YEAR 7 MATHEMATICS CHALLENGE

Final, Oak Room (Hertfordshire Development Centre)

Thursday 25th April 2024

William Thallon, Secondary Mathematics Adviser

David Cook, Lead Primary Mathematics Adviser

FORMAT OF CHALLENGE

Round 1	General Maths questions
Round 2	Memory Round
Round 3	Estimation and Problem-Solving Round
Round 4	General Maths questions

60 marks for each round

HFL Education
FORMERLY HERTS FOR LEARNING

PRELIMINARIES

- You should have pens or pencils, rubbers, and rough working out paper only.
- No calculators, no measuring equipment, and no use of computers, phones, Internet etc!
- Decide on a team name, which should include the name of your school. Include the team name on all the Answer Sheets you hand in.

HFL Education
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PRELIMINARIES

- Don’t leave any answers blank. ‘Near misses’ or partially correct answers may score points.
- Where necessary, make sure you include the correct **units**. If you forget to do this, you will not gain full marks for the question, even if the numerical answer is correct.

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Round 1

General Mathematics Questions

90 seconds for each question

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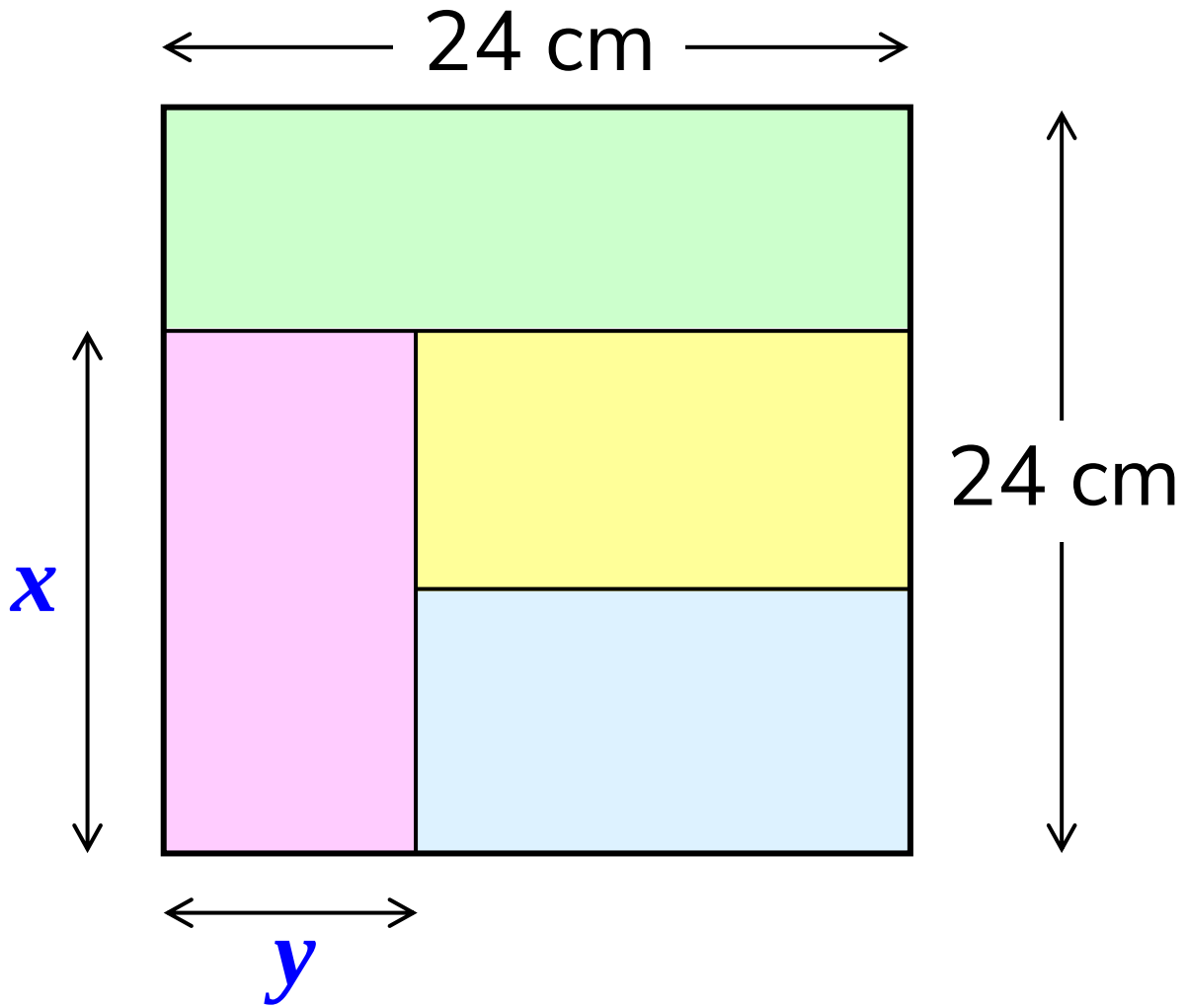
ROUND 1, QUESTION 1

Work out $\dfrac{132}{0.\dot{3}}$

ROUND 1, QUESTION 2

In the diagram, a square of side 24 cm has been divided into four rectangles of **equal area**.

The diagram is not drawn to scale.

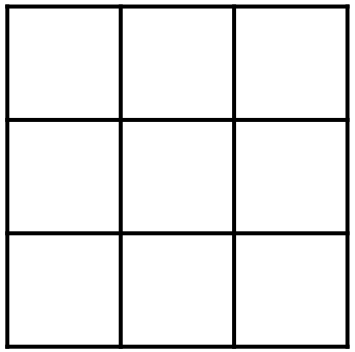


Work out the lengths x and y.

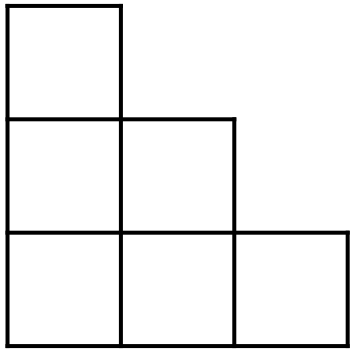
ROUND 1, QUESTION 3

Here are three views of a solid object made from identical cubes

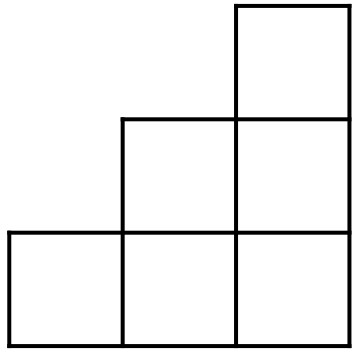
Plan
(view from above)



Front elevation
(view from the front)



Side elevation
(view from the side)



What is the minimum number of cubes needed to make this object?

ROUND 1, QUESTION 4

At a school, exactly $\frac{7}{12}$ of Year 7 own a pet.

At the same school, exactly $\frac{5}{7}$ of Year 7 own a bicycle.

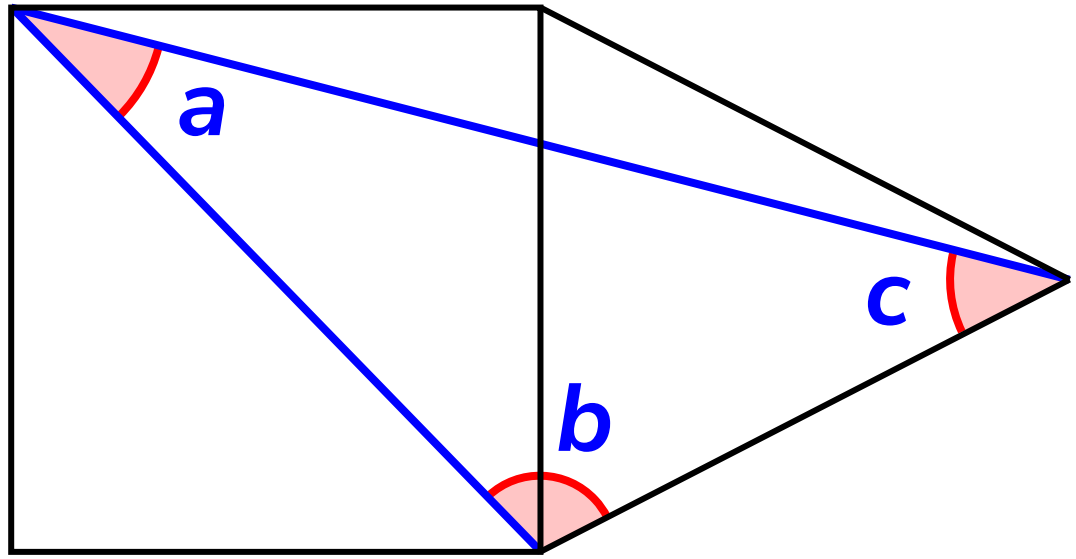
The number of students in Year 7 is between 100 and 200.

How many students are in Year 7?

ROUND 1, QUESTION 5

The diagram contains an equilateral triangle joined to a square

It is **not** drawn to scale.



Work out the angles *a*, *b* and *c*.

ROUND 1, QUESTION 6

Here is an example of a linear sequence with five terms:

13 **17** **21** **25** **29**

Three of the terms are prime numbers.

Find a linear sequence with five terms where **all five terms** are prime numbers

End of Round 1

ANSWERS TO ROUND 1

ROUND 1, QUESTION 1

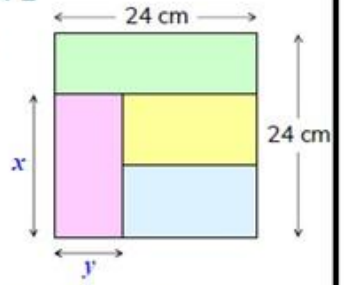
Work out $\frac{132}{0.\dot{3}}$

396

ROUND 1, QUESTION 2

In the diagram, a square of side 24 cm has been divided into three rectangles of **equal area**.

The diagram is not drawn to scale.

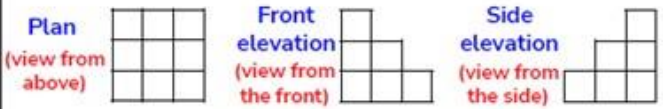


Work out the lengths x and y.

x = 18 cm y = 8 cm

ROUND 1, QUESTION 3

Here are three views of a solid object made from identical cubes



What is the minimum number of cubes needed to make this object?

13

ROUND 1, QUESTION 4

At a school, exactly $\frac{7}{12}$ of Year 7 own a pet.

At the same school, exactly $\frac{5}{7}$ of Year 7 own a bicycle.

The number of students in Year 7 is between 100 and 200.

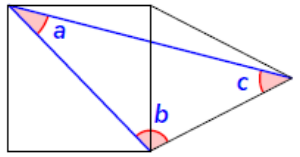
How many students are in Year 7?

168

ROUND 1, QUESTION 5

The diagram contains an equilateral triangle joined to a square

It is **not** drawn to scale.



Work out the angles a, b and c.

a = 30°, b = 105°, c = 45°

ROUND 1, QUESTION 6

Here is an example of a linear sequence with five terms:

13 17 21 25 29

Three of the terms are prime numbers.

Find a linear sequence with five terms where all five terms are prime numbers

5, 11, 17, 23, 29

Round 2

Memory Round

ROUND 2

We are going to show a mathematical poster to two members of the team (the **observers**).

The other two members of the team (the **scribes**) will not see the poster. The observers must describe the poster from memory, and the scribes must draw it.

The observers are not allowed to draw the poster, or make notes when they are looking at the poster.

When describing the poster, observers must use words only. They are not allowed to draw anything, or use their hands in any way.

ROUND 2

The observers will have **four** chances to view the poster.

30 seconds to view
2 minutes to go and describe

30 seconds to view
2 minutes to describe

30 seconds to view
2 minutes to describe

30 seconds to view
2 minutes to describe

Scribes can draw at any time during the whole period.

ROUND 2

Hint for the observers

Don’t try to memorise the entire poster at once. The poster is in a number of sections, so focus on one or two parts at a time.

Note to the scribes

Place your piece of paper in **landscape** orientation (i.e. the same way up as the screen you are currently looking at).

Round 2

Memory Round

End of Round 2

Eight ways to multiply 462 by 27

Method 1
Long Multiplication

	4	6	2
	×	2	7
9	2	4	0
+ 3	2	3	4
1	**2**	**4**	**7**	**4**

This uses the fact that
462 × **27** = 462 × **20** + 462 × **7**

Method 2
27 = 3 × 3 × 3

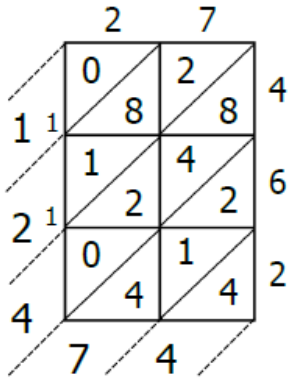
	4	6	2
		×	3
1	3	8	6
		×	3
4	1	5	8
		×	3
1	**2**	**4**	**7**	**4**

Method 3
Egyptian multiplication

1	4 6 2	× 2
2	9 2 4	× 2
~~4~~	~~1 8 4 8~~	etc
8	3 6 9 6	
16	7 3 9 2	
	1 2 4 7 4	

(27 = 1 + 2 + 8 + 16
so the '4 row' is not needed)

Method 4
Lattice multiplication



Answer = **12,474**

Method 5
Area method

	20	7
400	8,000	2,800
60	1,200	420
2	40	14

8000 + 2800 + 1200 + 420
+ 40 + 14 = **12,474**

Method 6
27 = 25 + 2

$$462 \times 25 = \frac{462 \times 100}{4} = \frac{46200}{4}$$

	1	1	5	5	0
4	4	6	$^{2}2$	$^{2}0$	0

so 462 × **25** = 11,550

462 × **2** = 924

so 462 × **27** = 11,550 + 924
= **12,474**

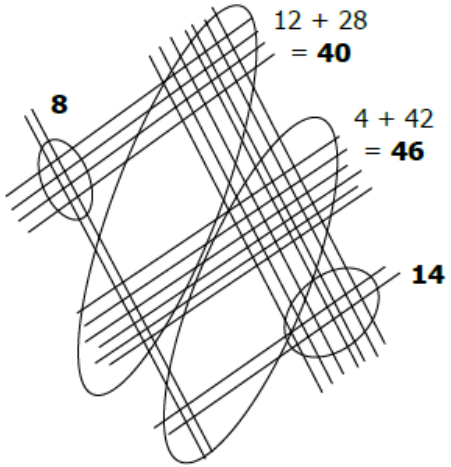
Method 7
Russian multiplication

Halve the left-hand number, ignoring fractions.
Double the right-hand number

Cross out rows with an even number on the left.

27		4	6	2
13		9	2	4
~~6~~	~~1~~	~~8~~	~~4~~	~~8~~
3		3	6	9	6
1		7	3	9	2
	1	**2**	**4**	**7**	**4**

Method 8
Chinese multiplication



8 000 + **40** 00 + **46** 0 + **14**
= **12,474**

Round 3

Estimation and Problem-Solving

ROUND 3, QUESTION 1

Estimate the mass of the tin.

20 g

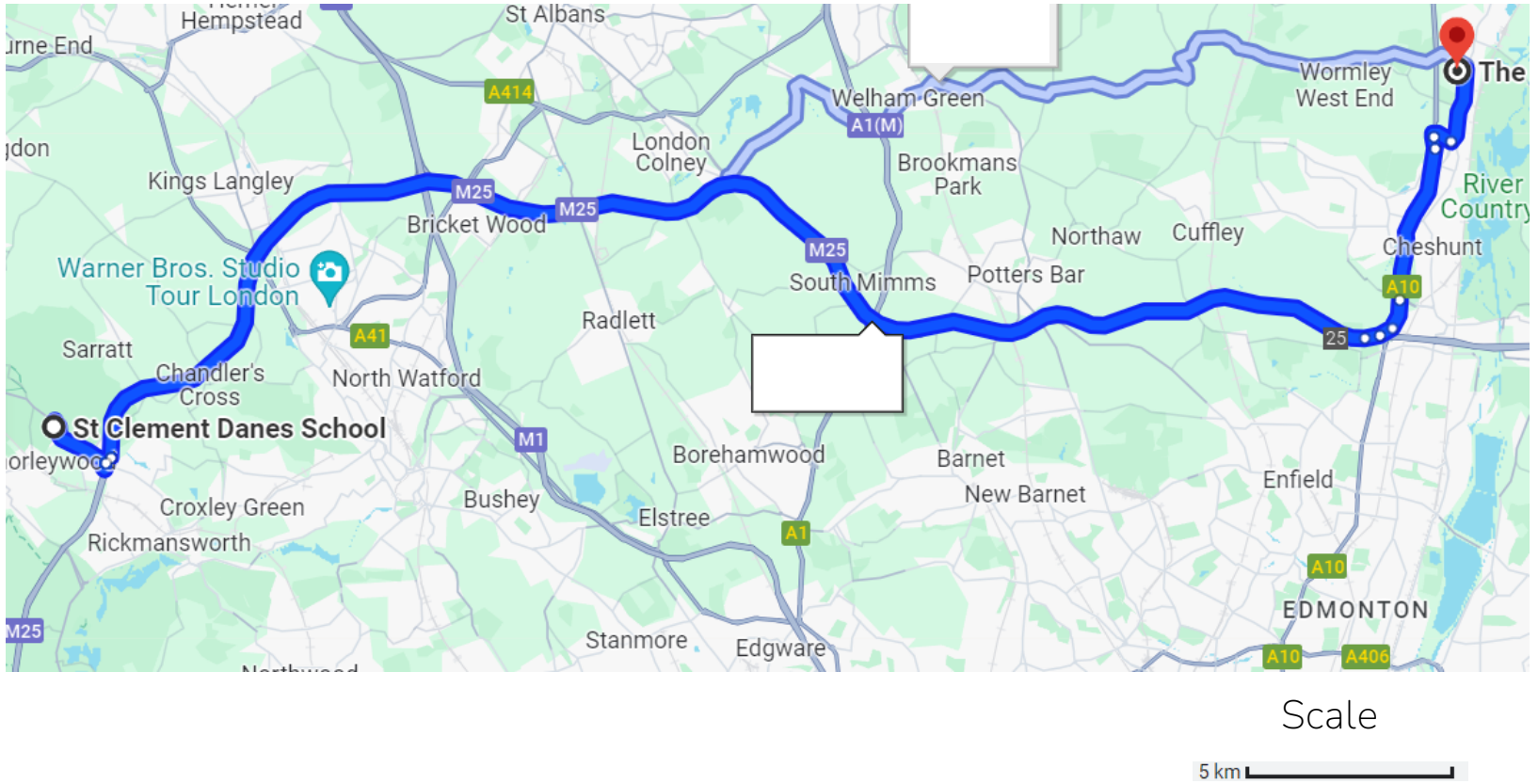
10 g

ROUND 3, QUESTION 2

Estimate the number of pumpkin seeds in the bag.

(Do not open the bag.)

ROUND 3, QUESTION 3



Estimate the length of the blue route (in kilometres).

ROUND 3, QUESTION 4

Some numbers can be written as the sum of two square numbers.

Examples: **40 = 4 + 36** **65 = 16 + 49**

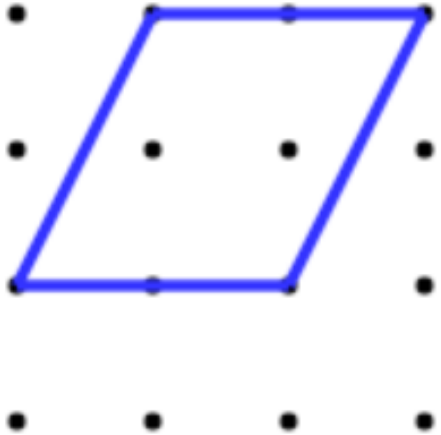
Some numbers (e.g. 41, 79) cannot.

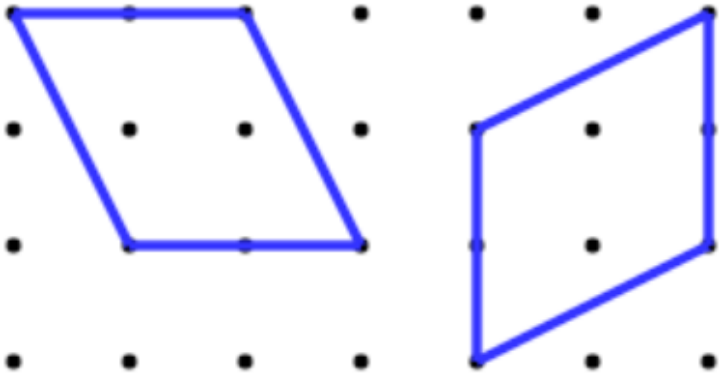
Which numbers between 51 and 100 **cannot** be written as the sum of two square numbers.

(Count zero as a square number.)

ROUND 3, QUESTION 5

Use the 4 by 4 dotty grids to draw as many **different** parallelograms as you can





These are 'repeats' of the shape above.

Each vertex must be on a dot.

Draw one parallelogram on each grid.

Include rhombuses.

Do **not** include rectangles or squares.

One point for every correct shape.

'Repeated' shapes will score zero.

ROUND 3, QUESTION 6

How many **odd numbers greater than 25,000** can be made using these number cards?

(Each card must be used exactly once: for example, 32541.)

End of Round 3

ANSWERS TO ROUND 3

ROUND 3, QUESTION 1

Estimate the mass of the tin.

360 g ± 30 g

ROUND 3, QUESTION 2

Estimate the number of pumpkin seeds in the bag.

(Do not open the bag.)

1800 ± 100

ROUND 3, QUESTION 3

Estimate the length of the blue route (in kilometres).

47 km ± 2

ROUND 3, QUESTION 4

Some numbers can be written as the sum of two square numbers.

Examples: 40 = 4 + 36 65 = 16 + 49

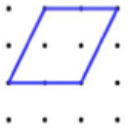
Some numbers (e.g. 41, 79) cannot.

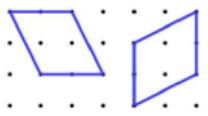
Which numbers between 51 and 100 **cannot** be written as the sum of two squares.

(Count zero as a square number.)

ROUND 3, QUESTION 5

How many different parallelograms can be drawn on a 4 by 4 dotty grid?





These are 'repeats' of the shape above.

- Include rhombuses. Do not include rectangles or squares.
- One point for every correct shape. One point deducted for every incorrect or repeated shape.

ROUND 3, QUESTION 6

How many **odd numbers greater than 25,000** can be made using these number cards?

1	2	3	4	5

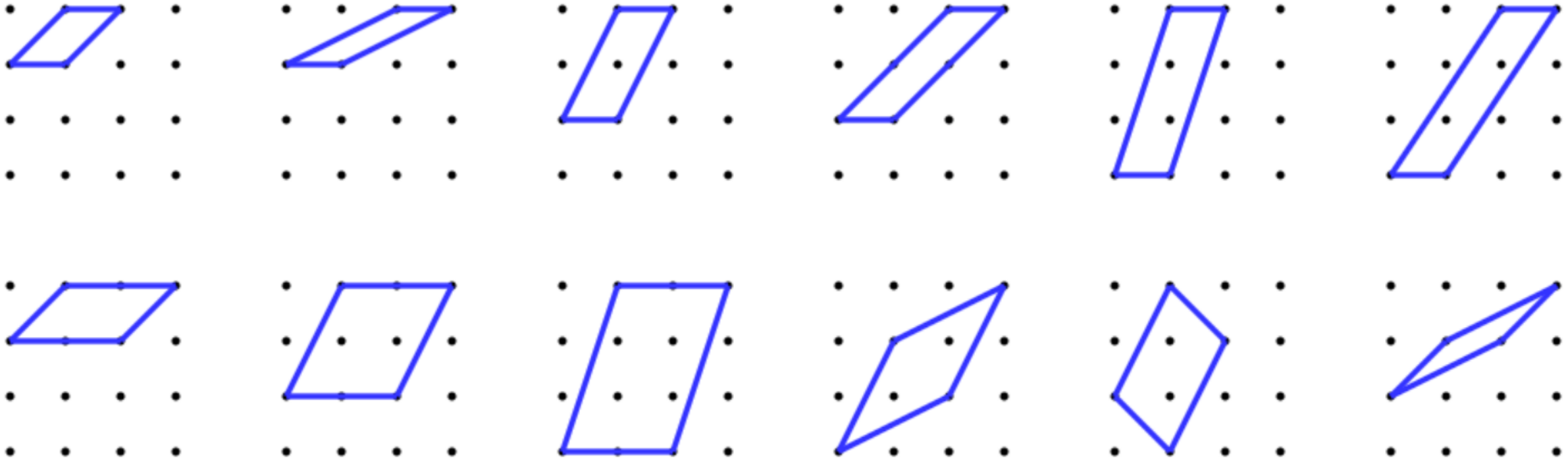
(Each card must be used exactly once: for example, 32541.)

46

ROUND 3, QUESTION 4

51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

ROUND 3, QUESTION 5



Round 4

General Mathematics Questions

90 seconds for Questions 1 to 4

2 minutes for Questions 5 and 6

ROUND 4, QUESTION 1

The number 9 is equal to the sum of the digits of its square.

$$9^2 = 81 \qquad 9 = 8 + 1$$

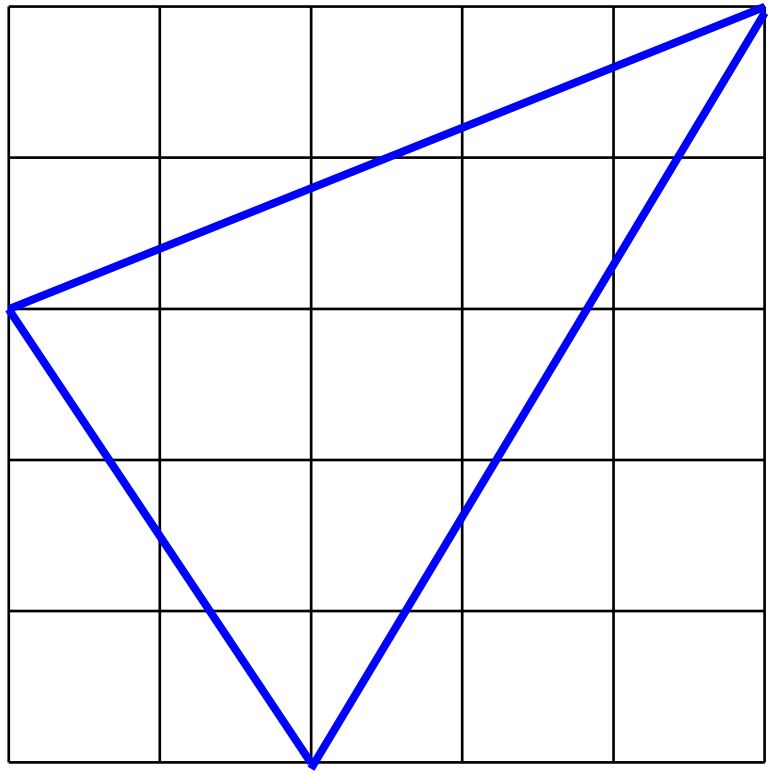
Find two numbers which are equal to the sum of the digits of their **cube**.

ROUND 4, QUESTION 3

Solve this equation.

$$\left(\frac{\sqrt{\frac{x}{2} + 10} + 3}{2} \right)^2 = 36$$

ROUND 4, QUESTION 2



Here is a triangle drawn on a centimetre square grid

What is the area of the triangle?

ROUND 4, QUESTION 4

50 students are given two Maths questions to answer.

- 13 got Question 1 right but Question 2 wrong
- 25 got Question 2 right but Question 1 wrong
- 5 got both questions wrong.

What percentage of the students who got Question 1 right also got Question 2 right?

ROUND 4, QUESTION 5

$\square$, $\triangle$ and $\bigcirc$ represent three different integers.

$$\frac{1}{\square} + \frac{1}{\triangle} + \frac{1}{\bigcirc} = \frac{14}{15}$$

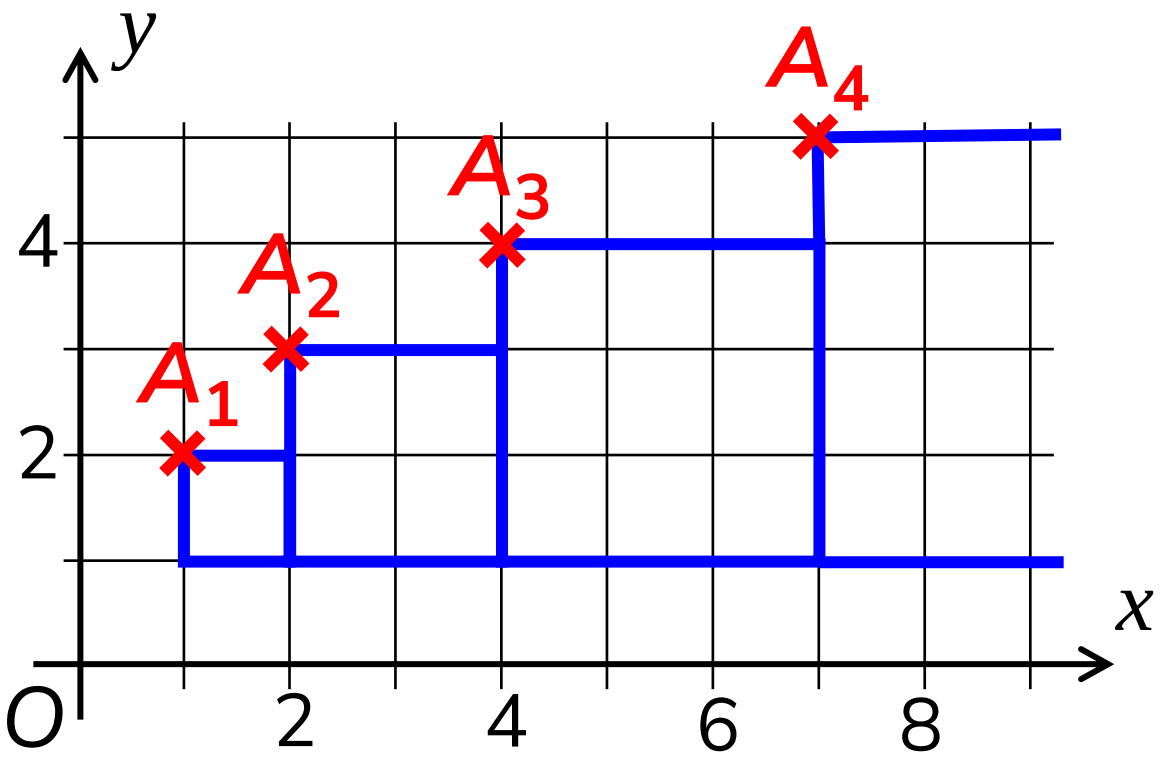
What are the three integers?

ROUND 4, QUESTION 6

A sequence of squares is drawn on a co-ordinate grid.

The sides of the squares increase by 1 each time.

The co-ordinates of the top left-hand corners are A_1, A_2, A_3 … and so on.



What are the coordinates of the point A_{20}?

End of Round 4

ANSWERS TO ROUND 4

ROUND 4, QUESTION 1

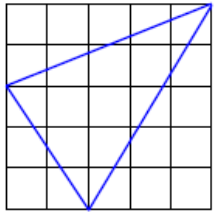
The number 9 is equal to the sum of the digits of its square.

$9^2 = 81$ $\quad$ $9 = 8 + 1$

Find two numbers which are equal to the sum of the digits of their **cube**.

1, 8

ROUND 4, QUESTION 2



Here is a triangle drawn on a centimetre square grid

What is the area of the triangle?

9.5 cm²

ROUND 4, QUESTION 3

Solve this equation.

$$\left(\frac{\sqrt{\frac{x}{2} + 10} + 3}{2}\right)^2 = 36$$

$x = 142$

ROUND 4, QUESTION 4

50 students are given two Maths questions to answer.

- 13 got Question 1 right but Question 2 wrong
- 25 got Question 2 right but Question 1 wrong
- 5 got both questions wrong.

What percentage of the students who got Question 1 right also got Question 2 right?

35%

ROUND 4, QUESTION 5

□, △ and ○ represent three different integers.

$$\frac{1}{\square} + \frac{1}{\triangle} + \frac{1}{\bigcirc} = \frac{14}{15}$$

What are the three integers?

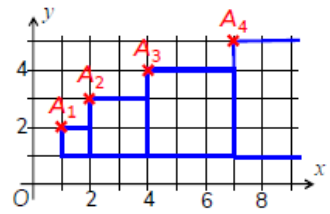
2, 3, 10

ROUND 4, QUESTION 6

A sequence of squares is drawn on a co-ordinate grid.

The sides of the squares increase by 1 each time.

The co-ordinates of the top left-hand corners are A_1, A_2, A_3 ... and so on.



What are the coordinates of the point A_{20}?

(191, 21)

YEAR 7 MATHS CHALLENGE 2024, FINAL

Firstly, **well done** to all!

The results are ...

YEAR 7 MATHS CHALLENGE 2024, FINAL

Thank you for taking part.

YEAR 7 MATHEMATICS CHALLENGE

Final, Oak Room (Hertfordshire Development Centre)

Thursday 25th April 2024

William Thallon, Secondary Mathematics Adviser

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