german math olympiad

PAST PAPERS

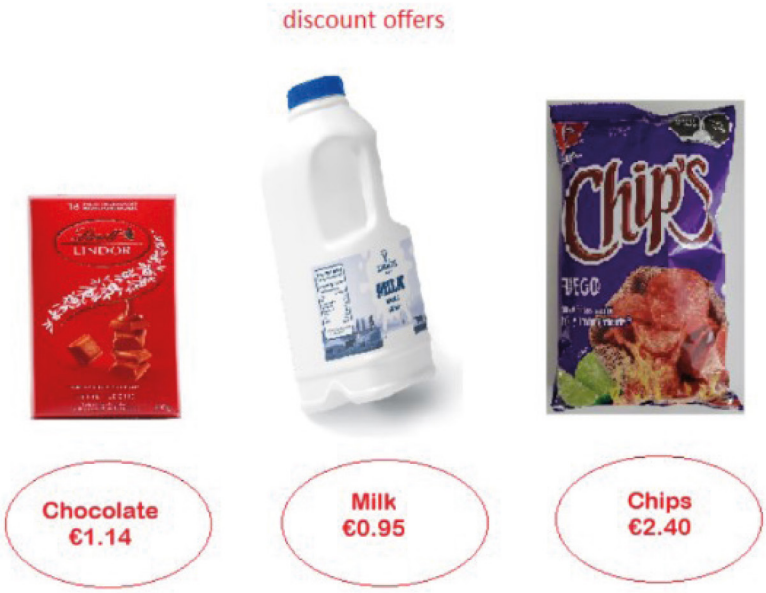
Grade 11

1-

Let x be an integer. For which value of x does the expression $\frac{x}{x-20}$ take its minimum value?

A) 19 B) 18 C) 21 D) 22

2-



Chloe sees that there is a discount on some of the products at the supermarket, so she buys 5 bars of chocolate, 20 cartons of milk, and 8 packets of chips.

How much change will the cashier return if Chloe gives her a €100 bill?

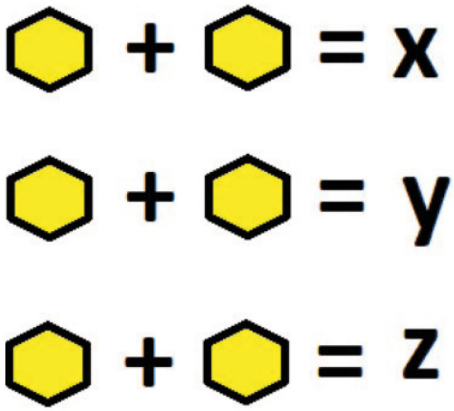
A) €52.10

B) €54.10

C) €56.10

D) €58.10

3-



The numbers 1, 2, 3, 4, 5 and 6 are to be placed in the boxes above, with a different number in each box.

According to this, what is the maximum value of the product x·y·z?

A) 231 B) 240 C) 243 D) 343

4-

Which of the following is the simplified form of the following expression?

$$\frac{x^4-6x^2+5}{(x-\sqrt{5})\cdot(x+\sqrt{5})} \div \frac{x-1}{2}$$

A) 2x B) 2x + 2 C) 2x – 2 D) 2

5-

Find the value of x if $\frac{x^2-40x+300}{(x^2-22x-240)} = 2$

A) –20 B) –22 C) –24 D) –26

6-

Given that a and b are integers and $a\sqrt{b}$ is equal to $\sqrt{5} + \sqrt{45}$, which of the following cannot be the value of a + b?

A) 9 B) 22 C) 45 D) 81

7-

Given the function

$$f: R - \{\frac{-2}{3}\} \to R - \{\frac{4}{3}\}$$

$$x = \frac{2\cdot(1-f(x))}{3\cdot f(x) - 4}$$

What is the value of f(2) ?

A) $\frac{4}{3}$ B) $\frac{5}{4}$ C) 2 D) $\frac{5}{2}$

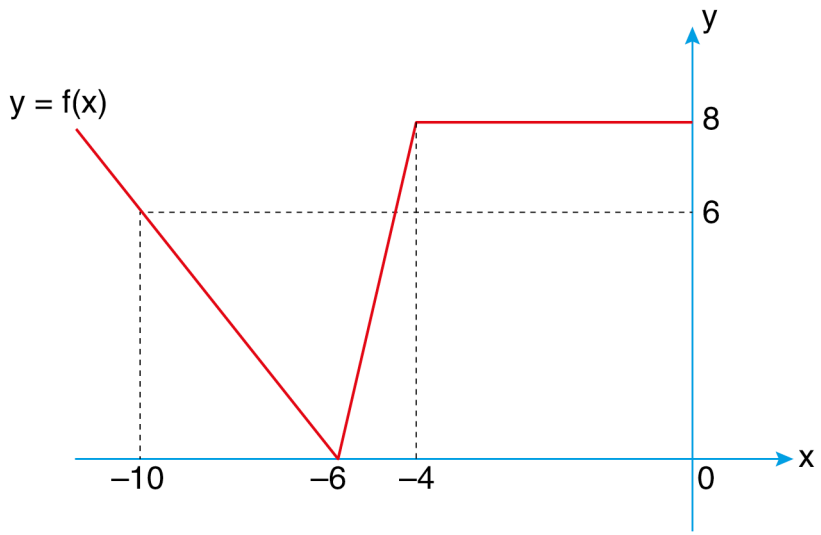
8-

How many integers are there in the range of the following function?

f: (-3, 2) → R, $f(x) = (\frac{1}{3})^x$

A) 3 B) 4 C) 13 D) 26

9-



Given the graph of the function f(x) as above, what is the value of the following sum?

f(–1) + f(–3) + f(–5) + f(–7) + f(-9)

A) 25 B) 26 C) 27 D) 28

10-

Given the inequality:

$2 \cdot 9^x + 6 \leq 8 \cdot 3^x$

How many integer values can x take?

A) 0 B) 1 C) 2 D) 3

11-

At a bakery, the prices of 3 different products in the same quantity are as follows:

Bagel: (x – 5) Euros

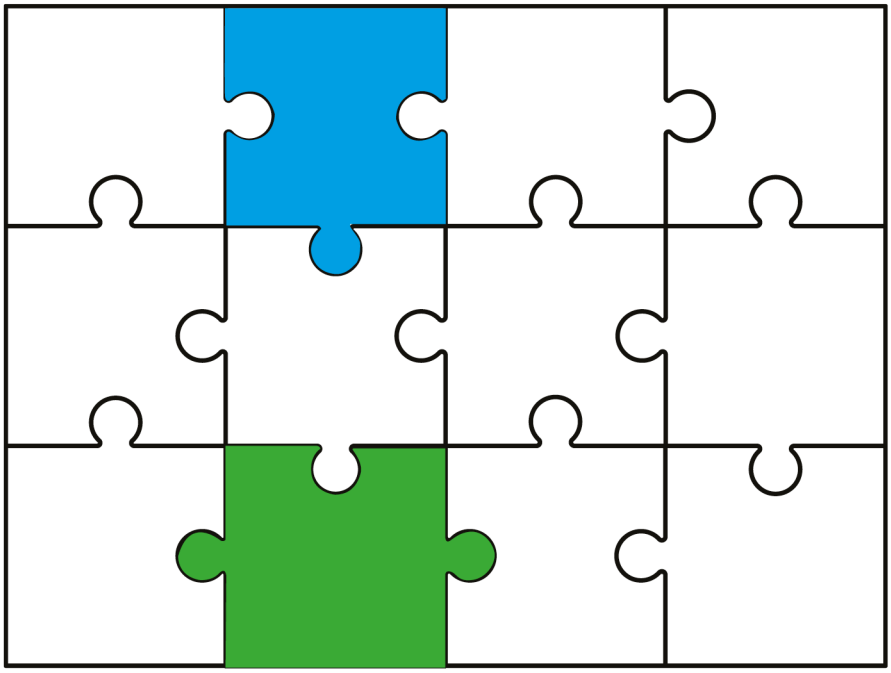
Doughnut: (2x – 8) Euros

Pie: (32 – 3x) Euros

If the bagel is the cheapest and the pie is the most expensive, in which interval does x lie?

A) $3 < x < 5$ B) $3 < x < 8$ C) $4 < x < 8$ D) $5 < x < 8$

12-



Identical square cardboards are turned into jigsaw pieces by adding protrusions and cutting matching indentations of the same area. A jigsaw made of 12 pieces is shown above.

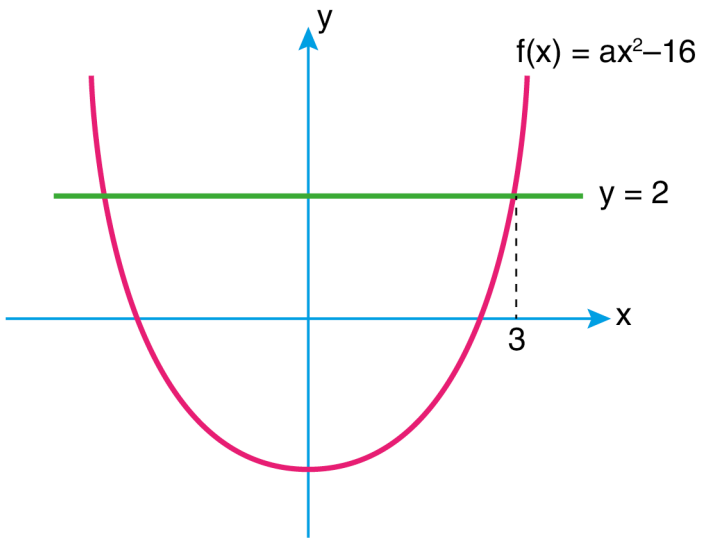
*** The blue piece has two indentations and one protrusion, and its area is 32 square units.**

*** The green piece has one indentation and two protrusions, and its area is 40 square units.**

Accordingly, what is the perimeter of the whole rectangular jigsaw?

A) 56 units B) 70 units C) 80 units D) 84 units

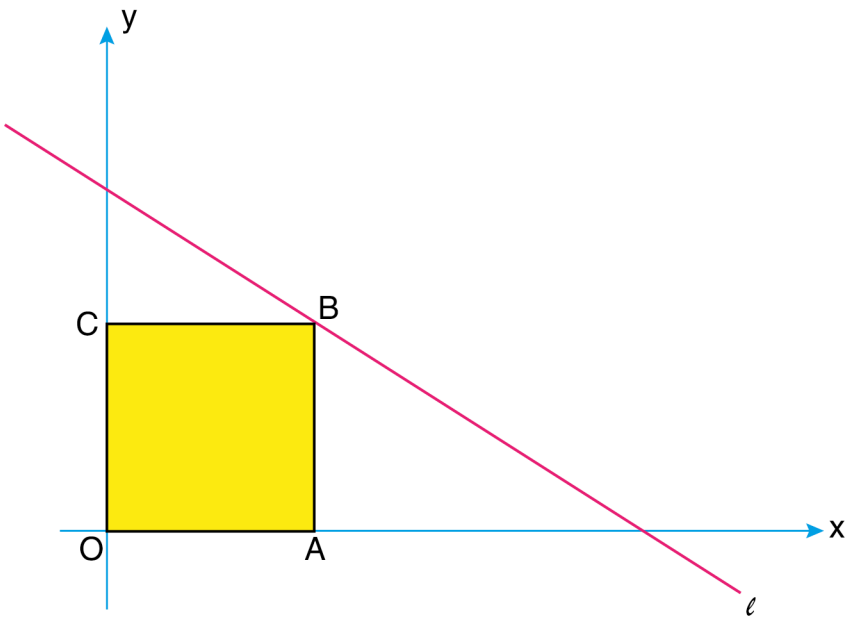
13-



The parabola $f(x)=ax^2-16$ and the line $y=2$ are given above.
Accordingly, what is the value of $f(2)$?

A) –2 B) –4 C) –6 D) –8

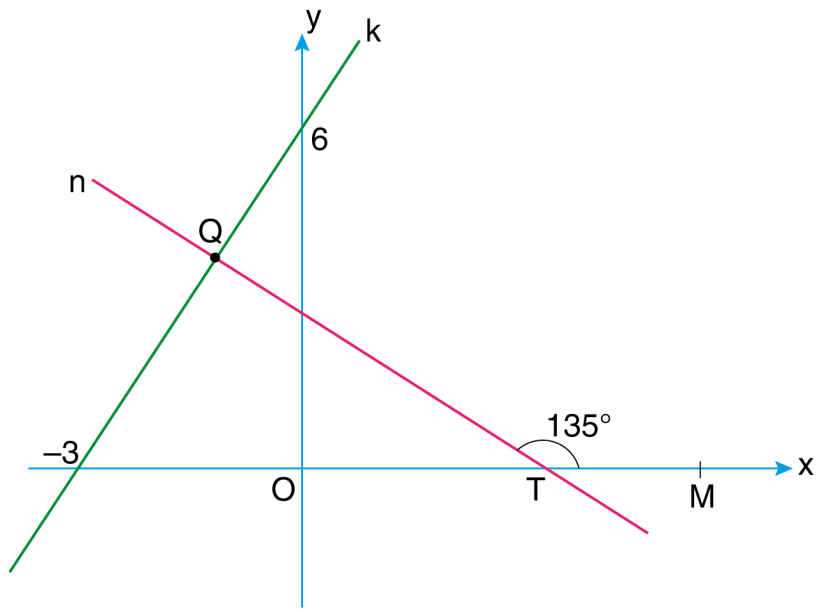
14-



In the coordinate plane, OABC is a square and $B \in l$,
$l: 2x+3y-15=0$
According to the information above, what is the area of the square OABC in square units?

A) 9 B) 16 C) 25 D) 36

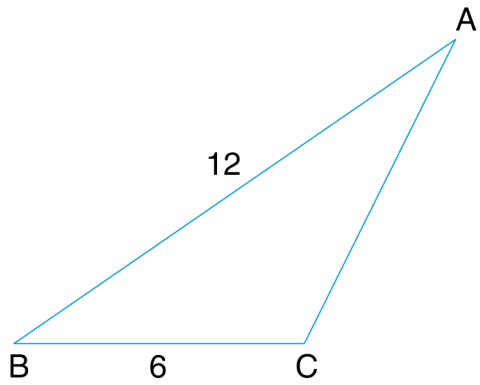
15-



In the coordinate plane, the lines k and n intersect at point Q. If the angle ∠QTM is 135°, what is the sum of the slopes of lines k and n?

A) –2 B) –1 C) 0 D) 1

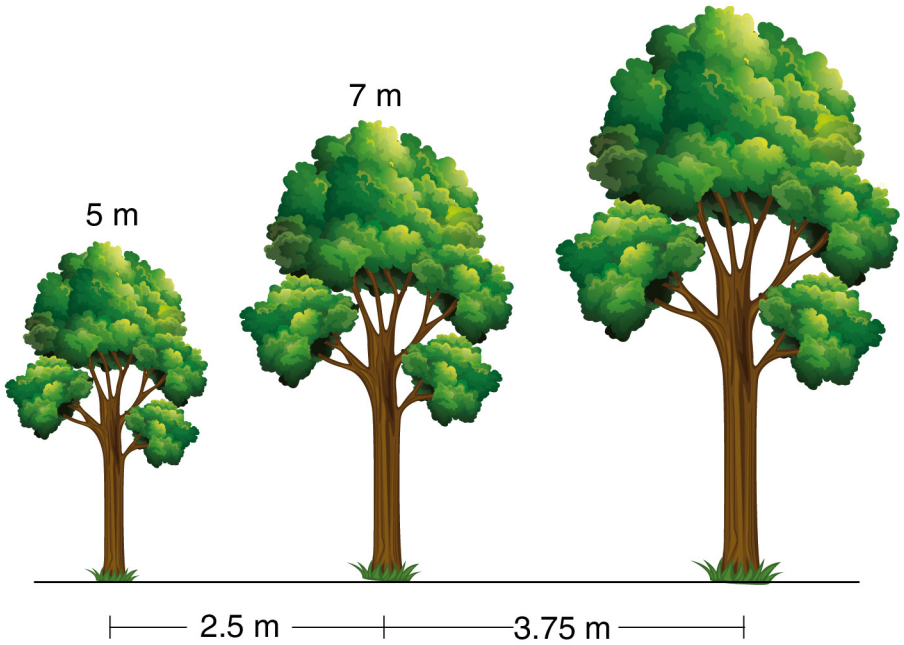
16-



In triangle ABC shown above, ∠ACB=∠BAC+90° . If |AB| = 12 units and |BC| = 6 units, what is the value of cos(∠BAC)?

A) $\frac{2}{\sqrt{5}}$ B) $\frac{1}{\sqrt{5}}$ C) $\frac{-1}{\sqrt{5}}$ D) $\frac{-2}{\sqrt{5}}$

17-

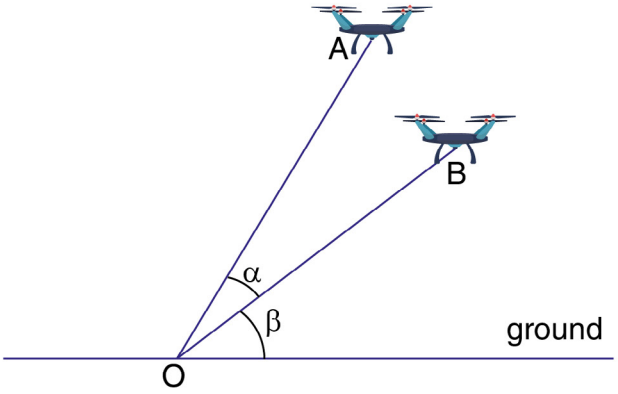


Three trees stand in a row on level ground. The first tree is 5 m tall and the second is 7 m tall. The distance between the first and the second is 2.5 m, and the distance between the second and the third is 3.75 m.

Given that the tips of the trees are collinear, what is the height of the third tree?

A) 8 m B) 9 m C) 10 m D) 11 m

18-



A drone is located at point A, 40metres above the ground, and another drone is located at point B, 30 metres above the ground, such that |OA| = |OB| where O is a point on the ground. The angle between the segment [OB] and the ground is β and the angle between [OA] and [OB] is α.

If $\tan(\beta)$ is 0.75, what is the value of $\tan(\alpha)$?

A) $\frac{7}{24}$ B) $\frac{1}{3}$ C) $\frac{5}{12}$ D) $\frac{3}{5}$

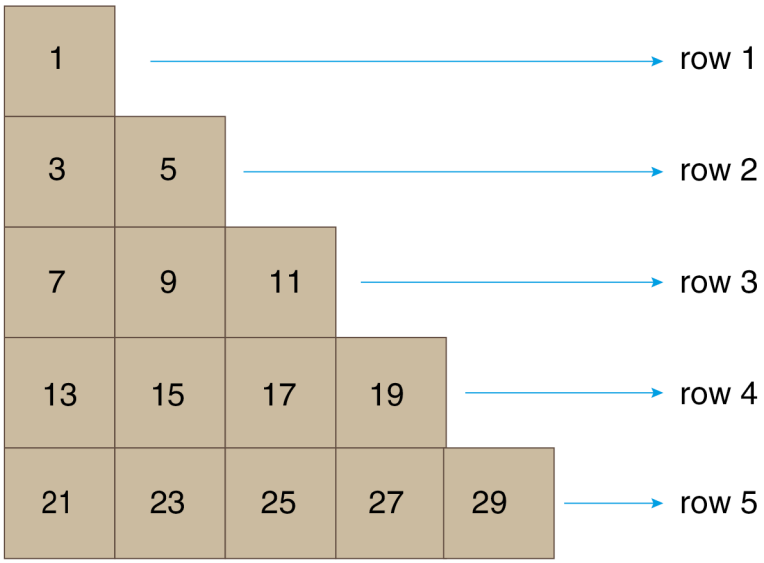
19-

$$(a_n) = \sum_{k=1}^{n} \left(\frac{1}{k+1} - \frac{1}{k+2}\right)$$

For the sequence (a_n) determined above, what is the value of a_{10} ?

A) $\frac{1}{2}$ B) $\frac{3}{4}$ C) $\frac{5}{12}$ D) $\frac{7}{8}$

20-



Consecutive odd numbers are written in the boxes according to the pattern shown above.

Accordingly, in which row does the number 415 appear?

A) row 17

B) row 18

C) row 19

D) row 20

21-

Three boxes of different heights — blue, yellow, and red — are placed side by side. The following statements are given:

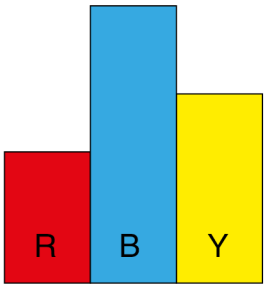
p: "The box with the greatest height is the blue box."

q: "The yellow box is next to the blue box."

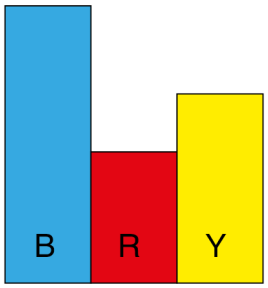
r: "The red box is on the far left."

If statement p is true, and statements q and r are false, which of the following could be the arrangement of the boxes?

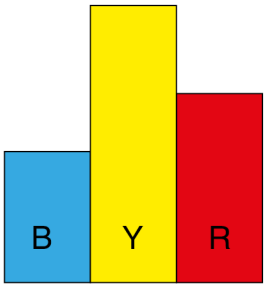
A)



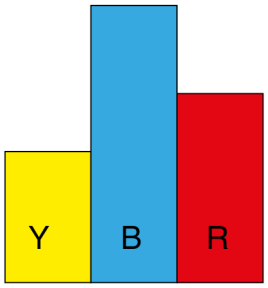
B)



C)



D)

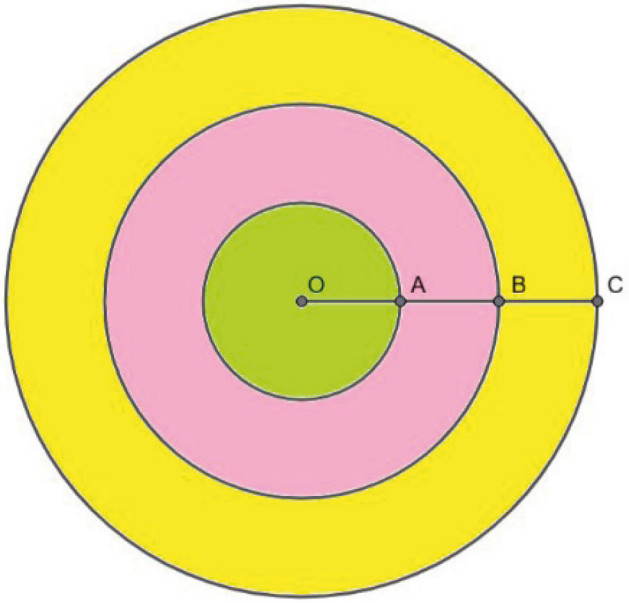


22-

Two fair dice are rolled together. Given that the sum of the numbers is greater than 6, what is the probability that their product is less than 16?

A) $\frac{3}{7}$ B) $\frac{5}{21}$ C) $\frac{8}{21}$ D) $\frac{10}{21}$

23-



In the dartboard shown above, which is formed by concentric circles centered at O, the segments satisfy $|OA|=|AB|=|BC|$.

What is the probability that a randomly thrown dart, assuming it always lands on the board, will hit the pink region?

A) $\frac{1}{9}$ B) $\frac{1}{3}$ C) $\frac{4}{9}$ D) $\frac{5}{9}$

24-

From the set {1, 2, 3, …, 9} two different numbers are chosen at random and arranged to form a two-digit number.

(first pick = tens, second pick = units)

How many of the resulting two-digit numbers are divisible by 3?

A) 18

B) 21

C) 24

D) 27

25-

x, 3, 6, 7, 9, 11, 13, 16,

In the data set above the range is 15.

What is the sum of all possible values of x?

A) 20 B) 19 C) 21 D) 18

26-

The ordered data set is given as:

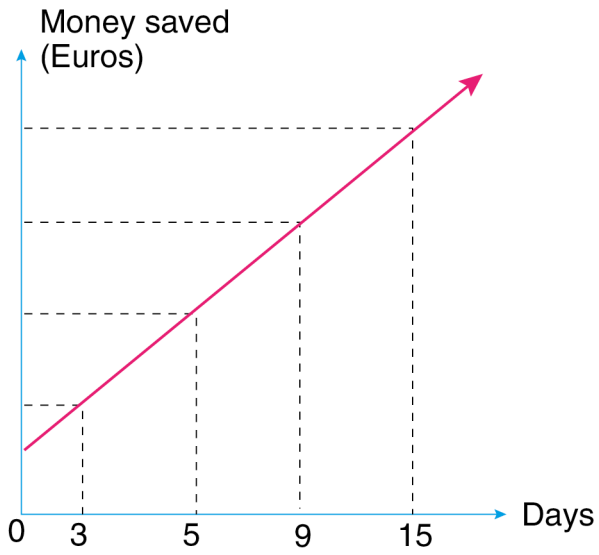
n+3, n+5, n+6, n+8, n+10

For this 5-number data set, Q_1 is the median of the lower two values and Q_3 is the median of the upper two values.

If $Q_1+Q_3=25$, what is the median of the data set after adding the number 24?

A) 12 B) 13 C) 14 D) 15

27-



The linear graph above shows the change in the amount of money a student has saved from their allowance over several days.

Accordingly, which of the following statements about the student's savings is correct?

I. The amount saved between days 5 and 9 is three times the amount saved between days 3 and 5.

II. The amount saved between days 5 and 15 is five times the amount saved between days 3 and 5.

III. The amount saved between days 9 and 15 is equal to the amount saved between days 3 and 9.

A) I and II

B) II and III

C) I and III

D) I, II, and III

28-

$$f(x)=\begin{cases} x^2-1, & x>1 \\ 1-3x, & x\leq 1 \end{cases}$$

For the piecewise function f(x)) given above, what is the value of the expression f(f(1+f(0)))?

A) 8 B) 7 C) 6 D) 5

29-

A school uses 350 L of water per day per classroom. There are 28 classrooms and 190 school days per year. Which expression best estimates the annual water use?

A) 350×28×190

B) 350+28+190

C) 350×(28+190)

D) 350×28+190

30-

Aidan is practising archery. Scores are integers. His average in his first 5 shots is 8.6. On his next (6th) shot, he scores 11.

What minimum score must he get on his 7th (last) shot to keep his overall average at least as high as after the 6th shot?

A) 9 B) 10 C) 11 D) 12

Answer Key

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