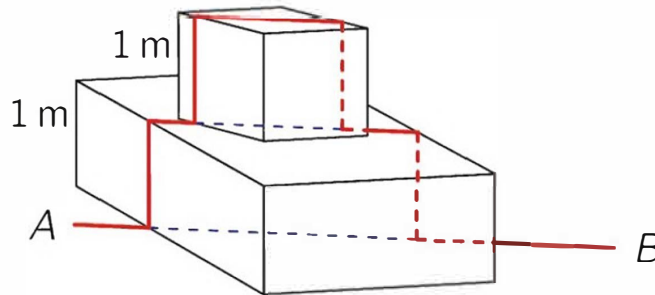


SECTION ONE - (3 point problems)

1. What is the sum of the last two digits of the product  $1 \cdot 2 \cdot 3 \cdot 4 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1$ ?

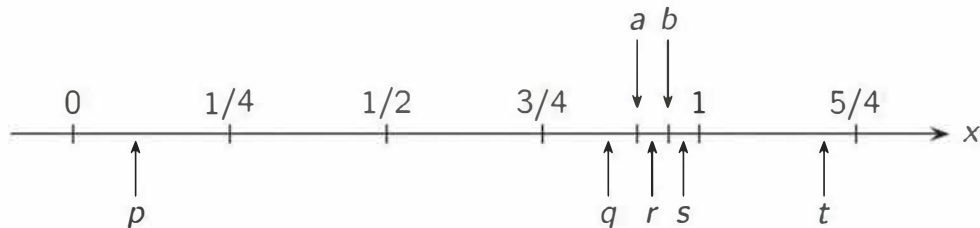
- (A) 2 (B) 4 (C) 6  
 (D) 8 (E) 16

2. An ant walked every day on a straight horizontal line path from A to B, which are 5 m apart. One day humans placed on its path two strange obstacles of height 1 m each. Now the ant walks along or above the same straight line except that it now has to climb up and down vertically over both the two obstacles, as in the picture. How long is its path now?



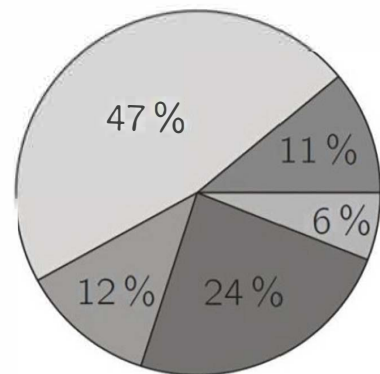
- (A) 7 m (B) 9 m  
 (C)  $5 + 4\sqrt{2}$  m (D)  $9 - 2\sqrt{2}$  m  
 (E) the length depends on the angles the obstacles are situated along the path

3. Rene marked two points  $a$  and  $b$  as accurately as possible on the number line. Which of the points  $p, q, r, s, t$  on the number line does represent best the product  $ab$ ?



- (A)  $p$  (B)  $q$  (C)  $r$   
 (D)  $s$  (E)  $t$

4. The pie chart shows how the students of my school get to school. Approximately twice as many go by bike as use public transport and roughly the same number come by car as walk. The rest use a moped. What percentage use a moped?



- (A) 6 % (B) 11 %  
 (C) 12 % (D) 24 %  
 (E) 47 %

# INTERNATIONAL KANGAROO MATHEMATICS CONTEST 2020

## KSF - Problems Student (Class 11 & 12)

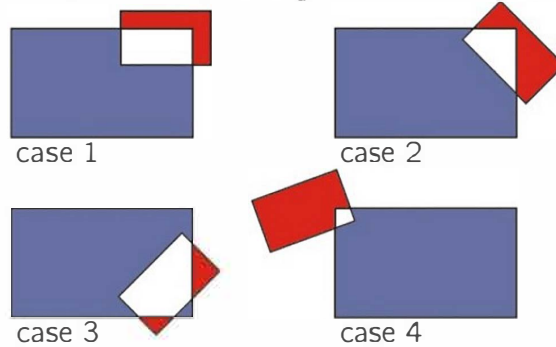
5. The sum of five three-digit numbers is 2664, as shown on the board. What is the value of  $A + B + C + D + E$ ?

$$\begin{array}{r}
 \phantom{+} A B C \\
 + \phantom{A} B C D \\
 + \phantom{A B} C D E \\
 + \phantom{A B C} D E A \\
 + \phantom{A B C D} E A B \\
 \hline
 2 \ 6 \ 6 \ 4
 \end{array}$$

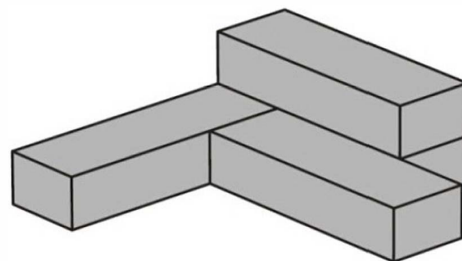
- |                 |                  |        |
|-----------------|------------------|--------|
| (A) 4<br>(D) 34 | (B) 14<br>(E) 44 | (C) 24 |
|-----------------|------------------|--------|
6. What is the value of  $\frac{1010^2 + 2020^2 + 3030^2}{2020}$ ?
- |                      |                      |          |
|----------------------|----------------------|----------|
| (A) 2020<br>(D) 6060 | (B) 3030<br>(E) 7070 | (C) 4040 |
|----------------------|----------------------|----------|
7. Let  $a$ ,  $b$  and  $c$  be integers satisfying  $1 \leq a \leq b \leq c$  and  $abc = 1000000$ . What is the largest possible value of  $b$ ?
- |                     |                     |         |
|---------------------|---------------------|---------|
| (A) 100<br>(D) 1000 | (B) 250<br>(E) 2000 | (C) 500 |
|---------------------|---------------------|---------|
8. If  $D$  dogs weigh  $K$  kilograms and  $E$  elephants weigh the same as  $M$  dogs, how many kilograms does one elephant weigh?
- |                     |                     |                     |
|---------------------|---------------------|---------------------|
| (A) $DKEM$          | (B) $\frac{DK}{EM}$ | (C) $\frac{KE}{DM}$ |
| (D) $\frac{KM}{DE}$ | (E) $\frac{DM}{KE}$ |                     |
9. There are two dice. Each one has two red faces, two blue faces and two white faces. If we roll both dice together, what is the probability that both show the same color?
- |                    |                   |                   |
|--------------------|-------------------|-------------------|
| (A) $\frac{1}{12}$ | (B) $\frac{1}{9}$ | (C) $\frac{1}{6}$ |
| (D) $\frac{2}{9}$  | (E) $\frac{1}{3}$ |                   |
10. Which of the following numbers is not divisible by 3 for any integer  $n$ ?
- |              |               |                |
|--------------|---------------|----------------|
| (A) $5n + 1$ | (B) $n^2$     | (C) $n(n + 1)$ |
| (D) $6n - 1$ | (E) $n^3 - 2$ |                |

**SECTION TWO - (4 point problems)**

- 11.** A blue rectangle and a red rectangle are overlapping. The figure shows 4 different such cases. We denote by  $B$  the area of the part of the blue rectangle that is not common to the two rectangles, and we denote by  $R$  the area of the red rectangle that is not common to the two. Which of the following statements is true about  $B - R$ ?



- (A) In case 1  $B - R$  is larger than in the other cases  
 (B) In case 2  $B - R$  is larger than in the other cases  
 (C) In case 3  $B - R$  is larger than in the other cases  
 (D) In case 4  $B - R$  is larger than in the other cases  
 (E)  $B - R$  is the same in all cases
- 12.** Five coins are lying on a table with the "heads" side up. At each step you must turn over exactly three of the coins. What is the least number of steps required to have all the coins lying with the "tails" side up?
- (A) 2                              (B) 3  
 (C) 4                              (D) 5  
 (E) It's not possible to have all the coins with their "tails" side up.
- 13.** Four identical boxes are glued together to make the shape shown in the picture. One litre of paint is needed to paint the outside of one such box. How many litres of paint are needed to paint the outside of the glued construction?



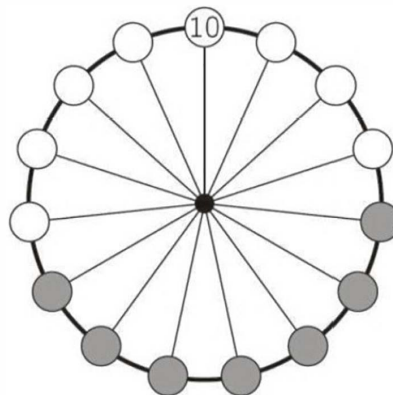
- (A) 2.5                              (B) 3                              (C) 3.25  
 (D) 3.5                              (E) 4
- 14.** Let  $a$ ,  $b$  and  $c$  be integers. Which of the following is certainly NOT equal to  $(a - b)^2 + (b - c)^2 + (c - a)^2$ ?
- (A) 0                              (B) 1                              (C) 2  
 (D) 6                              (E) 8

15. The first two digits of a 100-digit integer are 2 and 9. How many digits does the square of this number have?



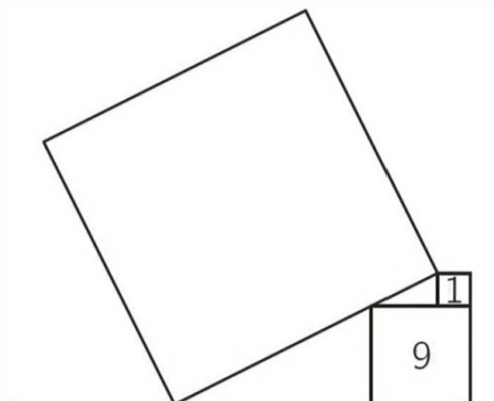
- (A) 101  
(B) 199  
(C) 200  
(D) 201  
(E) It cannot be determined

16. Matjaz has placed 15 numbers on a wheel. Only one of the numbers is visible, the 10 at the top. The sum of the numbers in any 7 consecutive positions on the wheel, such as the ones shaded grey, is always the same. When all 15 numbers are added, exactly how many of the numbers 75, 216, 365 and 2020 are possible totals?



- (A) zero  
(B) one  
(C) two  
(D) three  
(E) four

17. A large square touches two other squares, as shown in the diagram. The numbers in the small squares represent their areas. What is the area of the large square?



- (A) 49  
(B) 80  
(C) 81  
(D) 82  
(E) 100

INTERNATIONAL KANGAROO MATHEMATICS CONTEST 2020

KSF - Problems Student (Class 11 & 12)

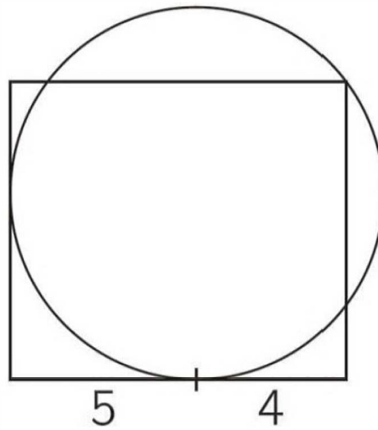
18. The sequence  $f_n$  is given by  $f_1 = 1$ ,  $f_2 = 3$  and  $f_{n+2} = f_n + f_{n+1}$  for  $n \geq 1$ . How many of the first 2020 elements of the sequence are even?

- (A) 673  
(D) 1011

- (B) 674  
(E) 1347

- (C) 1010

19. A circle and a rectangle have been drawn in such a way that the circle touches two of the sides of the rectangle and passes through one of its vertices. The distances of two vertices of the rectangle from one of the points where the circle touches the rectangle are 5 and 4, as shown. What is the area of the rectangle?

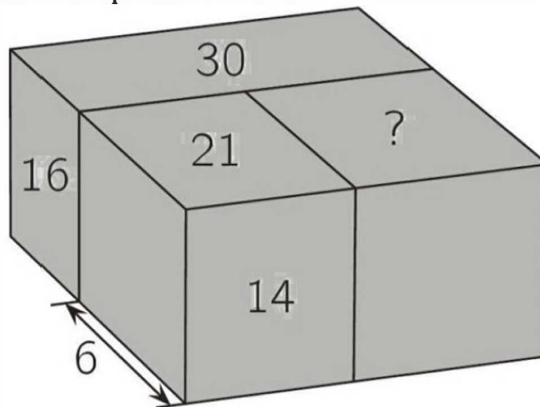


- (A)  $27\pi$   
(D) 63

- (B)  $25\pi$   
(E) none of the previous

- (C) 72

20. Three cuboids are arranged to make a larger cuboid as in the figure. The width of one of them is 6 and the areas of some of their faces are 14, 21, 16, 30, as shown. What is the area of the face with the question mark?



- (A) 18  
(D) 30

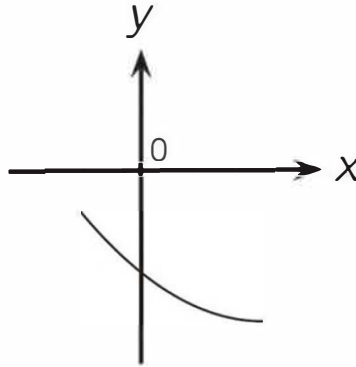
- (B) 24  
(E) cannot be determined

- (C) 28

**INTERNATIONAL KANGAROO MATHEMATICS CONTEST 2020**  
**KSF - Problems Student (Class 11 & 12)**

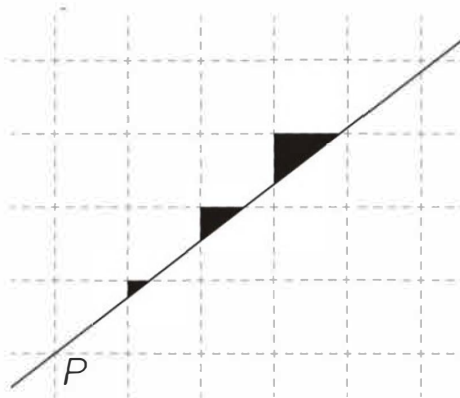
**SECTION THREE - (5 point problems)**

**21.** The figure shows a section of the parabola with equation  $y = ax^2 + bx + c$ . Which of the following numbers is positive?



- (A)  $c$                                       (B)  $b + c$                                       (C)  $ac$   
 (D)  $bc$                                       (E)  $ab$

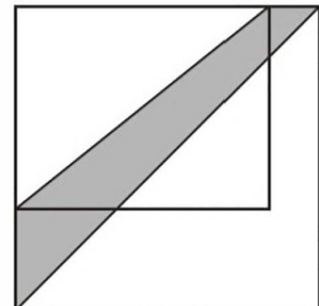
**22.** On a square grid paper, a little kangaroo draws a line passing through the lower left corner  $P$  of the grid and colours in three triangles as shown.



Which of the following could be the ratio of the areas of the triangles?

- (A) 1 : 2 : 3                                      (B) 1 : 2 : 4                                      (C) 1 : 3 : 9  
 (D) 1 : 4 : 8                                      (E) None of the previous is correct

**23.** The length of one of the sides of a rectangular garden is increased by 20% and the length of the other side is increased by 50%. The new garden is a square, as shown in the diagram. The shaded area between the diagonal of the square garden and the diagonal of the original rectangular garden is  $30m^2$ . What was the area of the original rectangular garden?



- (A)  $60m^2$                                       (B)  $65m^2$   
 (C)  $70m^2$                                       (D)  $75m^2$   
 (E)  $80m^2$

24. A large integer  $N$  is divisible by all except two of the integers from 2 to 11. Which of the following pairs of integers could be these exceptions?

(A) 2 and 3  
(D) 7 and 8

(B) 4 and 5  
(E) 10 and 11

(C) 6 and 7

25. In the morning, the ice-cream shop offers 16 flavours. Anna wants to choose a 2-flavour ice-cream. In the evening several flavours are sold out and Bella wants to choose a 3-flavour ice-cream from those flavours left. Both Anna and Bella can choose from the same number of possible combinations. How many flavours were sold out?

(A) 2  
(D) 5

(B) 3  
(E) 6

(C) 4

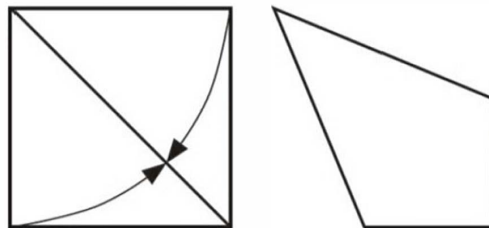
26. Tony has 71 marbles at his disposal in a box. He is allowed to take out exactly 30 marbles from the box or to return exactly 18 marbles to it. Tony is allowed to apply each operation as many times as he wishes. What is the smallest number of marbles than can be in the box?

(A) 1  
(D) 7

(B) 3  
(E) 11

(C) 5

27. Wajda took a square piece of paper of side 1 and folded two of its sides to the diagonal, as shown in the diagram, to make a quadrilateral. What is the area of this quadrilateral?



(A)  $2 - \sqrt{2}$

(B)  $\frac{\sqrt{2}}{2}$

(C)  $\sqrt{2} - 1$

(D)  $\frac{7}{10}$

(E)  $\frac{3}{5}$

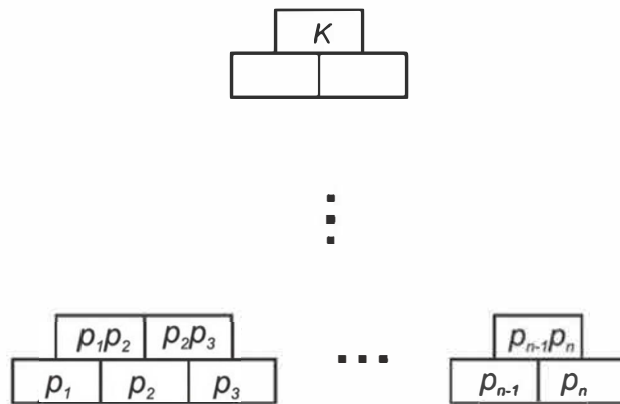
28. An iceberg has the shape of a cube. Exactly 90% of its volume is hidden below the surface of the water. Three edges of the cube are partially visible over the water. The visible parts of these edges are  $24\text{ m}$ ,  $25\text{ m}$  and  $27\text{ m}$ . How long is an edge of the cube?

(A)  $30\text{ m}$   
(D)  $35\text{ m}$

(B)  $33\text{ m}$   
(E)  $39\text{ m}$

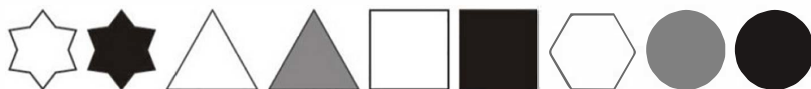
(C)  $34\text{ m}$

29. There are  $n$  different prime numbers  $p_1$  to  $p_n$  written from left to right in the bottom row of the table shown. The product of two numbers next to each other in the same row is written in the box directly above them. The number  $K = p_1^{\alpha_1} p_2^{\alpha_2} \dots p_n^{\alpha_n}$  is written in the box in top row. In a table where  $\alpha_2 = 8$ , how many numbers are divisible by the number  $p_4$ ?



- (A) 4 (B) 16 (C) 24  
 (D) 28 (E) 36

30. Adam and Britt try to find out which of the following figures is Carl's favourite.



Adam knows that Carl has told Britt its shape. Britt knows that Carl has told Adam its colour. Then the following conversation takes place. Adam: "I don't know Carl's favourite figure and I know that Britt doesn't know it either." Britt: "At first I didn't know Carl's favourite figure, but now I do." Adam: "Now I know it too." Which figure is Carl's favourite?

- (A) (B) (C)   
 (D) (E)