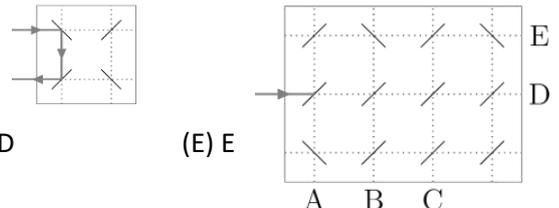


2. Eva paddles around five buoys with her boat (see diagram). Which of the buoys does she paddle around in an anti-clockwise direction?



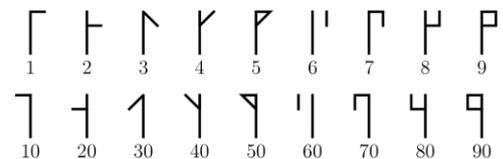
- (A) 1 and 4      (B) 2, 3 and 5      (C) 2 and 3      (D) 1, 4 and 5      (E) 1 and 3

3. The two-sided mirrors reflect the laser beams as shown in the small picture on the left. At which letter does the laser beam leave the picture on the right?



- (A) A      (B) B      (C) C      (D) D      (E) E

4. In the 13th century, monks used to write numbers in the following way: For the numbers 1 to 99 they used the signs shown here or a combination of two of these signs.



E.g. the number 24 was written like , the number 81 like and the number 93 like .

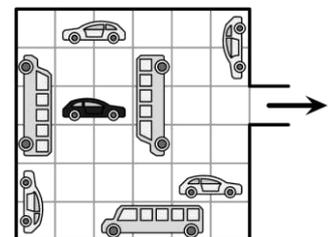
- What did the number 45 look like?  
 (A)      (B)      (C)      (D)      (E)

5. Marbles are sold in packages of 5, 10 or 25. Tom buys exactly 95 marbles. What is the minimum number of packages Tom has to buy?

- (A) 4      (B) 5      (C) 7      (D) 8      (E) 10

6. All vehicles in the garage can only drive forwards or backwards. The black car wants to leave the garage (see diagram). What is the minimum number of grey vehicles that need to move at least a little bit so that this is possible?

- (A) 2      (B) 3      (C) 4      (D) 5      (E) 6



7. Bodil lays these seven cards 

4
---

69
----

113
-----

9
---

51
----

5
---

67
----

 next to each other, so that the smallest possible 12-digit number which can be made from these cards is formed. What are the last three digits of this number?

- (A) 699      (B) 113      (C) 551      (D) 967      (E) 459

8. How much does this Ferris wheel need to turn so that a white gondola is on top for the first time?

- (A)  $\frac{1}{2}$  turn      (B)  $\frac{1}{3}$  turn      (C)  $\frac{1}{6}$  turn      (D)  $\frac{1}{12}$  turn      (E)  $\frac{5}{6}$  turn

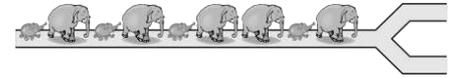


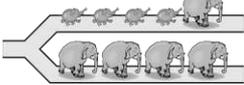
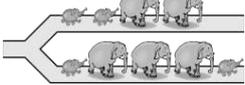
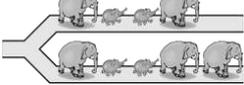
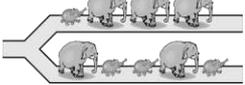
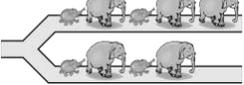
9. The sides of the square  $ABCD$  are 10 cm long.  
What is the total area of the shaded part?



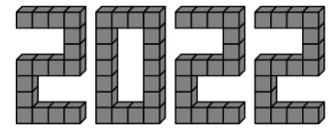
- (A)  $40 \text{ cm}^2$       (B)  $45 \text{ cm}^2$       (C)  $50 \text{ cm}^2$       (D)  $55 \text{ cm}^2$       (E)  $60 \text{ cm}^2$

10. Five big and four small elephants are marching along a path.  
Since the path is narrow the elephants cannot change their order.  
At the fork in the path each elephant either goes to the right or to the left.  
Which of the following situations cannot happen?



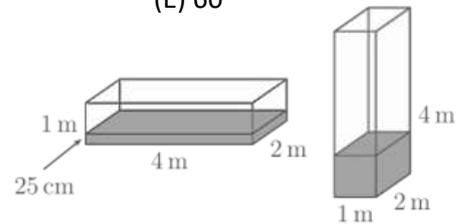
- (A)       (B)       (C)       (D)       (E) 

11. Marc builds the number 2022 as seen in the picture by glueing together 66 cubes of the same size. Afterwards he paints the entire surface of his work.  
On how many of the 66 cubes has Marc painted exactly four faces?



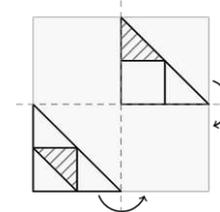
- (A) 16      (B) 30      (C) 46      (D) 54      (E) 60

12. In a box-shaped water tank with dimensions 4 m x 2 m x 1 m, the height of the water is 25 cm.  
The tank is then turned on its side (see picture on the right).  
How high is the water in the tank now?



- (A) 25 cm      (B) 50 cm      (C) 75 cm      (D) 1 m      (E) 1.25 m

13. Some art work can be seen on a square-shaped transparent piece of foil.  
The foil is folded over twice as shown in the diagram.  
What does the foil look like after it has been folded over twice?

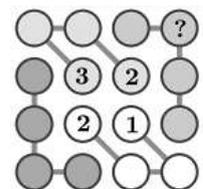


- (A)       (B)       (C)       (D)       (E) 

14. The year 2022 has three equal digits.  
This is the third time that Tortoise Eva has experienced a year where the same digit appears three times.  
What is the minimum age that tortoise Eva can be this year?

- (A) 20      (B) 22      (C) 23      (D) 56      (E) 134

15. Four circles are always connected by a line to form chains of four in a drawing.  
The numbers 1, 2, 3 and 4 appear in each row, each column and each chain of four.



Which number is in the circle with the question mark?

- (A) 1      (B) 2      (C) 3      (D) 4      (E) This cannot be determined.

16. Lisa has four differently heavy dogs. Each dog weighs a whole number of kilograms.  
All dogs together weigh 60 kg. The second heaviest dog weighs 28 kg.  
How heavy is the third heaviest dog?

- (A) 2 kg      (B) 3 kg      (C) 4 kg      (D) 5 kg      (E) 6 kg

17. Some identical glasses are stacked on top of each other.

A stack with eight glasses is 42 cm high. A stack with two glasses is 18 cm high.  
How high is a stack with six glasses?

- (A) 22 cm                      (B) 24 cm                      (C) 28 cm                      (D) 34 cm                      (E) 40 cm

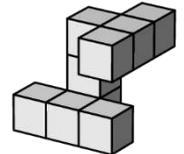


18. The bus stops in the villages A, B, C and D are situated along a road in this order.

The distance between two bus stops in neighbouring villages is 10 km.  
10 children live in village A, 20 in village B, 30 in village C and 40 in village D. All children take the bus to go to school. A new school is going to be built. In order to find a suitable place, the kilometers that each child would travel by bus are added together. The school is then built at the place where this sum is smallest.  
Where will the new school be built?

- (A) in A                      (B) in B                      (C) in the middle between B and C                      (D) in C                      (E) in D

19. Anna has glued together several cubes of the same size to form a solid (see picture).  
Which of the following pictures shows a different view of this solid?



- (A)                      (B)                      (C)                      (D)                      (E)

20. Werner inserts numbers in various ways into the empty squares  $\square + \square - \square = \square$  in such a way that the calculation is correct. He always uses four of the numbers 2, 3, 4, 5 or 6 where in each calculation each number is only allowed to appear once.

How many of the five numbers can Werner insert into the grey square?

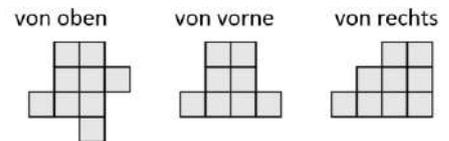
- (A) 1                      (B) 2                      (C) 3                      (D) 4                      (E) 5

21. A building is made up of cubes of the same size.

The three pictures show it from above (von oben), from the front (von vorne) and from the right (von rechts).

What is the maximum number of cubes used to make this building?

- (A) 18                      (B) 19                      (C) 20                      (D) 21                      (E) 22



22. Each animal in the picture on the right represents a natural number greater than zero. Different animals represent a different numbers.

The sum of the two numbers of each column is written underneath each column.

What is the maximum value the sum of the four numbers in the upper row can have?

- (A) 18                      (B) 19                      (C) 20                      (D) 21                      (E) 22

				?
15	11	3	7	

23. 30 people are sitting around a round table. Some of them are wearing a hat.

Those who do not wear a hat, have to speak the truth.

Those who wear a hat can either speak the truth or lie.

They all claim: „At least one of my two neighbouring people wears a hat.“

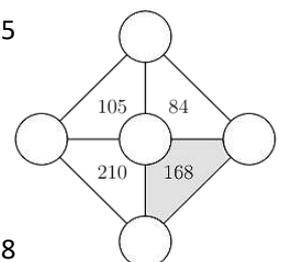
What is the biggest number of people that do not wear a hat?

- (A) 5                      (B) 10                      (C) 15                      (D) 20                      (E) 25

24. Kai has to insert the numbers 3, 4, 5, 6 and 7 into the five circles of the diagram on the right in the following way: The product of the three numbers in the vertices of each triangle has to be equal to the number stated within the triangle.

How big is the sum of the numbers in the vertices of the triangle with the number 168?

- (A) 12                      (B) 14                      (C) 15                      (D) 17                      (E) 18



# KÄNGURU DER MATHEMATIK 2022

## 17. 3. 2022

**Level: Kadett, Grades 7 - 8**

Name:	
School:	
Class:	

Time: 75 min.

30 starting points

each correct answer to questions 1. – 10.: 3 points

each correct answer to questions 11. – 20.: 4 points

each correct answer to questions 21. – 30.: 5 points

each questions left unanswered: 0 points

each incorrect answer: minus  $\frac{1}{4}$  of the points for the question



**Please write the letter (A, B, C, D, E) of the correct answer in the square under the question number (1 bis 30). Write clearly and carefully!**

1	2	3	4	5	6	7	8	9	10

11	12	13	14	15	16	17	18	19	20

21	22	23	24	25	26	27	28	29	30



Information über den Känguruwettbewerb: [www.kaenguru.at](http://www.kaenguru.at)  
Wenn du mehr in dieser Richtung machen möchtest,  
gibt es die Österreichische Mathematikolympiade.  
Infos unter: [www.oemo.at](http://www.oemo.at)

# Känguru der Mathematik 2022

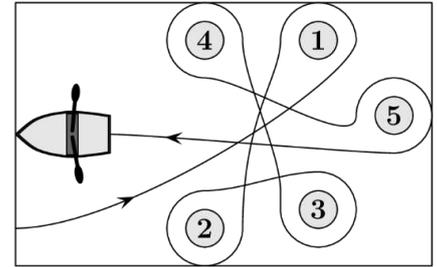
## Level Kadett (Schulstufe 7 and 8)

### Austria – 17. 3. 2022

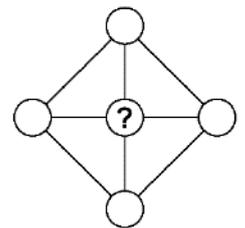


#### - 3 Point Examples -

1. What is  $(20+22) \div (20-22) = ?$   
 (A) -42      (B) -21      (C) -2      (D) 22      (E) 42
2. Meike paddles around five buoys with her boat (see diagram).  
 Which of the buoys does she paddle around in a clockwise direction?  
 (A) 2, 3 and 4    (B) 1, 2 and 3    (C) 1, 3 and 5    (D) 2, 4 and 5    (E) 2, 3 and 5

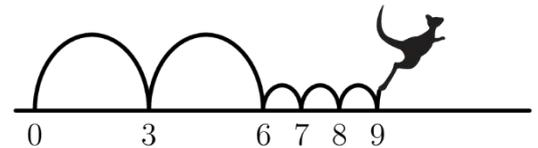


3. Beate arranges the five cards so that the smallest nine-digit number is created. Which card is furthest on the right?  
 (A) 4      (B) 8      (C) 31      (D) 59      (E) 107



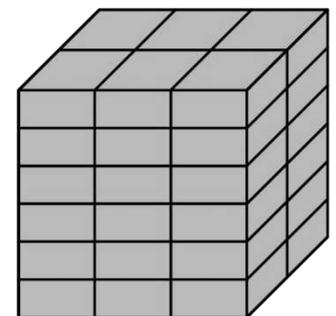
4. The numbers 3, 4, 5, 6, 7 are written inside the five circles of the shape. The product of the numbers in the four outer circles is 360. Which number is in the inner circle?  
 (A) 3      (B) 4      (C) 5      (D) 6      (E) 7
5. Anna, Beatrice and Clara altogether are 15 years old. Anna and Beatrice together are 11 years old. Beatrice and Clara together are 12 years old. How old is the oldest of the three?  
 (A) 4      (B) 5      (C) 6      (D) 7      (E) 8

6. Kengu likes to jump on the number line. He starts at 0, then always starts with two big jumps and then three small jumps (see diagram). He keeps repeating this in the same way, over and over again.  
 On which of the following numbers will he land in the course of his jumps?  
 (A) 82      (B) 83      (C) 84      (D) 85      (E) 86

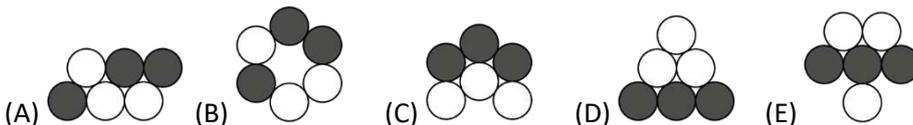


7. Otto attaches the number plate to his car the wrong way round, i.e. upside down. Luckily it doesn't matter because the number plate looks exactly the same this way.  
 Which of the following number plates could be the one from Otto?  
 (A) 04 NSN 40    (B) 60 SOS 09    (C) 80 BNB 08    (D) 06 HNH 60    (E) 08 NBN 80

8. Sonja builds the cube shown, out of equally sized bricks. The shortest side of one brick is 4 cm long. What dimensions in cm does one brick have?  
 (A)  $4 \times 6 \times 12$     (B)  $4 \times 6 \times 16$     (C)  $4 \times 8 \times 12$     (D)  $4 \times 8 \times 16$     (E)  $4 \times 12 \times 16$



9. The black-white caterpillar shown, rolls up to go to sleep. Which diagram could show the rolled-up caterpillar?  

10. Gerhard writes down the sum of the squares of two numbers. Unfortunately, some ink has run out (see diagram) and therefore we cannot read all the digits.  
 What is the last digit of the first number?

$$(2\text{█})^2 + (1\text{█}2)^2 = 7133029$$

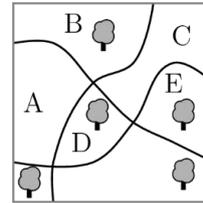
- (A) 3      (B) 4      (C) 5      (D) 6      (E) 7

11. There are five gaps in the following calculation. Adriana wants to write a „+“ into four of the gaps and a „-“ into one of the gaps so that the equation is correct. Where does she have to insert the „-“?

$$6 \square 9 \square 12 \square 15 \square 18 \square 21 = 45$$

- (A) between 6 and 9                      (B) between 9 and 12                      (C) between 12 and 15  
 (D) between 15 and 18                      (E) between 18 and 21

12. There are 5 trees and 3 paths in a park as shown on the map. Another tree is planted so that there is an equal number of trees on both sides of each path.



- In which section of the park will the new tree be planted?  
 (A) A                      (B) B                      (C) C                      (D) D                      (E) E

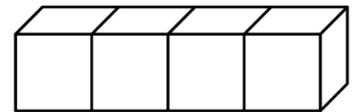
13. The distance between two shelves in Monika’s kitchen is 36 cm. She knows that a stack of 8 identical glasses is 42 cm high and a stack of 2 such glasses is 18 cm high. How many glasses has the biggest stack that will fit between two shelves?

- (A) 3                      (B) 4                      (C) 5                      (D) 6                      (E) 7



14. On an ordinary die the numbers on opposite sides always add up to 7. Four such dice are glued together as shown. All numbers that can still be seen on the outside of the solid are added together. What is the minimum of that total?

- (A) 52                      (B) 54                      (C) 56                      (D) 58                      (E) 60



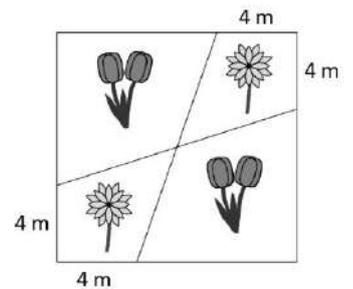
15. How many integers between 100 and 300 have only odd digits?

- (A) 25                      (B) 50                      (C) 75                      (D) 100                      (E) 150

16. Gardener Toni plants tulips and sunflowers in a square flowerbed with side length 12 m, as shown in the diagram. How big is the entire area where sunflowers are planted?



- (A) 36 m<sup>2</sup>                      (B) 40 m<sup>2</sup>                      (C) 44 m<sup>2</sup>                      (D) 46 m<sup>2</sup>                      (E) 48 m<sup>2</sup>



17. There are two clocks in my office. One of which is one minute fast every hour and the other one is two minutes behind every hour. Yesterday I have set them both on the correct time but when I checked today, one clock said 11:00 and the other 12:00.

At what time did I set the time yesterday?

- (A) 23:00                      (B) 19:40                      (C) 15:40                      (D) 14:00                      (E) 11:20

18. Werner has written some numbers on a piece of paper whose sum is 22. Ria has then subtracted each number from 7 and has also written down the results.

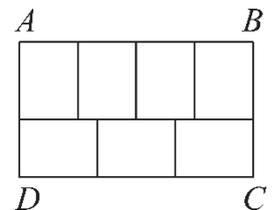
The sum of Ria’s numbers is 34. How many numbers has Werner written down?

- (A) 7                      (B) 8                      (C) 9                      (D) 10                      (E) 11

19. The big rectangle ABCD is made up of 7 congruent smaller rectangles (see diagram).

What is the ratio  $\frac{AB}{BC}$ ?

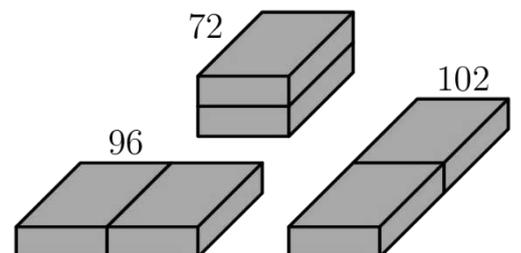
- (A)  $\frac{1}{2}$                       (B)  $\frac{4}{3}$                       (C)  $\frac{8}{5}$                       (D)  $\frac{12}{7}$                       (E)  $\frac{7}{3}$



20. Two identical bricks can be placed side by side in three different ways as shown in the diagrams. The surface areas of the resulting cuboids are 72, 96 and 102 cm<sup>2</sup>.

What is the surface area (in cm<sup>2</sup>) of one brick?

- (A) 36                      (B) 48                      (C) 52                      (D) 54                      (E) 60



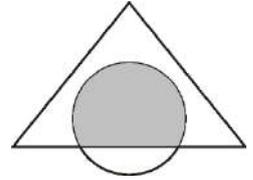
**- 5 Point Examples -**

21. Jenny writes numbers into a  $3 \times 3$  table so that the sums of the four numbers in each  $2 \times 2$  area of the table are the same. The numbers in three of the cells in the corner can already be seen in the diagram. Which number does she write into the cell in the fourth corner?

2		4
?		3

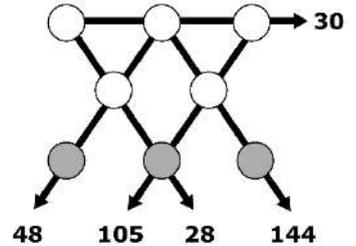
- (A) 0      (B) 1      (C) 4      (D) 5      (E) 6

22. A shape is made up of a triangle and a circle that partially overlap. The grey area is 45 % of the entire area of the shape. The white part of the triangle is 40 % of the total area of the shape. What percent of the area of the circle is the white part, outside the triangle?



- (A) 20 %      (B) 25 %      (C) 30 %      (D) 35 %      (E) 50 %

23. The numbers 1 to 8 are written into the circles shown so that there is one number in each circle. Along each of the five straight arrows the three numbers in the circles are multiplied. Their product is written next to the tip of the arrow. How big is the sum of the numbers in the three circles on the lowest row of the diagram?



- (A) 11      (B) 12      (C) 15      (D) 17      (E) 19

24. By bike it takes Marc 20 minutes to go from home to school and back. He rides the entire distance with a constant speed. By foot it takes him 60 minutes for the same distance. He also walks with a constant speed.

Yesterday Marc took his bike to go to Eva's house which is on the way to school. He left the bike there and continued on foot to school. On the way home he first walked to Eva's house and then cycled the rest of the way back home. He needed 52 minutes for the entire journey (from home to school and back home). Which part of his journey did he cover by bike?

- (A)  $\frac{1}{6}$       (B)  $\frac{1}{5}$       (C)  $\frac{1}{4}$       (D)  $\frac{1}{3}$       (E)  $\frac{1}{2}$

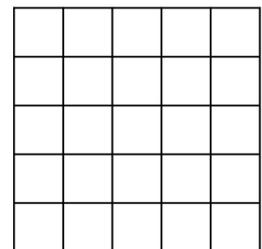
25. The four villages *A*, *B*, *C* and *D* are situated (not necessarily in this order) along a straight road. The villages *A* and *C* are 75 km away from each other, *B* and *D* 45 km away from each other and *B* and *C* 20 km away from each other. Which of the following distances **cannot** be the distance from *A* to *D*?

- (A) 10 km      (B) 50 km      (C) 80 km      (D) 100 km      (E) 140 km

26. A painter wants to mix 2 litres of blue paint with 3 litres of yellow paint to obtain 5 litres of green paint. He accidentally uses 3 litres of blue paint and 2 litres of yellow paint and thus produces the wrong shade of green. What is the minimum amount of this green paint he has to throw away so that he can use the rest to add blue or yellow paint in order to get exactly 5 litres of the correct shade of green?

- (A)  $\frac{5}{3}$  litre      (B)  $\frac{3}{2}$  litre      (C)  $\frac{2}{3}$  litre      (D)  $\frac{3}{5}$  litre      (E)  $\frac{5}{9}$  litre

27. What is the minimum number of cells of a  $5 \times 5$  grid that have to be coloured in so that every possible  $1 \times 4$  rectangle and every  $4 \times 1$  rectangle respectively in the grid has at least one cell coloured in?



- (A) 5      (B) 6      (C) 7      (D) 8      (E) 9

28. Mowgli asks a bear and a panther which day of the week it is. The bear always lies on Monday, Tuesday and Wednesday. The panther always lies on Thursday, Friday and Saturday. On all other days they both always speak the truth. The bear says: „Yesterday was one of my lying days.“ The panther says: „Yesterday was also one of my lying days.“ On which day of the week did this conversation take place?

- (A) Thursday      (B) Friday      (C) Saturday      (D) Sunday      (E) Monday

29. Some points are marked on a straight line. Renate marks another point between every pair of adjacent points. She repeats this process three more times.

Now 225 points are marked on the straight line. How many points were there to begin with?

- (A) 10      (B) 12      (C) 15      (D) 16      (E) 25

30. In total there are 2022 kangaroos and some koalas living within seven parks. As many kangaroos live in each park as there are koalas in all other parks together. How many koalas in total live in the seven parks?

- (A) 288      (B) 337      (C) 576      (D) 674      (E) 2022

# KÄNGURU DER MATHEMATIK 2022

17. 3. 2022



Level: Junior, Grades 9 - 10

Full name:	
School:	
Class:	

Time: 75 min.

30 starting points

each correct answer to questions 1. – 10.: 3 points

each correct answer to questions 11. – 20.: 4 points

each correct answer to questions 21. – 30.: 5 points

each questions left unanswered: 0 points

each incorrect answer: minus  $\frac{1}{4}$  of the points for the question

Please write the letter (A, B, C, D, E) of the correct answer in the square under the question number (1 bis 30). Write clearly and carefully!

1	2	3	4	5	6	7	8	9	10

11	12	13	14	15	16	17	18	19	20

21	22	23	24	25	26	27	28	29	30

### Zustimmungserklärung zur Datenverarbeitung für den österreichischen Wettbewerb „Känguru der Mathematik“

Mit meiner Unterschrift gebe ich das Einverständnis, dass meine angeführten personenbezogenen Daten (Vor- und Zuname, Klasse, Schulstufe, Schulstandort und Schulart) zum Zweck der Organisation und Durchführung des Wettbewerbs, der Auswertung der Wettbewerbsergebnisse (Ermitteln der erreichten Punkte und Prozentzahlen), des Erstellens von schulweiten Reihungen, sowie zur Erstellung und Veröffentlichung der Siegerlisten auf unserer Vereinshomepage (sofern mindestens 50 % der zu erreichenden Punktezahl erlangt werden bzw. ich unter den besten 10 einer Kategorie liege) verwendet werden dürfen.

### Betroffenenrechte

Die Verwendung dieser Daten ist bis 31. Dezember des 2. Folgejahres gestattet. Nach diesem 31. Dezember werden Vor- und Zuname, die Klasse und der Schulstandort gelöscht, wobei dieser durch die Angabe des Bundeslandes ersetzt wird. Die Verwendung der auf diese Art anonymisierten Daten ist nur mehr für statistische Zwecke auf der Grundlage der DSGVO erlaubt.

Ich habe ein Recht auf Auskunft über meine gespeicherten personenbezogenen Daten, sowie das Recht auf Berichtigung, Datenübertragung, Widerspruch, Einschränkung der Bearbeitung sowie Sperrung oder Löschung unrichtig verarbeiteter Daten.

Ich kann die erteilte Einwilligung jederzeit auf der Homepage des Vereines Känguru der Mathematik unter [www.kaenguru.at](http://www.kaenguru.at) mittels des dafür bereitgestellten Formulars mit Wirkung für die Zukunft widerrufen (Art. 21 Abs. 1 DSGVO).

Ein Widerruf hat zur Folge, dass die personenbezogenen Daten nach gegenseitiger Rücksprache innerhalb von 31 Tagen gelöscht werden.

Durch den Widerruf wird die Rechtmäßigkeit der aufgrund der Einwilligung bis zum Widerruf erfolgten Verarbeitung nicht berührt. (Art. 7 Abs. 2 DSGVO)



Information über den Känguruwettbewerb: [www.kaenguru.at](http://www.kaenguru.at)  
Wenn du mehr in dieser Richtung machen möchtest, gibt es die Österreichische Mathematikolympiade.  
Infos unter: [www.oemo.at](http://www.oemo.at)

# Känguru der Mathematik 2022

## Level Junior (Schulstufe 9 and 10)

### Austria – 17. 3. 2022

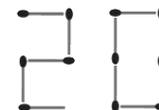


#### - 3 Point Examples -

1. What is  $\frac{20 \cdot 22}{(2+0) \cdot (2+2)}$  ?

- (A) 34      (B) 40      (C) 44      (D) 55      (E) 85

2. Karo has a box of matches with 30 matches. Using some of the matches she forms the number 2022. She has already formed the first two digits (see picture).



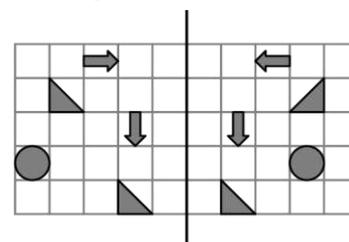
How many matches will be left in the box when she has finished the number?

- (A) 5      (B) 9      (C) 10      (D) 19      (E) 5

3. An equilateral triangle with side length 12 has the same perimeter as a square with side length  $x$ . What is the value of  $x$ ?

- (A) 9      (B) 12      (C) 16      (D) 24      (E) 36

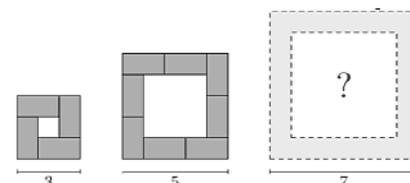
4. Various symbols are drawn on a piece of paper (see picture). The teacher folds the left side along the vertical line to the right.



How many symbols of the left side are now congruent on top of a symbol on the right side?

- (A) 1      (B) 2      (C) 3      (D) 4      (E) 5

5. Karin places tables of size  $2 \times 1$  according to the number of participants in a meeting. The diagram shows the table arrangements from above for a small, a medium and a large meeting.



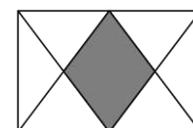
How many tables are used in a large meeting?

- (A) 10      (B) 11      (C) 12      (D) 14      (E) 16

6. I am smaller than my half and bigger than my double. The sum of me and my square is 0. Which number am I?

- (A) -2      (B) -1      (C) 0      (D) 1      (E) 2

7. The midpoints of both longer sides of a rectangle are connected with the vertices (see diagram). Which fraction of the rectangle is shaded?



- (A)  $\frac{1}{5}$       (B)  $\frac{1}{4}$       (C)  $\frac{2}{7}$       (D)  $\frac{1}{3}$       (E)  $\frac{2}{5}$

8. Sonja's smartphone displays the diagram on the right. It shows how long she has worked with four different apps in the previous week. This week he has spent only half the amount of time using two of the apps and the same amount of time as last week using the other two apps.



Which of the following pictures could be the diagram for the current week?

- (A)      (B)      (C)      (D)      (E)

9. In the multiplication grid displayed, each white cell should show the product of the numbers in the grey cells that are in the same row and column respectively. One number is already entered. The integer  $x$  is bigger than the positive integer  $y$ . What is the value of  $y$ ?

·	$x$	$x+1$
$y$		
$y+1$		77

- (A) 6      (B) 7      (C) 8      (D) 10      (E) 11

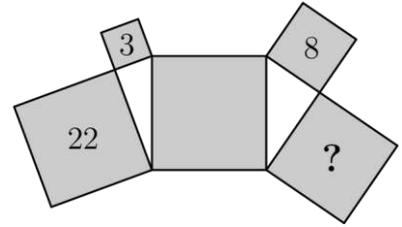
10. There are 5 people to choose from on a ballot paper. After counting 90 % of the votes the intermediate result looks as shown in the table. How many of the 5 people cannot win the election anymore?

Alex	Bella	Clint	Diana	Eddy
14	11	10	8	2

- (A) 1      (B) 2      (C) 3      (D) 4      (E) 5

**- 4 Point Examples -**

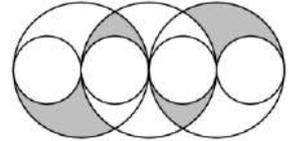
- 11.** Five squares and two right-angled triangles are placed as shown in the diagram. The numbers 3, 8 and 22 in the squares state the size of the area in  $m^2$ . How big is the area (in  $m^2$ ) of the square with the question mark?



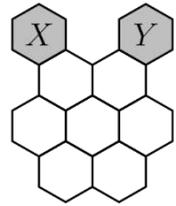
- 12.** 2022 tiles are placed in one long row. Adam removes every sixth tile. Then Beate removes every fifth of the remaining tiles. Subsequently Cora removes every fourth of the remaining tiles.

How many tiles are left?

- 13.** The diagram shows three big circles of equal size and four small circles. Each small circle touches two big circles and has radius 1. How big is the shaded area?



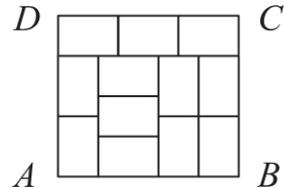
- 14.** A bee called Maja wants to hike from honeycomb X to honeycomb Y. She can only move from one honeycomb to the neighbouring honeycomb if they share an edge. How many, different ways are there for Maja to go from X to Y if she has to step onto every one of the seven honeycombs exactly once?



- 15.** The sum of two positive integers is three times as big as their difference. The product of the two numbers is four times as big as their sum. How big is the sum of the two numbers?

- 16.** The rectangle  $ABCD$  is made up of 12 congruent rectangles (see diagram).

How big is the ratio  $\frac{AD}{DC}$ ?



- (A)  $\frac{8}{9}$  (B)  $\frac{5}{6}$  (C)  $\frac{7}{8}$  (D)  $\frac{2}{3}$  (E)  $\frac{9}{8}$

- 17.** A rabbit and a hedgehog enter a race against each other. The circular racecourse is 550 m long. The starting line and the finish line are the same. The speed of the rabbit is a constant 10 m/s, the speed of the hedgehog is a constant 1 m/s. They start at the same time, but the hedgehog tries to cheat by going in the opposite direction. When the two meet, the hedgehog turns around immediately and follows the rabbit. How many seconds after the rabbit does the hedgehog reach the finish line?

- (A) 45 (B) 50 (C) 55 (D) 100 (E) 505

- 18.** The grandchildren ask their grandma how old she is. The grandma invites them to guess the age. The first child says 75, the second says 78 and the third says 81. It turns out that one child is wrong by 1 year, one by 2 years and one by 4 years.

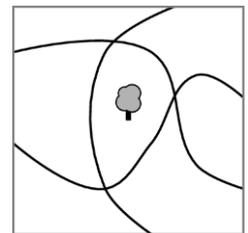
How many possibilities are there for the age of the grandma?

- (A) 0 (B) 1 (C) 2 (D) 3 (E) 4

- 19.** There are three paths running through our park in the city (see diagram). A tree is situated in the centre of the park.

What is the minimum number of trees that have to be planted additionally so that there are the same number of trees on either side of each path?

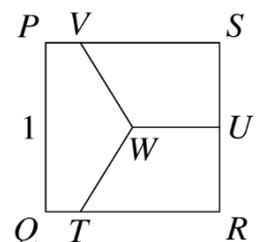
- (A) 1 (B) 2 (C) 3 (D) 4 (E) 5



- 20.** The diagram shows a square  $PQRS$  with side length 1. The point  $U$  is the midpoint of the side  $RS$  and the point  $W$  is the midpoint of the square.

The three line segments,  $TW$ ,  $UW$  and  $VW$  split the square into three equally big areas. How long is the line segment  $SV$ ?

- (A)  $\frac{1}{2}$  (B)  $\frac{2}{3}$  (C)  $\frac{3}{4}$  (D)  $\frac{4}{5}$  (E)  $\frac{5}{6}$



**- 5 Point Examples -**

**21.** Once I met six sisters whose ages were six consecutive integers. I asked each one of them: How old is the oldest of your sisters?

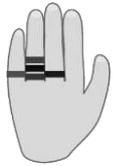
Which of the following numbers **cannot** be the sum of the six answers?

- (A) 95      (B) 125      (C) 167      (D) 205      (E) 233

**22.** Veronika wears five rings as shown.

How many, different ways are there for her to take off the rings one by one?

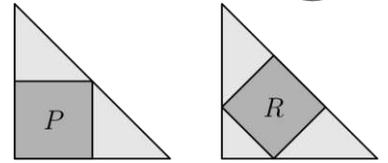
- (A) 16      (B) 20      (C) 24      (D) 30      (E) 45



**23.** One square is drawn inside each of the two congruent isosceles right-angled triangles. The area of square  $P$  is 45 units.

How many units is the area of square  $R$ ?

- (A) 35      (B) 40      (C) 45      (D) 50      (E) 60



**24.** In a certain city the inhabitants only communicate by asking questions. There are two kinds of inhabitants: the 'positive' that only ask questions that are answered with 'yes' and the 'negative' that only ask questions that are answered with 'no'. We meet the inhabitants Albert and Berta and Berta asks us: „Are Albert and I both negative?“

What kind of inhabitants are they?

- (A) Both are positive      (B) Both are negative  
 (C) Albert is positive and Berta is negative      (D) Albert is negative and Berta is positive  
 (E) There is not enough information to decide

**25.** Twelve weights have integer masses of 1 g, 2 g, 3 g, ..., 11 g and 12 g respectively. A vendor divides those weights up into 3 groups of 4 weights each. The total mass of the first group is 41 g, the mass of the second group is 26 g (see diagram).

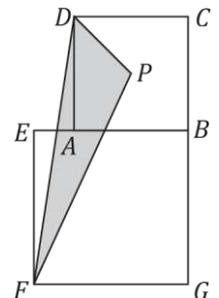
Which of the following weights is in the same group as the weight with 9 g?

- (A) 3 g      (B) 5 g      (C) 7 g      (D) 8 g      (E) 10 g



**26.** The diagonals of the squares  $ABCD$  and  $EFGB$  are 7 cm and 10 cm long respectively (see diagram). The point  $P$  is the point of intersection of the two diagonals of the square  $ABCD$ . How big is the area of the triangle  $FPD$  (in  $\text{cm}^2$ )?

- (A) 14.5      (B) 15      (C) 15.75      (D) 16.5      (E) 17.5



**27.** The product of the digits of a number  $N$  is 20.

Which of the following numbers **cannot** be the product of the digits of the number  $N + 1$ ?

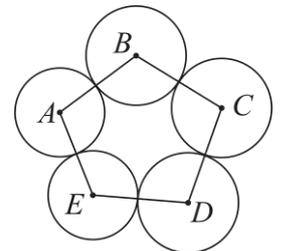
- (A) 24      (B) 25      (C) 30      (D) 35      (E) 40

**28.** Consider the five circles with midpoints  $A, B, C, D$  and  $E$  respectively, which touch each other as displayed in the diagram. The line segments, drawn in, connect the midpoints of adjacent circles.

The distances between the midpoints are  $AB = 16, BC = 14, CD = 17, DE = 13$  and  $AE = 14$ .

Which of the points is the midpoint of the circle with the biggest radius?

- (A) A      (B) B      (C) C      (D) D      (E) E



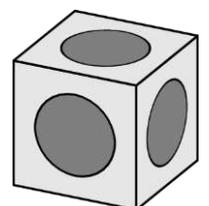
**29.** Eight teams take part in a football tournament where each team plays each other team exactly once. In each game the winner gets 3 points and the loser no points. In case of a draw both teams get 1 point. In the end all teams together have 61 points.

What is the maximum number of points that the team with the most points could have gained?

- (A) 21      (B) 19      (C) 18      (D) 17      (E) 16

**30.** A hemispheric hole is carved into each face of a wooden cube with sides of length 2. All holes are equally sized, and their midpoints are in the centre of the faces of the cube. The holes are as big as possible so that each hemisphere touches each adjacent hemisphere in exactly one point. How big is the diameter of the holes?

- (A) 1      (B) 2      (C)  $\sqrt{2}$       (D)  $\frac{3}{2}$       (E)  $\sqrt{\frac{3}{2}}$



# KÄNGURU DER MATHEMATIK 2022

17. 3. 2022



Level: Student, Grades 11–13

Full name:	
School:	
Class:	

Time: 75 min.

30 starting points

each correct answer to questions 1. – 10.: 3 points

each correct answer to questions 11. – 20.: 4 points

each correct answer to questions 21. – 30.: 5 points

each questions left unanswered: 0 points

each incorrect answer: minus  $\frac{1}{4}$  of the points for the question

**Please write the letter (A, B, C, D, E) of the correct answer in the square under the question number (1 bis 30). Write clearly and carefully!**

1	2	3	4	5	6	7	8	9	10

11	12	13	14	15	16	17	18	19	20

21	22	23	24	25	26	27	28	29	30

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Ich kann die erteilte Einwilligung jederzeit auf der Homepage des Vereines Känguru der Mathematik unter [www.kaenguru.at](http://www.kaenguru.at) mittels des dafür bereitgestellten Formulars mit Wirkung für die Zukunft widerrufen (Art. 21 Abs. 1 DSGVO).

Ein Widerruf hat zur Folge, dass die personenbezogenen Daten nach gegenseitiger Rücksprache innerhalb von 31 Tagen gelöscht werden.

Durch den Widerruf wird die Rechtmäßigkeit der aufgrund der Einwilligung bis zum Widerruf erfolgten Verarbeitung nicht berührt. (Art. 7 Abs. 2 DSGVO)

Ort, Datum

Unterschrift



Information über den Känguruwettbewerb: [www.kaenguru.at](http://www.kaenguru.at)

Wenn du mehr in dieser Richtung machen möchtest, gibt es die Österreichische Mathematikolympiade.

Infos unter: [www.oemo.at](http://www.oemo.at)

# Känguru der Mathematik 2022

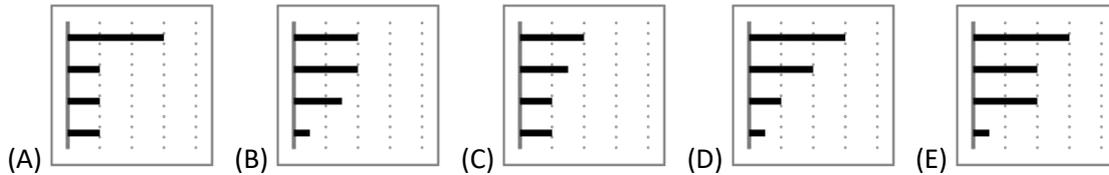
## Level Student (Schulstufe 11, 12 and 13)

### Austria – 18. 3. 2021



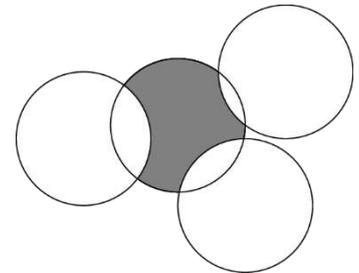
#### - 3 Point Examples -

1. Martin's smartphone displays the diagram on the right. It shows how long he has worked with four different apps in the previous week. The apps are sorted from top to bottom according to the amount of time they have been used. This week he has spent only half the amount of time using two of the apps and the same amount of time as last week using the other two apps. Which of the following pictures **cannot** be the diagram for the current week?



2. How many positive three-digit numbers are divisible by 13?  
 (A) 68 (B) 69 (C) 70 (D) 76 (E) 77
3. Bella is older than Charly and younger than Lily. Which two can be the same age if Teddy is older than Bella?  
 (A) Charly and Teddy (B) Teddy and Lily (C) Lily and Charly  
 (D) Bella and Lily (E) Teddy and Bella
4. Which one of the following numbers is **not** divisible by its own digit sum?  
 (A) 2022 (B) 2023 (C) 2024 (D) 2025 (E) 2027
5.  $5^8$  pencils are distributed evenly among 25 empty boxes. How many pencils are in each box?  
 (A)  $25^3$  (B)  $25^2$  (C)  $5^3$  (D)  $5^2$  (E) 5
6. The product of the digits of a ten-digit number is 15. How big is the sum of the digits of this number?  
 (A) 8 (B) 12 (C) 15 (D) 16 (E) 20

7. Four circles with radius 1 intersect each other as seen in the diagram. What is the perimeter of the grey area?

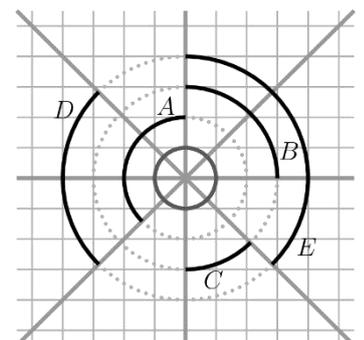


- (A)  $\pi$  (B)  $\frac{3\pi}{2}$  (C) a number between  $\frac{3\pi}{2}$  and  $2\pi$  (D)  $2\pi$  (E)  $\pi^2$
8. All integers from 2 to 2022 which can be written using only the digits 0 and 2 are written in ascending order in a list.  
 Which number is the middle number on that list?  
 (A) 200 (B) 220 (C) 222 (D) 2000 (E) 2002

9. How many real solutions does the equation  $(x - 2)^2 + (x + 2)^2 = 0$  have?  
 (A) 0 (B) 1 (C) 2 (D) 3 (E) 4



10. The points  $A$ ,  $B$ ,  $C$  and  $D$  are marked on a straight line in this order as shown in the diagram. We know that  $A$  is 12 cm from  $C$  and that  $B$  is 18 cm from  $D$ . How far apart from each other are the midpoints of the line segments  $AB$  and  $CD$ ?  
 (A) 6 cm (B) 9 cm (C) 12 cm (D) 13 cm (E) 15 cm



#### 4 Point Examples -

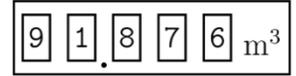
11. Four straight lines that intersect in one single point form eight equal angles (see diagram). Which one of the black arcs has the same length as the circumference of the little (grey) circle?  
 (A) A (B) B (C) C (D) D (E) E

12.  $a$ ,  $b$  and  $c$  are real numbers not equal to zero. It is known that the numbers  $-2a^4b^3c^2$  and  $3a^3b^5c^{-4}$  have the same sign. Which of the following statements is definitely correct?

- (A)  $ab > 0$  (B)  $b < 0$  (C)  $c > 0$  (D)  $bc > 0$  (E)  $a < 0$

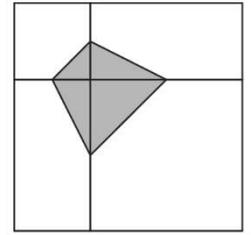
13. We check the water meter and see that all digits on the display are different. What is the minimum amount of water that has to be used before this happens again?

- (A)  $0.006 \text{ m}^3$  (B)  $0.034 \text{ m}^3$  (C)  $0.086 \text{ m}^3$  (D)  $0.137 \text{ m}^3$  (E)  $1.048 \text{ m}^3$



14. The square pictured, is split into two squares and two rectangles. The vertices of the shaded quadrilateral with area 3 are the midpoints of the sides of the smaller squares. What is the area of the non-shaded part of the big square?

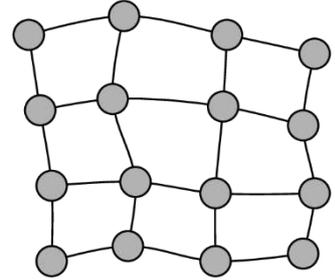
- (A) 12 (B) 15 (C) 18 (D) 21 (E) 24



15. What is the largest common divisor of  $2^{2021} + 2^{2022}$  and  $3^{2021} + 3^{2022}$  ?

- (A)  $2^{2021}$  (B) 1 (C) 2 (D) 6 (E) 12

16. The diagram shows a map with 16 towns which are connected via roads. The government is planning to build power plants in some towns. Each power plant can generate enough electricity for the town in which it stands as well as for its immediate neighbouring towns (i.e. towns that can be reached via a direct connecting road).



What is the minimum number of power plants that have to be built?

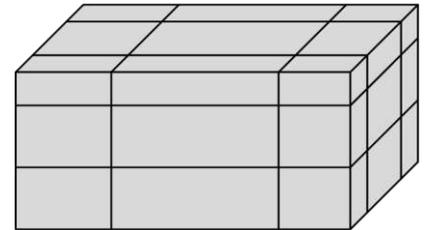
- (A) 3 (B) 4 (C) 5 (D) 6 (E) 7

17. In a tournament with 8 participants the players are randomly paired up in four teams for the first round and the winner of each encounter then proceeds to the second round. There are two games in the second round and the two winners then play the final. Anita and Martina are the two best players and will win against all others; in case they have to play against each other, Anita will win. How big is the chance that Martina will get to the final?

- (A) 1 (B)  $\frac{1}{2}$  (C)  $\frac{2}{7}$  (D)  $\frac{3}{7}$  (E)  $\frac{4}{7}$

18. A cuboid with surface area  $X$  is cut up along six planes parallel to the sides (see diagram). What is the total surface area of all 27 thus created solids?

- (A)  $X$  (B)  $2X$  (C)  $3X$  (D)  $4X$  (E) It depends on the position of the planes.

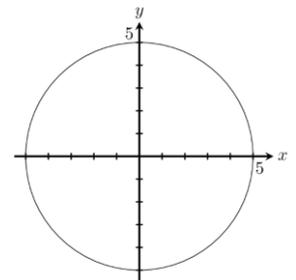


19. The arithmetic mean of five numbers is 24. The mean of the three smallest numbers is 19 and that of the three biggest is 28. What is the median of the five numbers?

- (A) 20 (B) 21 (C) 22 (D) 23 (E) 24

20. A circle with midpoint  $(0|0)$  has a radius of 5. How many points are there on the circumference where both co-ordinates are integers?

- (A) 5 (B) 8 (C) 12 (D) 16 (E) 20

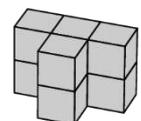


**- 5 Point Examples -**

21. The vertices of a 20-gon are labelled using the numbers 1 to 20 so that adjacent vertices always differ by 1 or 2. The sides of the 20-gon whose vertices are labelled with numbers that only differ by 1 are drawn in red. How many red sides does the 20-gon have?

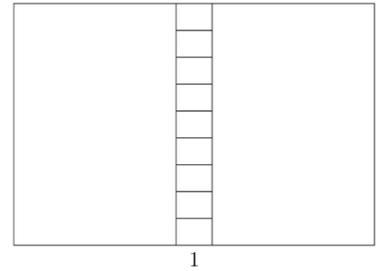
- (A) 1 (B) 2 (C) 4 (D) 5 (E) 10

22. Which two building blocks can be joined together so that the object shown is created?



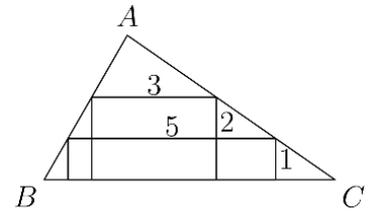
- (A) (B) (C) (D) (E)

23. A rectangle is split into 11 smaller rectangles as shown.  
 All 11 small rectangles are similar to the initial rectangle.  
 The smallest rectangles are aligned like the original rectangle (see diagram).  
 The lower sides of the smallest rectangles have length 1.  
 How big is the perimeter of the big rectangle?



- (A) 20 (B) 24 (C) 27 (D) 30 (E) 36

24. Two rectangles are inscribed into a triangle as shown in the diagram.  
 The dimensions of the rectangles are  $1 \times 5$  and  $2 \times 3$  respectively.  
 How big is the height of the triangle in A?

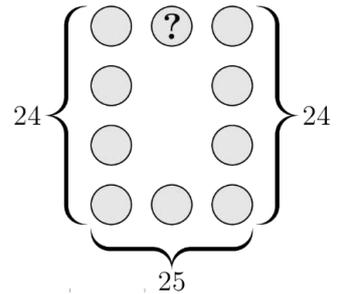


- (A) 3 (B)  $\frac{7}{2}$  (C)  $\frac{8}{3}$  (D)  $\frac{6}{5}$  (E) another number

25. How many three-digit numbers are there that are equal to five times the product of their digits?

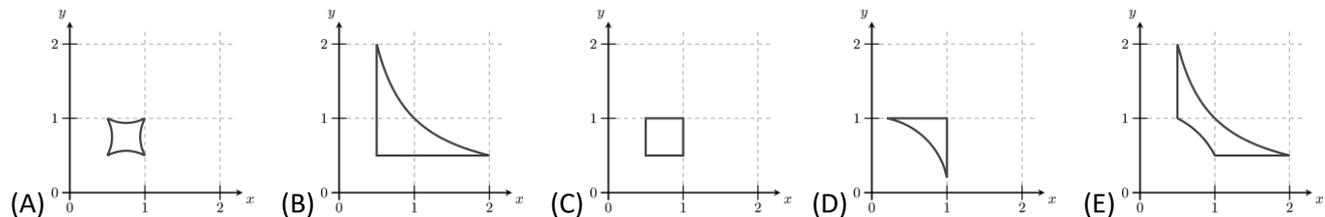
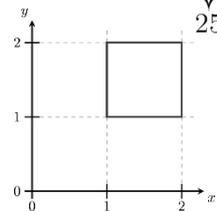
- (A) 1 (B) 2 (C) 3 (D) 4 (E) 5

26. The numbers 1 to 10 were written into the ten circles in the pattern shown in the picture.  
 The sum of the four numbers in the left and the right column is 24 each and the sum of the three numbers in the bottom row is 25. Which number is in the circle with the question mark?



- (A) 2 (B) 4 (C) 5 (D) 6 (E) another number

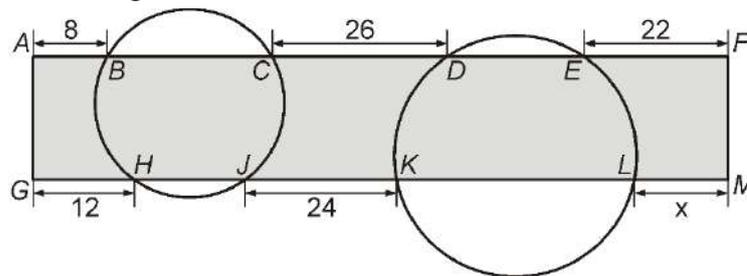
27. A square is placed in a co-ordinate system as shown. Each point  $(x|y)$  of the square is deleted and replaced by the point  $(\frac{1}{x} | \frac{1}{y})$ .  
 Which diagram shows the resulting shape?



28. Let  $N$  be a positive integer. How many integers are between  $\sqrt{N^2 + N + 1}$  and  $\sqrt{9N^2 + N + 1}$  ?  
 (A)  $N + 1$  (B)  $2N - 1$  (C)  $2N$  (D)  $2N + 1$  (E)  $3N$

29. A sequence  $\langle a_n \rangle$  has  $0 < a_1 < 1$ . For all  $n \geq 1$  we know that  $a_{2n} = a_2 \cdot a_n + 1$  and  $a_{2n+1} = a_2 \cdot a_n - 2$ .  
 We know that  $a_7 = 2$ . What is the value of  $a_2$ ?  
 (A)  $a_1$  (B) 2 (C) 3 (D) 4 (E) 5

30. Two circles intersect a rectangle  $AFMG$  as shown in the diagram. The line segments along the long side of the rectangle that are outside the circles have length  $AB = 8$ ,  $CD = 26$ ,  $EF = 22$ ,  $GH = 12$  and  $JK = 24$ .  
 How long is the length  $x$  of the line segment  $LM$ ?



- (A) 14 (B) 15 (C) 16 (D) 17 (E) 18

2022

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Felix	B	B	E	D	B	D	E	B	C	A	C	A	D	D	C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Écolier	E	C	C	A	B	E	D	C	B	C	B	A	E	C	D	A	B	A	E	C	C	E	B	D	-	-	-	-	-	
Benjamin	E	E	B	D	B	C	A	D	C	C	E	D	A	C	B	A	D	D	C	E	B	C	D	D	-	-	-	-	-	
Kadett	B	E	B	E	E	C	B	C	A	C	D	B	D	D	A	E	C	B	D	D	B	B	D	B	C	A	B	A	C	B
Junior	D	B	A	C	C	B	B	C	A	B	D	D	B	D	E	A	A	C	C	E	D	B	B	C	C	E	D	A	D	C
Student	E	B	B	E	A	D	D	B	A	E	D	E	D	D	E	B	E	C	B	C	B	A	D	B	A	E	C	C	D	C

# KÄNGURU DER MATHEMATIK 2023

16. 3. 2023

Level: Felix, Grade: Schulstufe 2

<b>Name:</b>	
<b>School:</b>	
<b>Class:</b>	

Time: 60 min.

15 starting points

each correct answer to questions 1. – 5.: 3 points

each correct answer to questions 6. – 10.: 4 points

each correct answer to questions 11. – 15.: 5 points

each question left unanswered: 0 points

each incorrect answer: minus  $\frac{1}{4}$  of the points for the question



Please write the letter (A, B, C, D, E) of the correct answer in the square under the question number (1 to 15). Write clearly and carefully!

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>

<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>

<b>11</b>	<b>12</b>	<b>13</b>	<b>14</b>	<b>15</b>

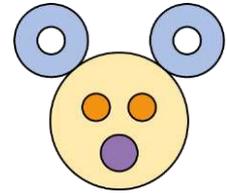


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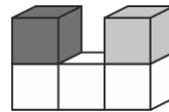
- 3 Point Examples -

1. Out of how many circles is the beaver made of?

- (A) 5      (B) 6      (C) 7      (D) 8      (E) 9



2. The picture shows 5 cubes from the front.



What do they look like from above?

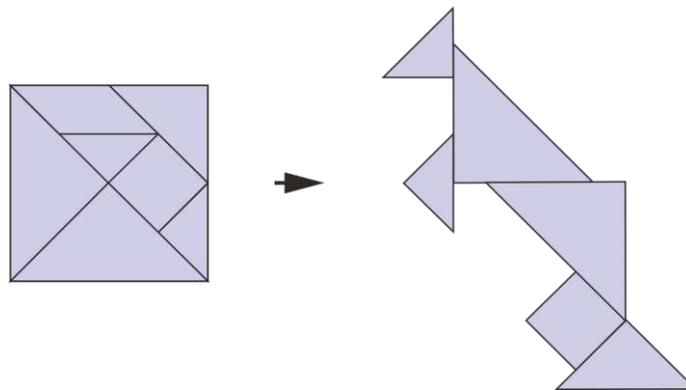
- (A) (B) (C) (D) (E) (Note: D and E options are visually identical in the image)

3. Each bowl has 4 balls. Add up the numbers on the balls.

In which bowl is the result biggest?

- (A) (B) (C) (D) (E)

4. Mr Beaver re-arranges the parts to build a kangaroo.

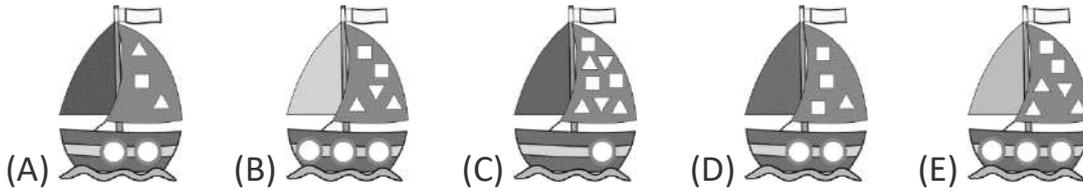


Which part is missing?

- (A) (B) (C) (D) (E)

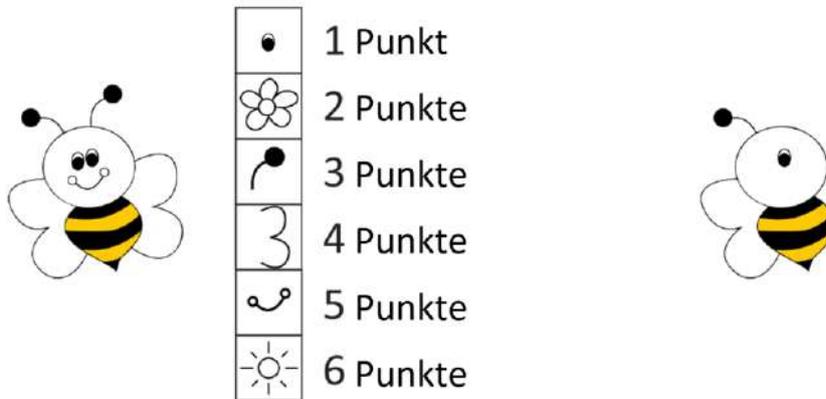
5. Sara says: „My boat has more than one circle. It also has 2 triangles more than squares.“

Which boat belongs to Sara?



- 4 Point Examples -

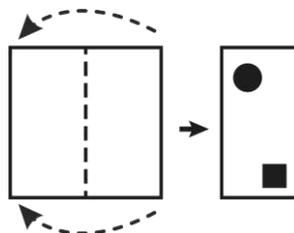
6. The bee on the right has a few pieces missing. Each piece costs points (Punkte).



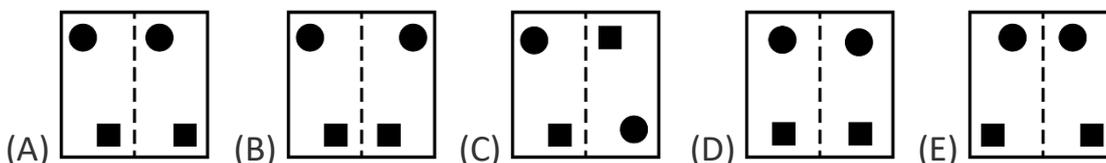
How many points does Maya need to complete the bee?

- (A) 9      (B) 10      (C) 11      (D) 12      (E) 13

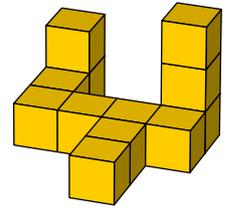
7. Susi folds a piece of paper in the middle. She stamps 2 holes.



What does the piece of paper look like when she unfolds it again?



8. Hansi sticks 12 cubes together to make this figure.  
He always puts one drop of glue between two cubes.  
How many drops of glue does he need?



- (A) 8                      (B) 9                      (C) 10                      (D) 11                      (E) 12

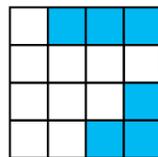
9. The two markers with a question mark have the same number.

$$\textcircled{10} + \textcircled{?} + \textcircled{?} + \textcircled{2} = 18$$

Which number do you have to put instead of the question mark so that the calculation is correct?

- (A) 1                      (B) 2                      (C) 3                      (D) 4                      (E) 5

10. Max wants to complete the jigsaw shown. He has different pieces.



Which pieces does he have to use?

- (A)      (B)      (C)
- (D)      (E)

**- 5 Point Examples -**

11. Emma came third in a dance competition for girls. 3 dancers came between her and the last girl.

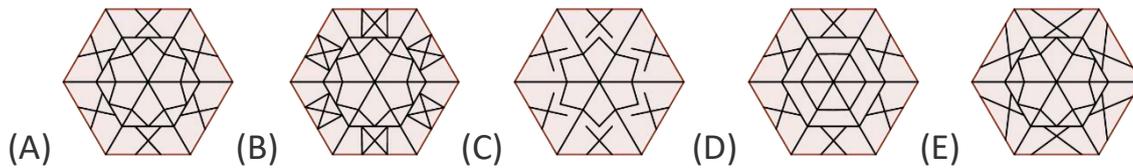
How many dancers took part in the competition?

- (A) 4                      (B) 5                      (C) 6                      (D) 7                      (E) 8



12. Elvis has 6 triangles with this pattern .

Which picture can he make with them?



13. Each of the children Ali, Lea, Josef, Vittorio and Sophie get a birthday cake.

The number on top of the cake shows how old the child is.

Lea is two years older than Josef, but one year younger than Ali.

Vittorio is the youngest.

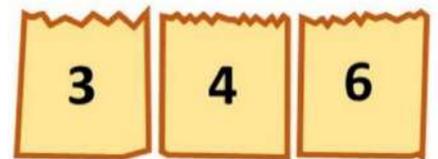
Which cake belongs to Sophie?



14. Maria has a total of 19 apples in 3 bags. She takes the same amount of apples from each bag.

Then there are 3, 4 and 6 apples in the bags.

How many apples did Maria take from each bag?



- (A) 1                      (B) 2                      (C) 3                      (D) 4                      (E) 5

15. Three frogs live in a pond. Each night only one of the frogs sings a song.

After 9 nights the first frog has sung 2 times. The second frog has listened to 5 songs.

How many songs did the third frog listen to?

- (A) 7                      (B) 6                      (C) 5                      (D) 4                      (E) 3

# KÄNGURU DER MATHEMATIK 2023

16. 3. 2023

Level: Écolier, Grade: Schulstufe 3 + 4

Name:	
School:	
Class:	

Time: 60 min.

24 starting points

each correct answer to questions 1. – 8.: 3 points

each correct answer to questions 9. – 16.: 4 points

each correct answer to questions 17. – 24.: 5 points

each questions left unanswered: 0 points

each incorrect answer: minus  $\frac{1}{4}$  of the points for the question



**Please write the letter (A, B, C, D, E) of the correct answer in the square under the question number (1 bis 24). Write clearly and carefully!**

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>

<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>13</b>	<b>14</b>	<b>15</b>	<b>16</b>

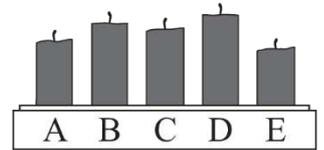
<b>17</b>	<b>18</b>	<b>19</b>	<b>20</b>	<b>21</b>	<b>22</b>	<b>23</b>	<b>24</b>



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- 3 Point Examples -

1. Five children each light a candle at the same time. Lisa blows out the candles at different times. Now they look as shown in the picture.



Which candle did Lisa blow out first?

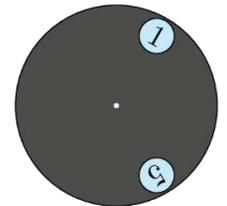
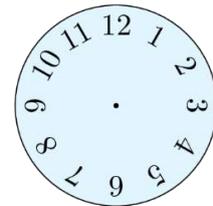
- (A) A                      (B) B                      (C) C                      (D) D                      (E) E
2. The two markers with a question mark have the same value.

$$\text{20} + \text{10} + \text{10} + \text{?} + \text{?} + \text{1} = 51$$

Which value do you have to use instead of the question mark so that the calculation is correct?

- (A) 1                      (B) 2                      (C) 5                      (D) 10                      (E) 20

3. A black disc with two holes is placed on top of a dial of a watch.

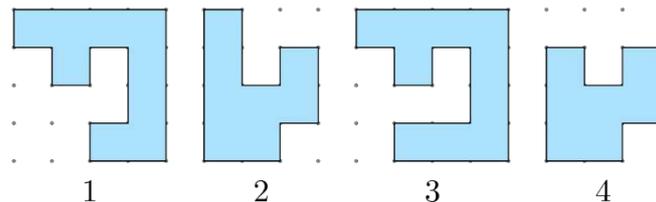


The black disc is turned.

Which two numbers can be seen at the same time?

- (A) 4 and 9              (B) 5 and 10              (C) 5 and 9              (D) 6 and 9              (E) 7 and 12

4. Alice has these four jigsaw pieces:

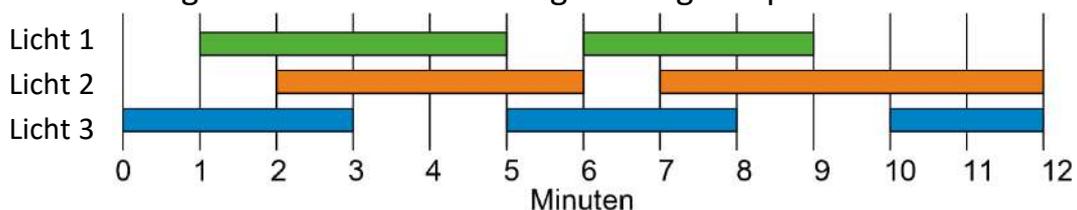


Which two can she put together to form this square?



- (A) 1 and 2              (B) 1 and 3              (C) 2 and 3              (D) 2 and 4              (E) 1 and 4

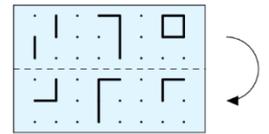
5. Maria switches the lights on and off according to the given plan.



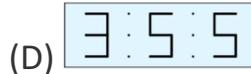
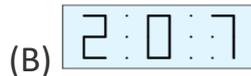
For how many minutes in total are there exactly two lights on at the same time?

- (A) 2                      (B) 6                      (C) 8                      (D) 9                      (E) 10

6. Christoph folds a see-through piece of foil along the dashed line.



What can he then see?



7. Anna has four discs of different sizes. She wants to build a tower using 3 discs.

A smaller disc always has to lie on top of a bigger disc.

How many ways are there for Anna to build this tower?

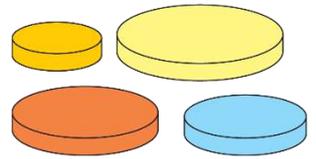
(A) 1

(B) 2

(C) 4

(D) 5

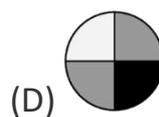
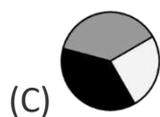
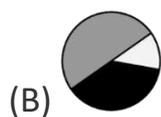
(E) 6



8. Daniel sticks these two pieces of paper on this black circle:  
The two pieces of paper are not allowed to overlap.



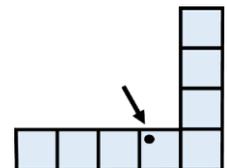
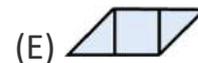
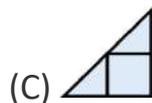
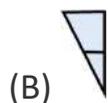
Which picture does he get?



**- 4 Point Examples -**

9. Using the pieces A, B, C, D and E one can fill this shape completely:

Which of the pieces lies on the dot?



10. The six weights of a scale weigh 1 kg, 2 kg, 3 kg, 4 kg, 5 kg and 6 kg.  
Rosi places five weights on the two scale pans so that they are balanced. The sixth weight is left aside.



Which weight is left aside?

(A) 1 kg

(B) 2 kg

(C) 3 kg

(D) 4 kg

(E) 5 kg

11. The diagram shows four cars 1, 2, 3 and 4. The arrows show where the cars move to in 5 seconds.

Which cars will crash into each other?

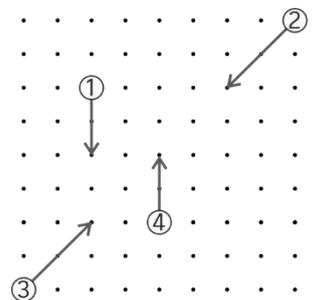
(A) 1 and 2

(B) 1 and 3

(C) 1 and 4

(D) 2 and 3

(E) 3 and 4



12. North of Straße A (street A) there are 7 houses.  
East of Straße B (street B) there are 8 houses.  
South of Straße A (street A) there are 5 houses.

How many houses are there West of Straße B (street B)?

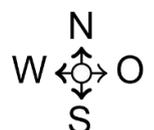
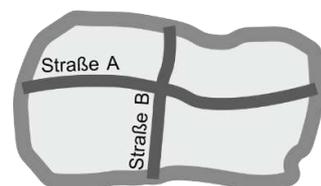
(A) 4

(B) 5

(C) 6

(D) 7

(E) 8



13. In a queue in front of a ferry there are 8 cars with 19 people in total. There are either 2 or 3 people in each car.

How many cars are there with exactly 2 people?

- (A) 2            (B) 3            (C) 4            (D) 5            (E) 6

14. 6 beavers and 2 kangaroos are standing on the fields in this  order: Of three animals in a row there is always exactly one kangaroo.

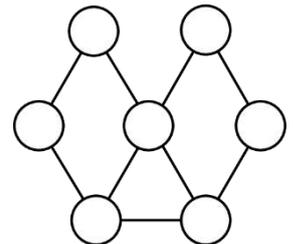
On which of these numbers stands a kangaroo?

- (A) 1            (B) 2            (C) 3            (D) 4            (E) 5

15. Hanni wants to colour in the circles in the diagram. When two circles are connected by a line they should have different colours.

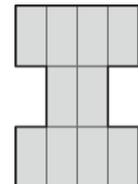
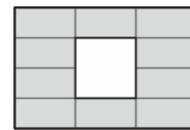
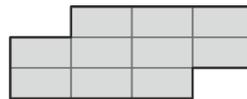
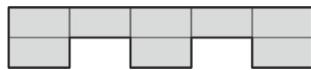
What is the minimum number of colours she needs?

- (A) 2            (B) 3            (C) 4            (D) 5            (E) 6



16. A building block is made up of five identical rectangles: 

How many of the patterns shown below can be made with two such building blocks without overlap?



- (A) 1            (B) 2            (C) 3            (D) 4            (E) 5

**- 5 Point Examples -**

17. An underground line has the six stations A, B, C, D, E and F. The train stops at every station. After reaching the end of the line A or F the train continues in the opposite direction.

The train conductor starts his journey in station B. His first stop is in station C.

In which station will be his 46<sup>th</sup> stop?

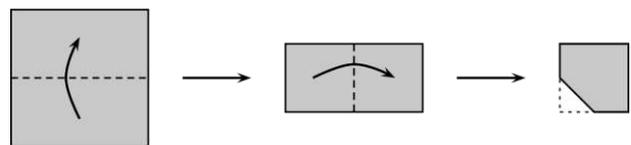
- (A) A            (B) B            (C) C            (D) D            (E) E

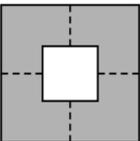
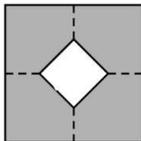
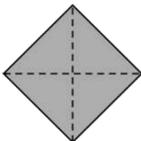
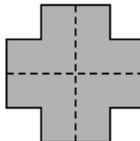
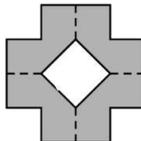


18. Rebecca folds a square piece of paper twice. Then she cuts off one corner as you can see in the diagram.

Then she unfolds the paper.

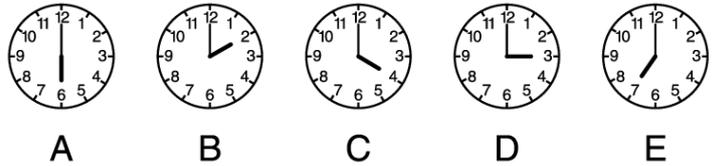
What could the paper look like now?



- (A)     (B)     (C)     (D)     (E) 

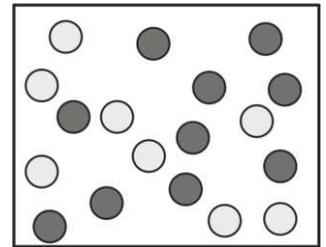
19. Three boys enter a room one after the other.  
 Hermann is not the first. Felix is not the second. Clemens is not the third.  
 How many different orders are there for the boys to enter the room?  
 (A) 1            (B) 2            (C) 3            (D) 4            (E) 6

20. Five clocks are hanging on the wall. One clock is one hour ahead. Another one is one hour late and one is correct. Two clocks have stopped working.



- Which clock shows the correct time?  
 (A) A            (B) B            (C) C            (D) D            (E) E

21. Adam has 9 marbles and Brenda also has 9 marbles. Together they have 8 white and 10 black marbles. Brenda has twice as many black marbles as white marbles.



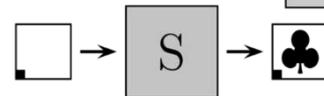
- How many black marbles does Adam have?  
 (A) 3            (B) 4            (C) 5            (D) 6            (E) 0

22. Else has two machines R and S.

If she puts a square piece of paper into machine R it is rotated:



If she puts the piece of paper in machine S it is printed on:



She wants to produce the following picture:

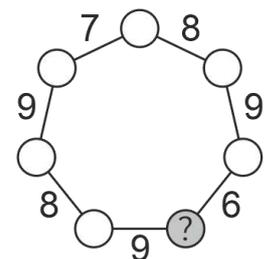


In which order does Else use the two machines so that she gets this picture?



- (A) SRR            (B) RSR            (C) RSS            (D) RRS            (E) SRS

23. A teacher wants to write the numbers from 1 to 7 into the circles. He writes exactly one number in each circle. When he adds up the two numbers of circles that are next to each other, he gets the number that is written between the two circles.



Which number does he write in the circle with the question mark?

- (A) 1            (B) 2            (C) 3            (D) 4            (E) 5

24. Maria colours exactly 5 cells of this grid  in grey. Then she has her 5 friends guess which cells she has coloured in and their answers are the five patterns A, B, C, D and E. Maria looks at the patterns and says: „One of you is right. The others have each guessed exactly four cells correctly.“

Which pattern did Maria paint?

- (A)     (B)     (C)     (D)     (E) 

# KÄNGURU DER MATHEMATIK 2023

## 16. 3. 2023

**Level: Benjamin, Grade: Schulstufe 5 + 6**

Name:	
School:	
Class:	

Time: 60 min.

24 starting points

each correct answer to questions 1. – 8.: 3 points

each correct answer to questions 9. – 16.: 4 points

each correct answer to questions 17. – 24.: 5 points

each questions left unanswered: 0 points

each incorrect answer: minus  $\frac{1}{4}$  of the points for the question



**Please write the letter (A, B, C, D, E) of the correct answer in the square under the question number (1 bis 24). Write clearly and carefully!**

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>

<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>13</b>	<b>14</b>	<b>15</b>	<b>16</b>

<b>17</b>	<b>18</b>	<b>19</b>	<b>20</b>	<b>21</b>	<b>22</b>	<b>23</b>	<b>24</b>



Information über den Känguruwettbewerb: [www.kaenguru.at](http://www.kaenguru.at)  
Wenn du mehr in dieser Richtung machen möchtest,  
gibt es die Österreichische Mathematikolympiade.  
Infos unter: [www.oemo.at](http://www.oemo.at)

# Känguru der Mathematik 2023

## Level Benjamin (Schulstufe 5 and 6)

### Austria – 16. 3. 2023



#### - 3 Point Examples -

1. Holger writes the numbers up to 40 in the table in the same way as shown.  
Which of the pieces A to E can he then cut from the table?

1	2	3	4	5	6	7	8
9	10	11	12				

(A) 

12	23
22	33

 (B) 

12	21
20	28

 (C) 

12	21
20	29

 (D) 

12	22
21	30

 (E) 

12	22
21	31

2. Matchsticks are arranged to form numbers as shown. To form the number 15 one needs 7 matchsticks.  
To form the number 8 one needs the same amount.  
What is the biggest number that one can build using 7 matchsticks?

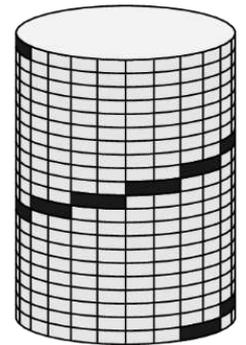
(A) (B) (C) (D) (E)

3. Which of the shapes **cannot** be split into two triangles using a single straight line?

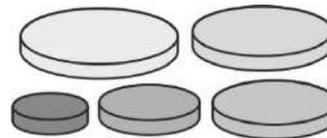
(A) (B) (C) (D) (E)

4. Nine steps of a staircase arranged in a cylindrical order starting at the bottom and leading all the way to the top can be seen. All steps are equally high.  
How many steps **cannot** be seen?

(A) 9 (B) 10 (C) 11 (D) 12 (E) 13

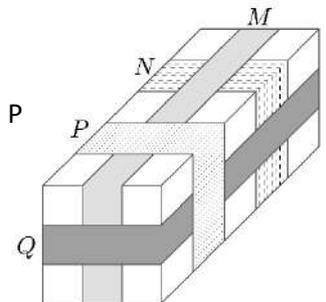


5. Anna has five discs of different sizes. She wants to use 4 of them to build a tower.  
She always has to place a smaller one on top of a bigger one.  
How many ways are there for Anna to build the tower?
- (A) 4 (B) 5 (C) 9 (D) 12 (E) 20



6. Four ribbons M, N, P and Q are wrapped around a box.  
In which order were they wrapped around the box?

(A) M, N, Q, P (B) N, M, P, Q (C) N, Q, M, P (D) N, M, Q, P (E) Q, N, M, P



7. Alice has four jigsaw pieces.

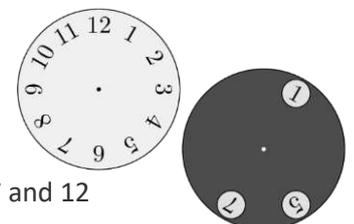
1 2 3 4

- Which two can be fitted together to form a hexagon?

(A) 1 and 2 (B) 1 and 3 (C) 2 and 3 (D) 2 and 4 (E) 1 and 4

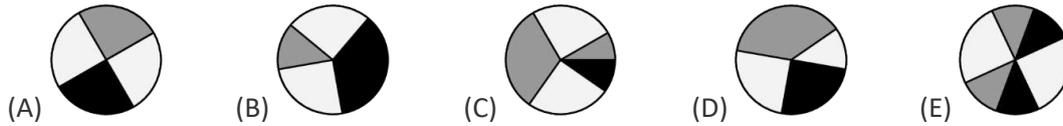
8. A dark disc with three holes is placed on top of a dial of a watch (see diagram). Then the disc is rotated around its centre.  
Which numbers can be seen at the same time?

(A) 4, 6 and 12 (B) 1, 5 and 10 (C) 2, 4 and 9 (D) 3, 6 and 9 (E) 5, 7 and 12



**- 4 Point Examples -**

9. Jan sticks these three pieces of paper  on top of a black circle . Which picture can he **not** obtain?

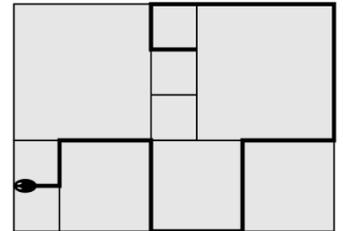


10. Franziska writes down three consecutive two-digit numbers. They are in increasing order. Instead of the digits she uses symbols and writes  $\square\triangle, \heartsuit\triangle, \heartsuit\square$ . What does Franziska's next number look like?

- (A)  $\square\heartsuit$     (B)  $\square\square$     (C)  $\heartsuit\heartsuit$     (D)  $\triangle\square$     (E)  $\heartsuit\triangle$

11. A terrace is covered with square tiles of different sizes. The smallest tile has a perimeter of 80 cm. A snake lay down along the edges of the tiles (see diagram). How long is the snake?

- (A) 380 cm    (B) 400 cm    (C) 420 cm    (D) 440 cm    (E) 1680 cm



12. The picture of a digital watch can be seen in a mirror:



Which picture of the watch can be seen in the mirror 30 minutes later?

- (A)     (B)     (C)     (D)     (E) 

13. Maria, Peter, Richard and Tina play football in the classroom. While doing so a window pane broke. When the head mistress wanted to find out who broke the window pane she got the following answers: Maria: „It was Peter.“ Peter: „It was Richard.“ Richard: „It wasn't me.“ Tina: „It wasn't me.“ Later it became clear that only one child spoke the truth. Who broke the window pane?

- (A) Maria    (B) Tina    (C) Peter    (D) Richard    (E) It cannot be determined.

14. The sums of the numbers in the white and in the grey fields should be equally big. Which two numbers have to be swapped so that the sums are equally big?

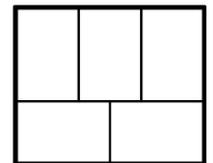
- (A) 1 and 11    (B) 2 and 8    (C) 3 and 7    (D) 4 and 13    (E) 7 and 13

1	3	5	2	13
7	4	6	8	11

15. The big rectangle is made up of five small rectangles (see diagram). Lukas wants to colour in the small rectangles in red, blue and yellow. Two rectangles next to each other should be coloured in different colours.

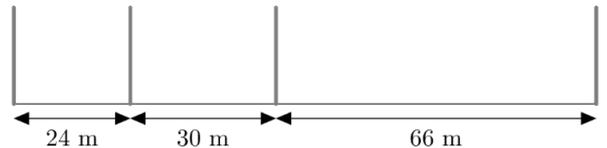
How many ways are there for Lukas to do that?

- (A) 3    (B) 4    (C) 5    (D) 6    (E) 7



16. 4 posts are placed along a 120 m long running track. How many more posts have to be placed so that the running track is split into equally long sections that way?

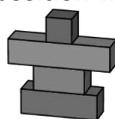
- (A) 12    (B) 15    (C) 17    (D) 20    (E) 37



**- 5 Point Examples -**

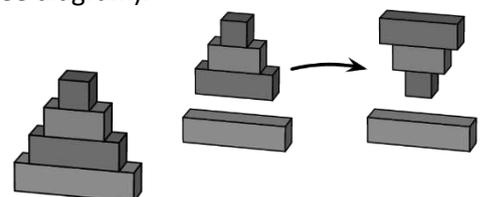
17. In a game one is allowed to take (some or all) building blocks from the top of a stack of building blocks, turn them upside down and place them back in the same position within one move (see diagram).

Goran starts with this stack of building blocks:



In the end all building blocks should be ordered according to size like this: What is the minimum number of moves Goran needs to make?

- (A) 2    (B) 3    (C) 4    (D) 5    (E) 6

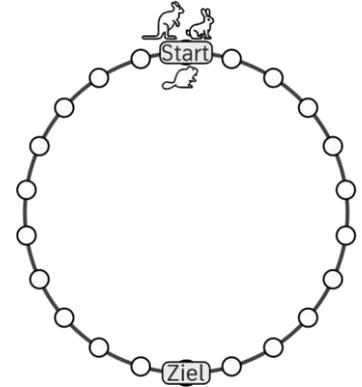


18. Robert and Sonja play a game with the following rules: taking it in turn they can take 1, 2, 3, 4 or 5 cards from the pile on each move. Whoever takes the last card has lost.

At the moment there are 10 cards on the pile and it is Robert's turn.

How many cards should he leave for Sonja so that he can be certain to win?

- (A) 9 (B) 8 (C) 7 (D) 6 (E) 5



19. A rabbit, a beaver and a kangaroo are having a competition. All three begin at the same time from the "Start" and hop in the same direction.

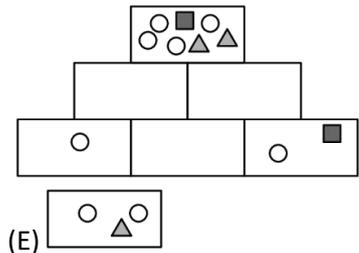
The beaver always moves one position forwards with each jump. The rabbit always moves two positions forwards with one jump and the kangaroo always three positions. Whoever takes the least amount of jumps to land exactly in the position labelled „Ziel“ is the winner.

Who wins the competition?

- (A) Kangaroo and rabbit (B) Rabbit (C) Kangaroo (D) Beaver (E) Kangaroo and beaver

20. Tina draws shapes into each field of the pyramid. Each field in the second and third row contains exactly the shapes of the two fields below. Some fields are already done.

Which shapes does she draw into the empty field of the bottom row?



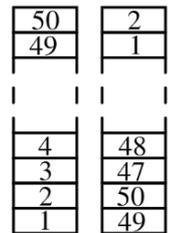
- (A) (B) (C) (D) (E)

21. A tower is made up of bricks that are labelled with the numbers from 1 to 50 from bottom to top. Bob uses these bricks to build a new tower.

Each time he takes the two topmost bricks off the old tower and places them down on top of the new tower without changing their order (see diagram).

Which two bricks lie on top of each other when he is finished with the re-arrangement?

- (A) 29 and 28 (B) 34 and 35 (C) 29 and 26 (D) 31 and 33 (E) 27 and 30



22. Martin has three cards that are labelled on both sides with a number.

Martin places the three cards on the table without paying attention to back or front. He adds the three numbers that he can then see.

How many different sums can Martin get that way?

- (A) 3 (B) 5 (C) 6 (D) 9 (E) A different amount.



23. Anna has two machines R and S. If she places a square piece of paper in machine R it is rotated 90° in a clockwise direction. → R → (Hint: Note the marking in the corner!)

If she places the piece of paper in machine S, it gets printed on. → S →

She wants to produce this picture:

In which order does Anna use the two machines so that this picture is made?



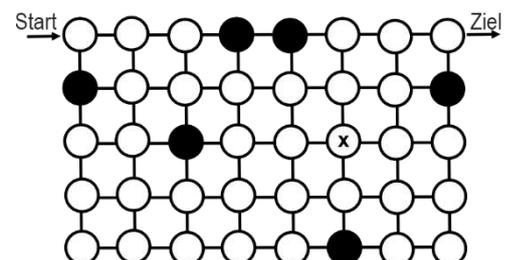
- (A) SRRR (B) RSRR (C) SRSR (D) RRRS (E) SRRS

24. Monika wants to find a path through the labyrinth from 'Start' to 'Ziel'. She has to stick to the following rules:

She is only allowed to move horizontally and vertically respectively. She has to enter every white circle exactly once but is not allowed to enter a black circle.

In which direction does Monika have to move forwards when she reaches the circle marked with x?

- (A) ↓ (B) ↑ (C) → (D) ← (E) there are several possibilities



# KÄNGURU DER MATHEMATIK 2023

## 16. 3. 2023

**Level: Kadett, Grade: Schulstufe 7 + 8**

Name:	
School:	
Class:	

Time: 75 min.

30 starting points

each correct answer to questions 1. – 10.: 3 points

each correct answer to questions 11. – 20.: 4 points

each correct answer to questions 21. – 30.: 5 points

each questions left unanswered: 0 points

each incorrect answer: minus  $\frac{1}{4}$  of the points for the question



**Please write the letter (A, B, C, D, E) of the correct answer in the square under the question number (1 bis 30). Write clearly and carefully!**

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>

<b>11</b>	<b>12</b>	<b>13</b>	<b>14</b>	<b>15</b>	<b>16</b>	<b>17</b>	<b>18</b>	<b>19</b>	<b>20</b>

<b>21</b>	<b>22</b>	<b>23</b>	<b>24</b>	<b>25</b>	<b>26</b>	<b>27</b>	<b>28</b>	<b>29</b>	<b>30</b>



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Infos unter: [www.oemo.at](http://www.oemo.at)

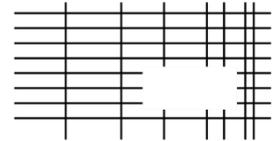
**Känguru der Mathematik 2023**  
**Level Kadett (Schulstufe 7 and 8)**  
**Austria – 16. 3. 2023**



**- 3 Point Examples -**

1. The diagram shows a grid made of vertical and horizontal lines. Which part was cut from the grid?

- (A) (B) (C) (D) (E)

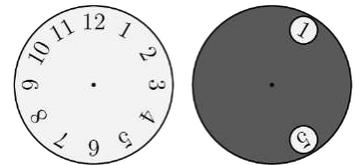


2. Which of the following shapes **cannot** be cut into two trapeziums with one single straight line?

- (A) (triangle) (B) (rectangle) (C) (trapezium)  
 (D) (regular hexagon) (E) (square)

3. A dark disc with two holes is placed on top of a dial of a watch as shown. The dark disc is now rotated so that the number 8 can be seen through one of the holes. Which of the numbers could one see through the other hole now?

- (A) 4 and 12 (B) 1 and 5 (C) 1 and 4 (D) 7 and 11 (E) 5 and 12

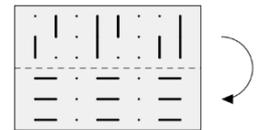


4. John throws 150 coins onto a table. 60 of them show „head“, the others show „tail“. He wants the same amount of coins to show „head“ as „tail“. How many coins that show „head“ does he have to turn over?

- (A) 10 (B) 15 (C) 20 (D) 25 (E) 30

5. Kristina has a piece of see-through foil on which some points and lines are drawn. She folds the foil along the dotted line. What can she see now?

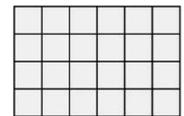
- (A) (B) (C) (D) (E)



6. A grid should be cut along the black lines into several identical shapes. No piece is to be left over.

Into which of the following shapes is it **not** possible to cut this grid in this way?

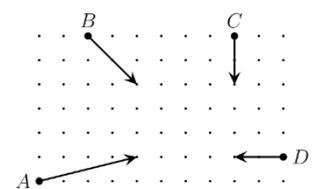
- (A) (B) (C) (D) (E)



7. The diagram shows the starting position, the direction and the distance covered within 5 seconds by four bumper cars.

Which two cars will first crash into each other?

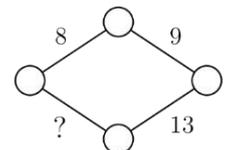
- (A) A and B (B) A and C (C) A and D (D) B and C (E) C and D



8. Werner wants to label each side and each corner point of the rhombus shown with exactly one number. He wants the number on each side to be equal to the sum of the numbers on the corner points of that sides.

Which number is he going to write in the place of the question mark?

- (A) 11 (B) 12 (C) 13 (D) 14 (E) 15



9. Anna has five circular discs that are all of different sizes. She wants to build a tower using three discs where a smaller disc always has to lie on top of a bigger disc. How many ways are there for Anna to build the tower?

- (A) 5 (B) 6 (C) 8 (D) 10 (E) 15



10. Evita wants to write the numbers from 1 to 8 with one number in each field. The sum of the numbers in each row should be equal. The sum of the numbers in the four columns should also be the same. She has already written in the numbers 3, 4 and 8 (see diagram).

Which number does she have to write in the dark field?

- (A) 1 (B) 2 (C) 5 (D) 6 (E) 7



**- 4 Point Examples -**

11. Dorli writes down three consecutive natural numbers in increasing order.

She replaces the digits using symbols and gets:  $\square\diamond\diamond, \heartsuit\Delta\Delta, \heartsuit\Delta\square$ .

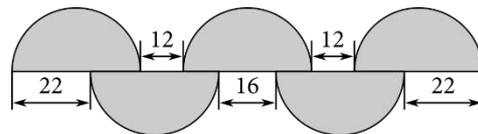
What would be the next bigger number in this notation?

- (A)  $\heartsuit\heartsuit\diamond$       (B)  $\square\heartsuit\square$       (C)  $\heartsuit\Delta\diamond$       (D)  $\heartsuit\diamond\square$       (E)  $\heartsuit\Delta\heartsuit$

12. The diagram shows 5 equally big semicircles and the length of 5 distances.

How big is the radius of one semicircle?

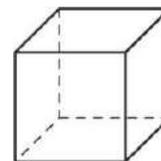
- (A) 12      (B) 16      (C) 18      (D) 22      (E) 36



13. Some edges of a cube are coloured in red so that each sides of the cube has at least one red edge.

What is the minimum number of red edges that the cube has?

- (A) 2      (B) 3      (C) 4      (D) 5      (E) 6



14. The digits 0 to 9 can be formed using matchsticks (see diagram).

How many different positive whole numbers can be formed this way with exactly 6 matchsticks?

- (A) 2      (B) 4      (C) 6      (D) 8      (E) 9



15. The side lengths of a square are 1 cm long.

How many points on a plane surface are there that are exactly 1 cm away from two corner points of the square?

- (A) 4      (B) 5      (C) 6      (D) 10      (E) 12

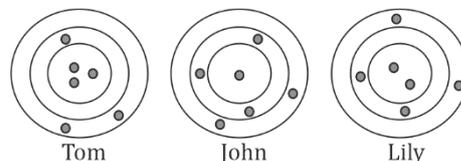
16. Some kangaroos and three beavers are standing in a circle. No beaver stands directly next to another beaver. There are exactly three kangaroos that are standing next to another kangaroo.

What is the biggest possible number of kangaroos in the circle?

- (A) 4      (B) 5      (C) 6      (D) 7      (E) 8

17. Tom, John and Lily have each shot 6 arrows on a disc with three sections (see diagram). The number of points of a hit depends on the section that has been hit. Tom has 46 points and John has 34 points. How many points did Lily get?

- (A) 37      (B) 38      (C) 39      (D) 40      (E) 41



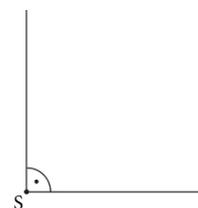
18. Max and two of his friends are standing in a line. The number of people in the line is a multiple of 3. He realises that there are the same number of people in front of him as there are behind him. His two friends are both behind him: one is in position 19, the other one in position 28 of the line. In which position of the line is Max?

- (A) 14.      (B) 15.      (C) 16.      (D) 17.      (E) 18.

19. Two rays starting in  $S$  form a right angle. More rays starting in  $S$  are drawn within the right angle so that each angle  $10^\circ, 20^\circ, 30^\circ, 40^\circ, 50^\circ, 60^\circ, 70^\circ$  and  $80^\circ$  is enclosed by two rays.

What is the minimum number of rays that have to be drawn?

- (A) 2      (B) 3      (C) 4      (D) 5      (E) 6



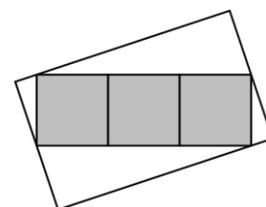
20. The sum of 2023 consecutive integers is 2023. What is the sum of the digits of the biggest of those numbers?

- (A) 4      (B) 5      (C) 6      (D) 7      (E) 8

**- 5 Point Examples -**

21. The diagram shows a grey rectangle that lies within a bigger rectangle which sides it touches. Two corner points of the grey rectangle are the midpoints of the shorter sides of the bigger rectangle. The grey rectangle is made up of three squares that each have an area of  $25\text{ cm}^2$ . How big is the area of the bigger rectangle in  $\text{cm}^2$ ?

- (A) 125      (B) 136      (C) 149      (D) 150      (E) 172



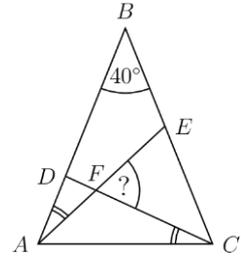
22. Snow White organises a chess tournament for the seven dwarfs lasting several days. Every dwarf has to play every other dwarf exactly once.

On Monday Grumpy plays 1 game, Sneezy plays 2, Sleepy 3, Bashful 4, Happy 5 and Doc 6 games.  
How many games does Dopey, the 7th dwarf, play on Monday?

- (A) 1 (B) 2 (C) 3 (D) 4 (E) 5

23. The shown triangle  $ABC$  is isosceles with  $\sphericalangle ABC = 40^\circ$ .  
The two angles indicated  $\sphericalangle EAB$  and  $\sphericalangle DCA$  are equally big.  
How big is the angle  $\sphericalangle CFE$ ?

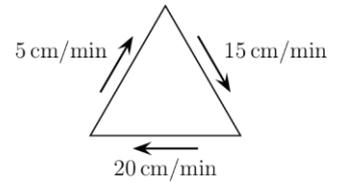
- (A)  $55^\circ$  (B)  $60^\circ$  (C)  $65^\circ$  (D)  $70^\circ$  (E)  $75^\circ$



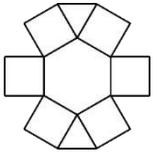
24. An ant walks along the sides of an equilateral triangle (see diagram). Its velocity is 5 cm/min along the first side, 15 cm/min along the second and 20 cm/min along the third.

With which average velocity in cm/min does the ant walk once around the entire triangle?

- (A) 10 (B)  $\frac{80}{11}$  (C)  $\frac{180}{19}$  (D) 15 (E)  $\frac{40}{3}$



25. Elisabeth wants to write the numbers 1 to 9 in the fields of the diagram shown so that the product of the numbers of two fields next to each other is no greater than 15.  
Two fields are called „next to each other“ if they share a common edge.

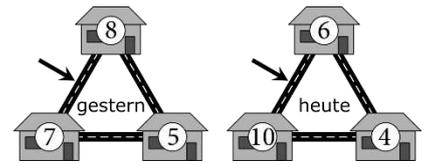


How many ways are there for Elisabeth to label the fields?

- (A) 8 (B) 12 (C) 16 (D) 24 (E) 32

26. Several mice live in three houses. Last night every mouse left their house and moved directly to one of the other two houses. The diagram shows how many mice were in each house yesterday and today.  
How many mice used the path that is indicated with an arrow?

- (A) 9 (B) 11 (C) 12 (D) 16 (E) 19



27. Bart wrote the number 1015 as a sum of numbers that are made up of only the digit 7. In total he uses the digit 7, 10 times. Now he wants to write the number 2023 as a sum of numbers that are made up of only the digit 7. He uses the digit 7, 19 times in total.  
How often does he have to use the number 77?

- (A) 2 (B) 3 (C) 4 (D) 5 (E) 6

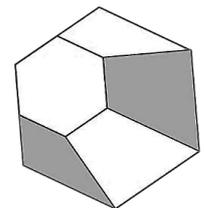
$$\begin{array}{r} 777 \\ + 77 \\ + 77 \\ + 77 \\ \hline 7 \\ \hline 1015 \end{array}$$

28. A regular hexagon is split into four quadrilaterals and a smaller regular hexagon.

The ratio  $\frac{\text{Area of the dark sections}}{\text{Area of the small hexagon}} = \frac{4}{3}$ .

How big is the ratio  $\frac{\text{Area of the small hexagon}}{\text{Area of the big hexagon}}$ ?

- (A)  $\frac{3}{11}$  (B)  $\frac{1}{3}$  (C)  $\frac{2}{3}$  (D)  $\frac{3}{4}$  (E)  $\frac{3}{5}$



29. Jakob wrote six consecutive numbers on six little pieces of white paper, one number per piece of paper. He stuck those six pieces of paper on the front and back of three coins. Then he threw the coins three times. After the first throw the numbers 6, 7, 8 were on top (see diagram) which Jakob then coloured in red.

After the second throw the sum of the numbers on top was 23 and after the third throw the sum was 17.

How big is the sum of the numbers on the three white pieces of paper?

- (A) 18 (B) 19 (C) 23 (D) 24 (E) 30



30. A rugby team scored 24, 17 and 25 points in their 7<sup>th</sup>, 8<sup>th</sup> and 9<sup>th</sup> game of the previous season. The average number of points per game was higher after 9 games than after their first 6 games. Their average after 10 games was more than 22 points. What is the minimum number of points they have scored in their 10<sup>th</sup> game?

- (A) 22 (B) 23 (C) 24 (D) 25 (E) 26

# KÄNGURU DER MATHEMATIK 2023

16. 3. 2023



Level: Junior, Grade: Schulstufe 9 + 10

Full name:

School:

Class:

Time: 75 min.

30 starting points

each correct answer to questions 1. – 10.: 3 points

each correct answer to questions 11. – 20.: 4 points

each correct answer to questions 21. – 30.: 5 points

each questions left unanswered: 0 points

each incorrect answer: minus  $\frac{1}{4}$  of the points for the question

Please write the letter (A, B, C, D, E) of the correct answer in the square under the question number (1 bis 30). Write clearly and carefully!

1	2	3	4	5	6	7	8	9	10

11	12	13	14	15	16	17	18	19	20

21	22	23	24	25	26	27	28	29	30

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Mit meiner Unterschrift gebe ich das Einverständnis, dass meine angeführten personenbezogenen Daten (Vor- und Zuname, Klasse, Schulstufe, Schulstandort und Schularart) zum Zweck der Organisation und Durchführung des Wettbewerbs, der Auswertung der Wettbewerbsergebnisse (Ermitteln der erreichten Punkte und Prozentzahlen), des Erstellens von schulweiten Reihungen, sowie zur Erstellung und Veröffentlichung der Siegerlisten auf unserer Vereinshomepage (sofern mindestens 50 % der zu erreichenden Punktezahl erlangt werden bzw. ich unter den besten 10 einer Kategorie liege) verwendet werden dürfen.

### Betroffenenrechte

Die Verwendung dieser Daten ist bis 31. Dezember des 2. Folgejahres gestattet. Nach diesem 31. Dezember werden Vor- und Zuname, die Klasse und der Schulstandort gelöscht, wobei dieser durch die Angabe des Bundeslandes ersetzt wird. Die Verwendung der auf diese Art anonymisierten Daten ist nur mehr für statistische Zwecke auf der Grundlage der DSGVO erlaubt.

Ich habe ein Recht auf Auskunft über meine gespeicherten personenbezogenen Daten, sowie das Recht auf Berichtigung, Datenübertragung, Widerspruch, Einschränkung der Bearbeitung sowie Sperrung oder Löschung unrichtig verarbeiteter Daten.

Ich kann die erteilte Einwilligung jederzeit auf der Homepage des Vereines Känguru der Mathematik unter [www.kaenguru.at](http://www.kaenguru.at) mittels des dafür bereitgestellten Formulars mit Wirkung für die Zukunft widerrufen (Art. 21 Abs. 1 DSGVO).

Ein Widerruf hat zur Folge, dass die personenbezogenen Daten nach gegenseitiger Rücksprache innerhalb von 31 Tagen gelöscht werden.

Durch den Widerruf wird die Rechtmäßigkeit der aufgrund der Einwilligung bis zum Widerruf erfolgten Verarbeitung nicht berührt. (Art. 7 Abs. 2 DSGVO)

Ort, Datum

Unterschrift



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# Känguru der Mathematik 2023

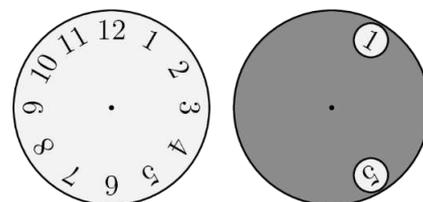
## Level Junior (Schulstufe 9 and 10)

### Austria – 16. 3. 2023



#### - 3 Point Examples -

1. A dark disc with two holes is placed on the dial of a watch as shown in the diagram. The dark disc is now rotated so that the number 10 can be seen through one of the holes.

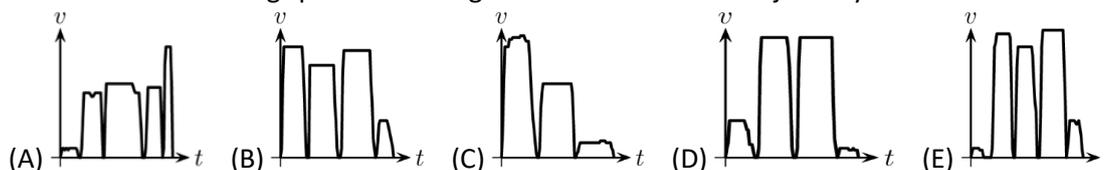


Which of the numbers could one see through the other hole now?

- (A) 2 and 6    (B) 3 and 7    (C) 3 and 6    (D) 1 and 9    (E) 2 and 7

2. On her way to school Maria first had to run to the underground, she exited from that after two stops and subsequently walked the rest of the way by foot all the way to school.

Which of the following speed-time-diagrams best describes her journey to school?

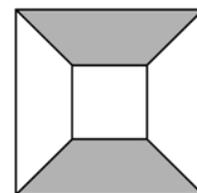


3. The two integers  $m$  and  $n$  are positive and odd. Which of the following numbers is odd?

- (A)  $m \cdot n + 2$     (B)  $(m + 1) \cdot (n + 1)$     (C)  $m + n + 2$     (D)  $m \cdot (n + 1)$     (E)  $m + n$

4. A small square with side length 4 cm is drawn within a big square with side length 10 cm; their sides are parallel to each other (see diagram). What percentage of the figure is shaded?

- (A) 25 %    (B) 30 %    (C) 40 %    (D) 42 %    (E) 45 %

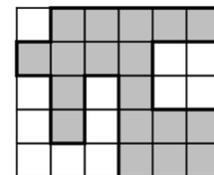


5. Today is Thursday. What day of the week is it in 2023 days?

- (A) Tuesday    (B) Wednesday    (C) Thursday    (D) Friday    (E) Saturday

6. The big rectangle shown is divided into 30 equally big squares. The perimeter of the area shaded in grey is 240 cm. How big is the area of the big rectangle?

- (A) 480 cm<sup>2</sup>    (B) 750 cm<sup>2</sup>    (C) 1080 cm<sup>2</sup>    (D) 1920 cm<sup>2</sup>    (E) 2430 cm<sup>2</sup>

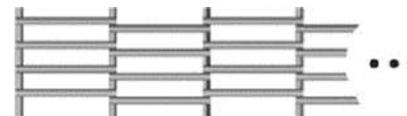


7. If one adds the ages of all members of a family of five together, one gets 80. The two youngest children are 6 and 8 years old. How big was the sum of the ages of the family members 7 years ago?

- (A) 35    (B) 36    (C) 44    (D) 46    (E) 66

8. A straight wooden fence is made up of vertical beams stuck in the ground which are each connected to the next beam by 4 horizontal beams. The fence begins and ends with a vertical beam. Out of how many beams could such a fence be made?

- (A) 95    (B) 96    (C) 97    (D) 98    (E) 99



9. How many pairs of positive integers  $(a, b)$  fulfil the equation  $\frac{a}{5} = \frac{7}{b}$ ?

- (A) 0    (B) 1    (C) 2    (D) 3    (E) 4

10. After playing 200 games of chess, Beth's winning rate is exactly 49 %.

What is the minimum number of games she has to still play to increase her winning rate to 50 %?

- (A) 1    (B) 2    (C) 3    (D) 4    (E) 5

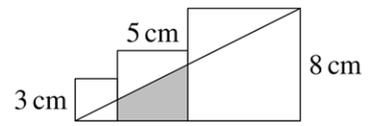
#### - 4 Points Examples -

11. Jennifer wants to save water. She reduces the water pressure and thus reduces the water usage by one quarter. Furthermore, she reduces the time she takes a shower by one quarter.

By which fraction in total does she reduce the water usage for her shower?

- (A) by  $\frac{1}{4}$     (B) by  $\frac{3}{8}$     (C) by  $\frac{1}{16}$     (D) by  $\frac{5}{12}$     (E) by  $\frac{7}{16}$

12. The diagram shows three adjacent squares with side lengths 3 cm, 5 cm and 8 cm. How big is the area of the shaded in trapezium?

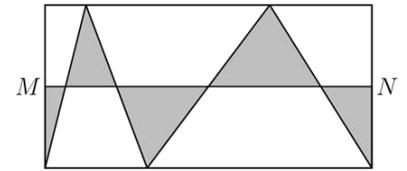


- (A)  $13 \text{ cm}^2$     (B)  $\frac{55}{4} \text{ cm}^2$     (C)  $\frac{61}{4} \text{ cm}^2$     (D)  $\frac{65}{4} \text{ cm}^2$     (E)  $\frac{69}{4} \text{ cm}^2$

13. A rope with length 95 m is cut into three pieces so that each piece is half as long again as the respective previous piece. How long is the longest of the three pieces?

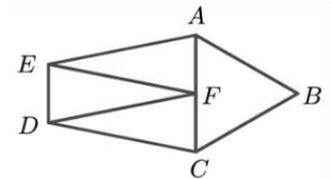
- (A) 39 m    (B) 42 m    (C) 45 m    (D) 48 m    (E) 54 m

14. The points  $M$  and  $N$  are the midpoints of two sides of the big rectangle (see diagram). Which part of the area of the big rectangle is shaded?



- (A)  $\frac{1}{6}$     (B)  $\frac{1}{5}$     (C)  $\frac{1}{4}$     (D)  $\frac{1}{3}$     (E)  $\frac{1}{2}$

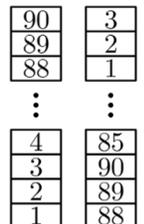
15. The pentagon  $ABCDE$  is split into four triangles that all have the same perimeter (see diagram). Triangle  $ABC$  is equilateral and the triangles  $AEF$ ,  $DFE$  and  $CDF$  are congruent isosceles triangles.



How big is the ratio of the perimeter of the pentagon  $ABCDE$  to the perimeter of the triangle  $ABC$ ?

- (A) 2    (B)  $\frac{3}{2}$     (C)  $\frac{4}{3}$     (D)  $\frac{5}{3}$     (E)  $\frac{5}{2}$

16. A tower consists of blocks that are labelled from bottom to top with the numbers from 1 to 90. Bob uses these blocks to build a new tower. For each step he takes the top three blocks from the old tower and places them on the new tower without changing their order (see diagram). How many blocks are there in the new tower between the blocks with the numbers 39 and 40?



- (A) 0    (B) 1    (C) 2    (D) 3    (E) 4

17. A staircase has 2023 steps. Every third step is coloured in black. The first seven steps of this staircase can be fully seen in the diagram. Anita walks up the staircase and steps on each step exactly once. She can start with either the right or the left foot and then steps down alternately with the right or left foot.



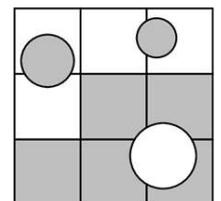
What is the minimum number of black steps she sets her right foot on?

- (A) 332    (B) 333    (C) 336    (D) 337    (E) 672

18. We call a positive integer *powerfree* if none of its digits can be written as a power of an integer with an exponent bigger than 1. For example, the number 53 is powerfree, but the number 54 is not powerfree since  $4 = 2^2$ . Which one of the following numbers is the difference between the biggest and the smallest two-digit powerfree numbers?

- (A) 24    (B) 55    (C) 63    (D) 88    (E) 89

19. A square with side length 30 cm is split into 9 squares. The big square contains three circles with radii 5 cm (bottom right), 4 cm (top left) as well as 3 cm (top right) as seen in the diagram. How many  $\text{cm}^2$  are shaded in grey?



- (A)  $500 + 25\pi$     (B) 500    (C)  $400 + 50\pi$     (D) 400    (E)  $500 - 25\pi$

20. The arithmetic mean of five different prime numbers is an integer number. What is the smallest possible number of this arithmetic mean?

- (A) 5    (B) 6    (C) 7    (D) 8    (E) 9

**- 5 Points Examples -**

21. The numbers from 1 to 9 should be distributed among the 9 squares in the diagram according to the following rules:



There should be one number in each square. The sum of three adjacent numbers is always a multiple of 3. The numbers 3 and 1 are already placed.

How many ways are there to place the remaining numbers?

- (A) 9    (B) 12    (C) 15    (D) 18    (E) 24

22. How many different ways are there to read the word *BANANA* in the following table if we can only cross to a field that shares an edge with the current field and we can use fields several times?

B	A	B
A	N	A
B	A	B

- (A) 56      (B) 64      (C) 84      (D) 112      (E) 128

23. Starting with the four numbers

2, 0, 2, 3

the kangaroo-machine creates numbers according to the following rule: the next number is always the smallest non-negative integer that is different to the four directly previous numbers.

Which number is in position 2023?

- (A) 0      (B) 1      (C) 2      (D) 3      (E) 4

24. A circle with midpoint (75|30) and radius 10 is cut from a rectangle with vertices (0|0), (100|0), (100|50) and (0|50).

What is the gradient of the straight line that goes through the point (75|30) and divides the remaining part of the rectangle into two parts with equal area?

- (A)  $\frac{1}{5}$       (B)  $\frac{1}{3}$       (C)  $\frac{1}{2}$       (D)  $\frac{2}{5}$       (E)  $\frac{2}{3}$

25. When Matilda's smartphone is fully charged it has a battery life of

32 hours if she phones continuously,

20 hours if she surfs the internet continuously and

80 hours if she does not use it at all.

Matilda boards a train with a half full battery. During her time on board she spends the same amount of time each on phoning, surfing the internet and not using the phone at all. Just when she arrives at her destination the battery is empty.

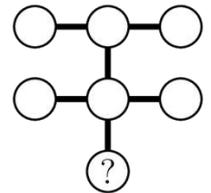
How many hours did the train ride take?

- (A) 10      (B) 12      (C) 14      (D) 16      (E) 18

26. Seven pairwise different single-digit numbers are distributed among the circles shown so that the product of the three numbers that are connected by a straight line is the same in all three cases.

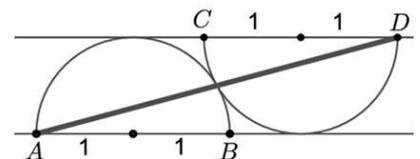
Which number is written in the circle with the question mark?

- (A) 2      (B) 3      (C) 4      (D) 6      (E) 8



27. Consider the two touching semicircles with radius 1 and their diameters *AB* and *CD* respectively that are parallel to each other. The extensions of the two diameters are also tangents to the respective other semicircle (see diagram). How big is the square of the length *AD*?

- (A) 16      (B)  $8+4\sqrt{3}$       (C) 12      (D) 9      (E)  $5+2\sqrt{3}$



28. Leon has drawn a closed loop on the surface of a cuboid.

Which net **cannot** show his loop?

- (A)      (B)      (C)      (D)      (E)

29. Several points are marked on a straight line. Renate marks another point between each pair of adjacent points. She repeats this process three more times. Now there are 225 points marked on this straight line.

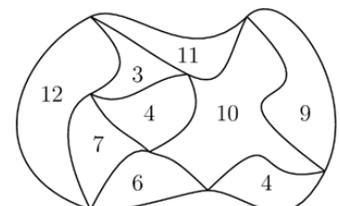
How many points were marked to start with?

- (A) 15      (B) 20      (C) 25      (D) 29      (E) 32

30. The diagram shows the map of a big park. The park is split into several sections and the number in each section states its perimeter in km.

How big is the perimeter of the entire park in km?

- (A) 18      (B) 22      (C) 26      (D) 32      (E) 42



# KÄNGURU DER MATHEMATIK 2023

16. 3. 2023



Level: Student, Grade: Schulstufe 11–13

Full name:

School:

Class:

Time: 75 min.

30 starting points

each correct answer to questions 1. – 10.: 3 points

each correct answer to questions 11. – 20.: 4 points

each correct answer to questions 21. – 30.: 5 points

each questions left unanswered: 0 points

each incorrect answer: minus  $\frac{1}{4}$  of the points for the question

**Please write the letter (A, B, C, D, E) of the correct answer in the square under the question number (1 bis 30). Write clearly and carefully!**

1	2	3	4	5	6	7	8	9	10

11	12	13	14	15	16	17	18	19	20

21	22	23	24	25	26	27	28	29	30

### Zustimmungserklärung zur Datenverarbeitung für den österreichischen Wettbewerb „Känguru der Mathematik“

Mit meiner Unterschrift gebe ich das Einverständnis, dass meine angeführten personenbezogenen Daten (Vor- und Zuname, Klasse, Schulstufe, Schulstandort und Schulart) zum Zweck der Organisation und Durchführung des Wettbewerbs, der Auswertung der Wettbewerbsergebnisse (Ermitteln der erreichten Punkte und Prozentzahlen), des Erstellens von schulweiten Reihungen, sowie zur Erstellung und Veröffentlichung der Siegerlisten auf unserer Vereinshomepage (sofern mindestens 50 % der zu erreichenden Punktezahl erlangt werden bzw. ich unter den besten 10 einer Kategorie liege) verwendet werden dürfen.

### Betroffenenrechte

Die Verwendung dieser Daten ist bis 31. Dezember des 2. Folgejahres gestattet. Nach diesem 31. Dezember werden Vor- und Zuname, die Klasse und der Schulstandort gelöscht, wobei dieser durch die Angabe des Bundeslandes ersetzt wird. Die Verwendung der auf diese Art anonymisierten Daten ist nur mehr für statistische Zwecke auf der Grundlage der DSGVO erlaubt.

Ich habe ein Recht auf Auskunft über meine gespeicherten personenbezogenen Daten, sowie das Recht auf Berichtigung, Datenübertragung, Widerspruch, Einschränkung der Bearbeitung sowie Sperrung oder Löschung unrichtig verarbeiteter Daten.

Ich kann die erteilte Einwilligung jederzeit auf der Homepage des Vereines Känguru der Mathematik unter [www.kaenguru.at](http://www.kaenguru.at) mittels des dafür bereitgestellten Formulars mit Wirkung für die Zukunft widerrufen (Art. 21 Abs. 1 DSGVO).

Ein Widerruf hat zur Folge, dass die personenbezogenen Daten nach gegenseitiger Rücksprache innerhalb von 31 Tagen gelöscht werden.

Durch den Widerruf wird die Rechtmäßigkeit der aufgrund der Einwilligung bis zum Widerruf erfolgten Verarbeitung nicht berührt. (Art. 7 Abs. 2 DSGVO)

Ort, Datum

Unterschrift



Information über den Känguruwettbewerb: [www.kaenguru.at](http://www.kaenguru.at)  
Wenn du mehr in dieser Richtung machen möchtest,  
gibt es die Österreichische Mathematikolympiade.  
Infos unter: [www.oemo.at](http://www.oemo.at)

**Känguru der Mathematik 2023**  
**Level Student (Schulstufe 11, 12 and 13)**  
**Austria – 16. 3. 2023**



- 3 Point Examples -

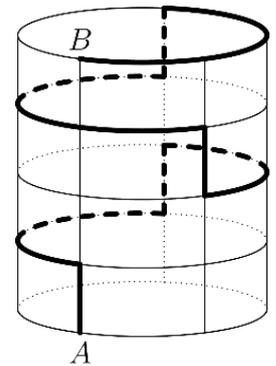
1. What is the simplified representation of the following fraction?  $\frac{7777^2}{5555 \cdot 2222}$

- (A) 1      (B)  $\frac{7}{10}$       (C)  $\frac{49}{10}$       (D)  $\frac{77}{110}$       (E) 49

2. Julia rolls 5 dice at the same time. She obtains a sum total of 19 points. What is the biggest number of sixes she can have rolled?

- (A) 0      (B) 1      (C) 2      (D) 3      (E) 4

3. A cylindrical tin is 15 cm high. The circumference of the base circle is 30 cm. An ant walks from point A at the base to point B at the top. Its path is partly vertically upwards and partly along horizontal circular arcs. Its path is drawn in bold on the diagram (with a solid line on the front and a dashed line at the back). How long is the total distance covered by the ant?

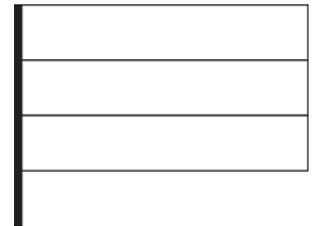


- (A) 45 cm      (B) 55 cm      (C) 60 cm      (D) 65 cm      (E) 75 cm

4. Let  $A$  be a 2023-digit number where every digit is 1. What is the sum of the digits of the number  $A \cdot 1111$ ?

- (A) 8080      (B) 8083      (C) 8086      (D) 8092      (E) 8101

5. Emma should colour in the three strips of the flag shown. She has four colours available. She can only use one colour for each strip and immediately adjacent strips are not to be of the same colour.



How many different ways are there for her to colour in the flag?

- (A) 24      (B) 27      (C) 32      (D) 36      (E) 64

6. We call a positive integer  $n$  *twoprime*, if it has exactly three different positive factors, namely 1, 2 and the number  $n$  itself. How many twoprime numbers are there?

- (A) 0      (B) 1      (C) 2      (D) 3      (E) 4

7. What is the units digit of the following product?  $(5^5 + 1) \cdot (5^{10} + 1) \cdot (5^{15} + 1)$

- (A) 0      (B) 1      (C) 3      (D) 5      (E) 6

8. What is the value of the following sum?

$$2^{0^{2^3}} + 0^{2^{3^2}} + 2^{3^{2^0}} + 3^{2^{0^2}}$$

- (A) 3      (B) 4      (C) 7      (D) 12      (E) more than 100

9. 23 animals are sitting in the first row of a cinema. Each animal is either a beaver or a kangaroo. Each animal has at least one kangaroo next to it.

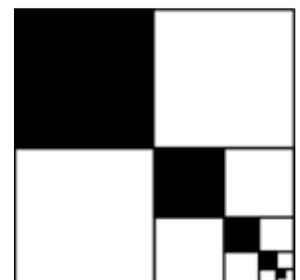
What is the maximum amount of beavers in the row?

- (A) 7      (B) 8      (C) 10      (D) 11      (E) 12

10. A square with area 84 is split into four squares. The upper left square is coloured in black. The lower right square is again split into four squares and so on. The process is repeated infinitely many times.

How big is the area coloured in black?

- (A) 24      (B) 28      (C) 31      (D) 35      (E) 42

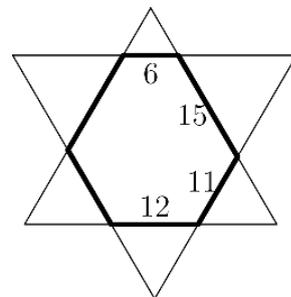


- 4 Point Examples -

7	9					
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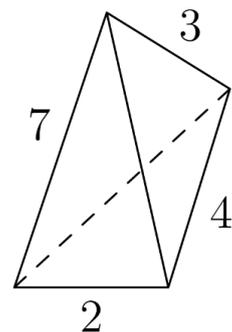
11. The numbers from 1 to 9 are to be distributed to the nine squares in the diagram according to the following rules: There is to be one number in each square. The sum of three adjacent numbers is always a multiple of 3. The numbers 7 and 9 are already written in. How many ways are there to insert the remaining numbers?

- (A) 9      (B) 12      (C) 15      (D) 18      (E) 24



12. Two equilateral triangles of different sizes are placed on top of each other so that a hexagon is formed on the inside whose opposite sides are parallel. Four of the side lengths of the hexagon are stated in the diagram. How big is the perimeter of the hexagon?

- (A) 64      (B) 66      (C) 68      (D) 70      (E) 72



13. Consider the five numbers  $a_1, a_2, a_3, a_4, a_5$  with sum  $S$ . It is known that  $a_k = k + S$  for  $1 \leq k \leq 5$ . What is the value of  $S$ ?

- (A)  $\frac{15}{4}$       (B)  $-\frac{15}{4}$       (C)  $-15$       (D) 15      (E) another number

14. In a three-sided pyramid all side lengths are integers. Four of the side lengths can be seen in the diagram. What is the sum of the two remaining side lengths?

- (A) 9      (B) 10      (C) 11      (D) 12      (E) 13

15. How many pairs of integers  $(m, n)$  fulfil the inequality  $|2m - 2023| + |2n - m| \leq 1$ ?

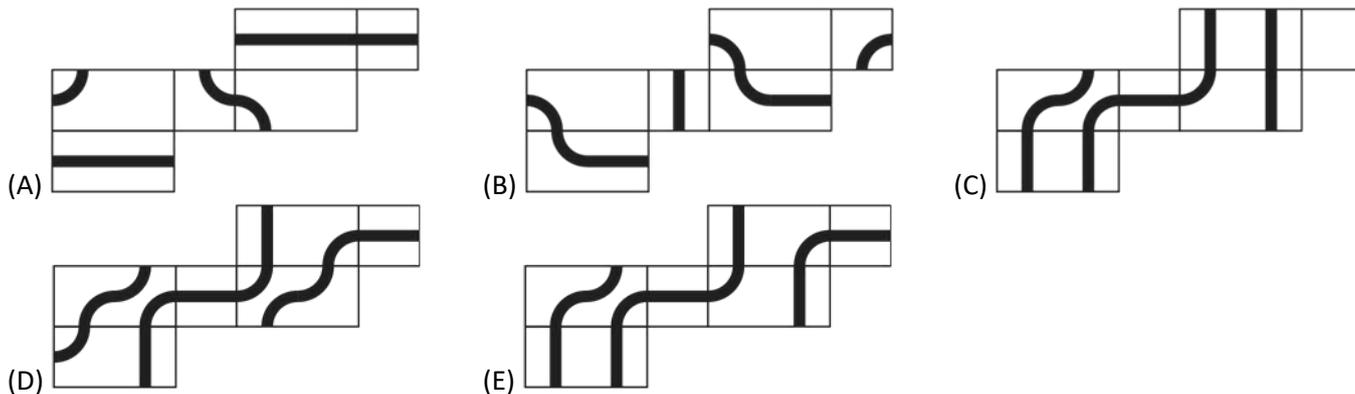
- (A) 0      (B) 1      (C) 2      (D) 3      (E) 4

16. The number  $5^{5^6}$  is to be written in the form  $n^n$  where  $n$  is a natural number. What is the value of  $n$ ?

- (A)  $5 \cdot 5^4$       (B)  $5 \cdot 5^5$       (C)  $5^{30}$       (D) 30      (E)  $25^{25}$

17. Leon has drawn a closed path on the surface of a cuboid.

Which net can represent his path?



18. For each positive integer  $n$  the number  $n!$  is defined as the product of all numbers from 1 to  $n$ . For example,  $4! = 4 \cdot 3 \cdot 2 \cdot 1 = 24$ . For a certain  $N$  the formula  $N! = 6! \cdot 7!$  holds.

How big is the sum of the digits of  $N$ ?

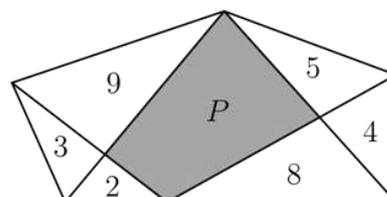
- (A) 1      (B) 2      (C) 4      (D) 8      (E) 9

19. The graphs of the functions  $y = x^3 + 3x^2 + ax + 2a + 4$  all pass through a common point independent of the choice of  $a$ . How big is the sum of the co-ordinates of this common point?

- (A) 2      (B) 4      (C) 7      (D) 8      (E) another number

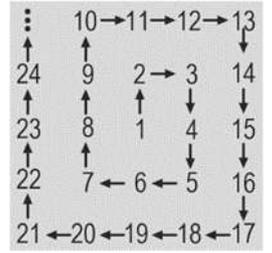
20. A pentagon is cut into smaller parts as shown in the diagram. The numbers in the triangles state the area of the according triangle. How big is the area  $P$  of the grey quadrilateral?

- (A) 15      (B)  $\frac{31}{2}$       (C) 16      (D) 17      (E) another number



**- 5 Point Examples -**

21. The diagram shows a spiral of consecutive numbers starting with 1. In which order will the numbers 625, 626 and 627 appear in the spiral?

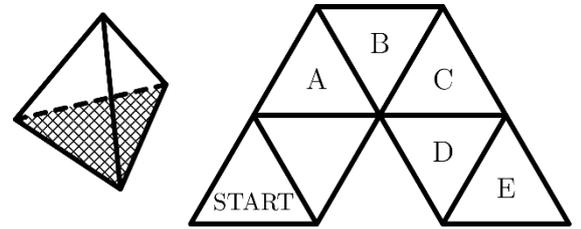


- (A) (B) (C) (D) (E)

22. How many positive integers divide  $2^{20} \cdot 3^{23}$  but not  $2^{10} \cdot 3^{20}$ ?  
 (A) 13 (B) 30 (C) 273 (D) 460 (E) another number

23. 13 athletes took part in a three-part climbing competition. There are no draws in any part. The final rank of each athlete is determined by arranging the products of the ranks in each of the three parts: If an athlete for example comes 4th once, 3rd once and 6th once, he has  $4 \cdot 3 \cdot 6 = 72$  points. The higher the number of points, the worse the final rank. What is the worst possible final rank Hans can get to if he was 1<sup>st</sup> in two of the parts?  
 (A) 2. (B) 3. (C) 4. (D) 5. (E) 6.

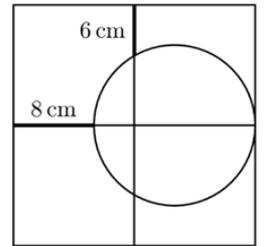
24. A game marker in the shape of a regular tetrahedron has one marked area. That side is placed on the triangle marked START. The marker is then moved within the diagram always to the next adjacent triangle by rolling it around an edge. On which triangle is the marker when it is on the marked side again for the first time?  
 (A) A (B) B (C) C (D) D (E) E



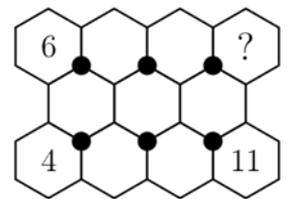
25. A part of a polynomial of degree five is illegible due to an ink stain. It is known that all zeros of the polynomial are integers. What is the highest power of  $x-1$  that divides this polynomial?  
 (A)  $(x-1)^1$  (B)  $(x-1)^2$  (C)  $(x-1)^3$  (D)  $(x-1)^4$  (E)  $(x-1)^5$



26. The big square shown is split into four small squares. The circle touches the right side of the square in its midpoint. How big is the side length of the big square? (Hint: The diagram is not drawn to scale.)  
 (A) 18 cm (B) 20 cm (C) 24 cm (D) 28 cm (E) 30 cm

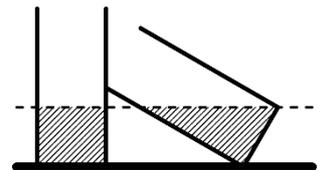


27. What is the biggest common factor of all numbers of the form  $n^3 \cdot (n+1)^3 \cdot (n+2)^3 \cdot (n+3)^3 \cdot (n+4)^3$  where  $n$  is a positive integer?  
 (A)  $2^9 \cdot 3^3$  (B)  $2^3 \cdot 3^3 \cdot 5^3$  (C)  $2^6 \cdot 3^3 \cdot 5^3$  (D)  $2^8 \cdot 3^2 \cdot 5^3$  (E)  $2^9 \cdot 3^3 \cdot 5^3$



28. The numbers from 1 to 11 are written in the empty hexagons. The sums of the three numbers in three hexagons with a common bold point are always equal. Three of the eleven numbers are already written in (see diagram). Which number is written in the hexagon with the question mark?  
 (A) 5 (B) 4 (C) 7 (D) 3 (E) 9

29. Two identical cylindrical glasses contain the same amount of water. The left glass is upright, while the right one rests against the other one at a slant. The water level in both glasses is at the same height. The water level in the leaning glass touches its bottom in exactly one point (see diagram). The bases of both glasses have an area of  $3\pi$  cm<sup>2</sup>. How much water is in each glass?



(A)  $9\pi$  cm<sup>3</sup> (B)  $6\pi$  cm<sup>3</sup> (C)  $3\sqrt{3}\pi$  cm<sup>3</sup> (D)  $\frac{3\pi}{4}$  cm<sup>3</sup> (E) It cannot be uniquely determined from this information.

30. The product of six consecutive numbers is a 12-digit number of the form  $abb\ cdd\ cdd\ abb$ , where the digits  $a$ ,  $b$ ,  $c$  and  $d$  are also consecutive numbers in any order. What is the value of the digit  $d$ ?  
 (A) 1 (B) 2 (C) 3 (D) 4 (E) 5

2023

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Felix 1	D	A	A	E	E	B	D	A	D	A	C	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Felix 2	D	B	A	A	E	E	B	D	C	A	D	A	C	B	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Ecolier	D	C	C	E	C	A	C	E	E	A	D	A	D	C	B	D	D	B	B	D	B	B	D	E	-	-	-	-	-	
Benjamin	C	D	A	D	B	D	B	A	C	C	C	D	B	A	D	C	B	C	E	D	E	E	B	A	-	-	-	-	-	
Kadett	E	A	A	B	C	D	B	B	D	E	E	C	B	C	E	B	D	D	B	A	D	C	D	C	C	B	E	A	A	C
Junior	A	D	A	D	C	D	D	B	E	D	E	B	C	C	D	E	D	B	B	B	E	E	C	A	D	A	B	C	A	C
Student	C	C	E	D	D	B	E	D	D	B	E	D	B	C	B	A	D	A	E	C	B	C	B	E	D	A	E	E	A	C