Year 8 Mathematics Challenge Final

Hertfordshire Development Centre

Tuesday 19th June 2018

@HfLSecMaths

William Thallon
Secondary Mathematics Adviser

Preliminaries

- If your school has more than one team, decide on a ‘Team A’ and a ‘Team B’.
- Make sure you write your team name on each Answer Sheet.
- Units are important! Correct answers with incorrect or missing units will not get full marks.
- Pens/pencils only. No calculators or measuring equipment.

The five rounds

Round 1	General Maths questions
Round 2	Memory Round
Round 3	Problem-solving Round

Break

Round 4	Estimation Round
Round 5	General Maths questions

60 marks for each round.

Round 1

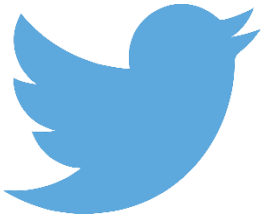
General Mathematics Questions

Herts for Learning

Round 1 **Question 1**

In a school of 1,200 students:

- 850 have a Twitter account;
- 620 have a Facebook account;
- 330 have both.



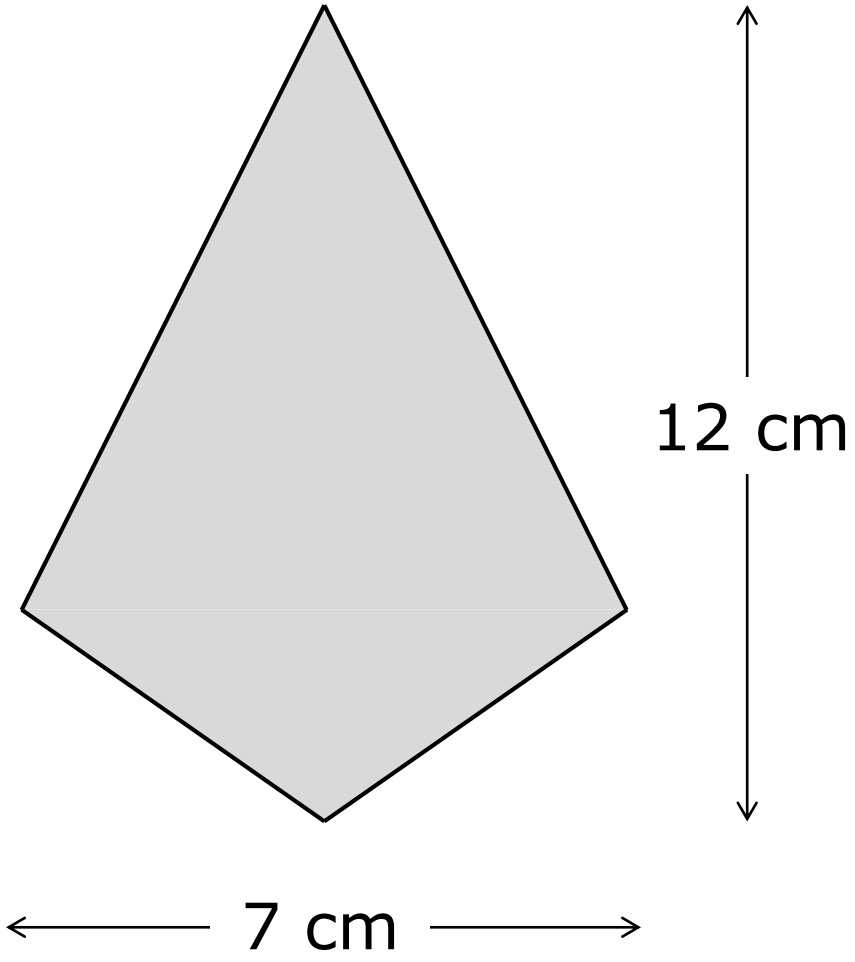
How many students have neither?

Round 4

Question 2

This kite has a width of 7 cm and a height of 12 cm.

Work out its area.



Round 1

Question 3

You have a large copy of this train timetable on your table.

South-West Trains

London Waterloo to Winchester, effective Friday 19th November 2017 to Sunday 24th June 2018

Weekdays only

	FE	1B		1		1B	MO	1
London Waterloo	08:15	08:28	08:42	08:51	09:15	09:28	09:42	09:51
Clapham Junction	08:36	08:49	09:03	09:12	09:36	09:49	10:03	10:12
Woking	09:03		09:30		10:03		10:30	
Guildford	09:16		09:43		10:16		10:43	
Havant	09:53		10:20		10:53		11:20	
Fareham	10:07		10:34	10:10	11:07		11:34	11:10
Basingstoke		10:06		10:29		11:06		11:29
Micheldever		10:36				11:36		
Winchester		10:46		11:09		11:46		12:09

FE: except Friday
MO: Monday only
1: First-class accommodation available
B: Buffet trolley

Alison wants to travel by train from Woking to Winchester, travelling on Monday.

She arrives at Woking Station at 09:15.

According to this timetable, what is the earliest she should arrive in Winchester?

Round 1

Question 4

Figure 1 shows a regular pentagon and five squares.

The side lengths of all the shapes are equal.

Figure 1

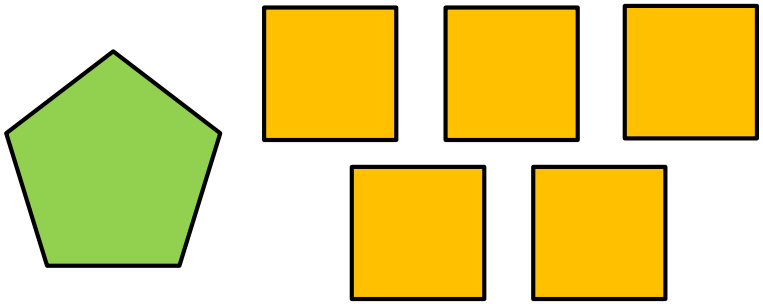
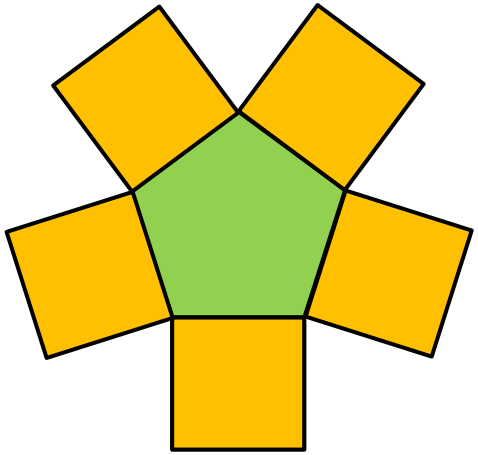


Figure 2



The shapes are joined together to make the shape shown in Figure 2.

The perimeter of the shape in Figure 2 is 60 cm **less** than the total perimeter of the shapes in Figure 1.

Work out the perimeter of the shape in Figure 2.

Round 1 **Question 5**

The value of x is $-\frac{1}{2}$.

Place the following expressions in ascending order.

$$2x \qquad \frac{x}{2} \qquad \frac{2}{x} \qquad x^2$$

(Write the expressions, not their values.)

Round 1

Question 6

There are four people in a quiz team:

Akash	Bobbie	Carla	Dominika

To choose a captain and vice-captain, their names are put into a hat and drawn out at random.

The first person drawn out of the hat will be the captain; the second one will be vice-captain.

What is the probability of getting Akash as captain and Bobbie as vice-captain?

Give your answer as a fraction in its simplest form.

Round 1: Answers

Q1 60

Q2 42 cm²

Q3 12:09

Q4 90 cm

Q5 $\frac{2}{x}$ $2x$ $\frac{x}{2}$ x^2

Q6 $\frac{1}{12}$

Round 2

Memory Round

Memory Round

We have a hidden mathematical poster.

Two members of your team (the **observers**) are allowed to come and look at the poster.

They must then go back and describe it for the other two people (the **scribes**) to draw.

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.

Memory Round

The observers will have four chances to view the poster.

30 seconds to view
2 minutes to 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.

After this, the team must hand their poster in immediately, with their team name on it.

Only ONE sheet must be handed in per team.

Memory Round

You now have one minute to:

- decide who will be the observers and who will be the scribes;
- find pencils, rubbers, rulers and anything else you might need;
- decide on tactics!

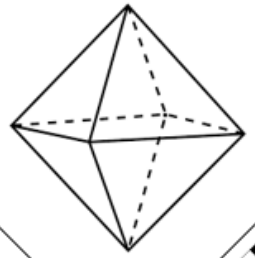
Planets in the solar system

'Octo'/'Octa' meant '8' in Latin/ ancient Greek.

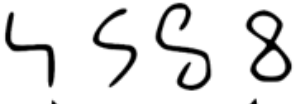
Octagon = plane shape with eight edges.

Octopus =

An octahedron is a solid shape with 8 faces.



Evolution of the figure 8

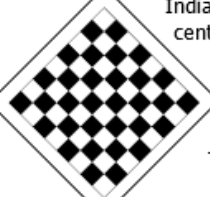


India, 1st century

Europe, 10th century

1 byte = 8 bits

VIII



Total number of teams in the quarter-finals

Notes in a major or minor scale

$\frac{1}{8}$ 0.125

Three ways to write the reciprocal of 8

12½%

8

The second cube number

1, 8, 27, 64, ...

The sixth Fibonacci number

1, 1, 2, 3, 5, 8, ...

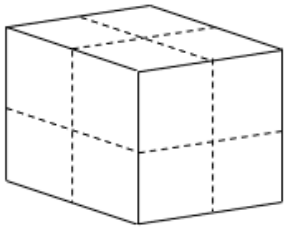
Japanese and Chinese lucky number

Maids-a-milking

100_2

Number of vegetables in V8 juice

If a number has three different, non-repeated prime factors, it will have 8 factors altogether.



The only perfect power ($8 = 2^3$) that is one less than another perfect power ($9 = 3^2$).

Furlongs in a mile

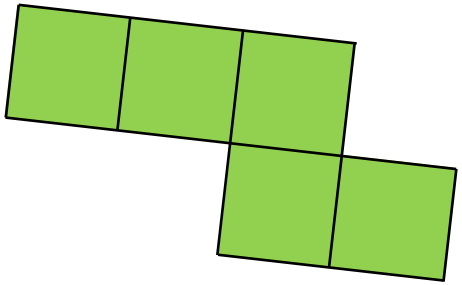
Round 3

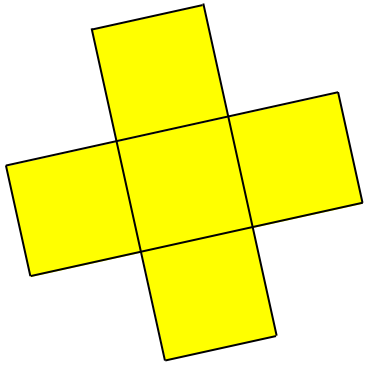
Problem-Solving Round

Round 3

You should have:

- 6 problem sheets
- 12 coloured shapes





- 18 plastic counters
- cards numbered 1 to 9
- a glue stick

Round 3

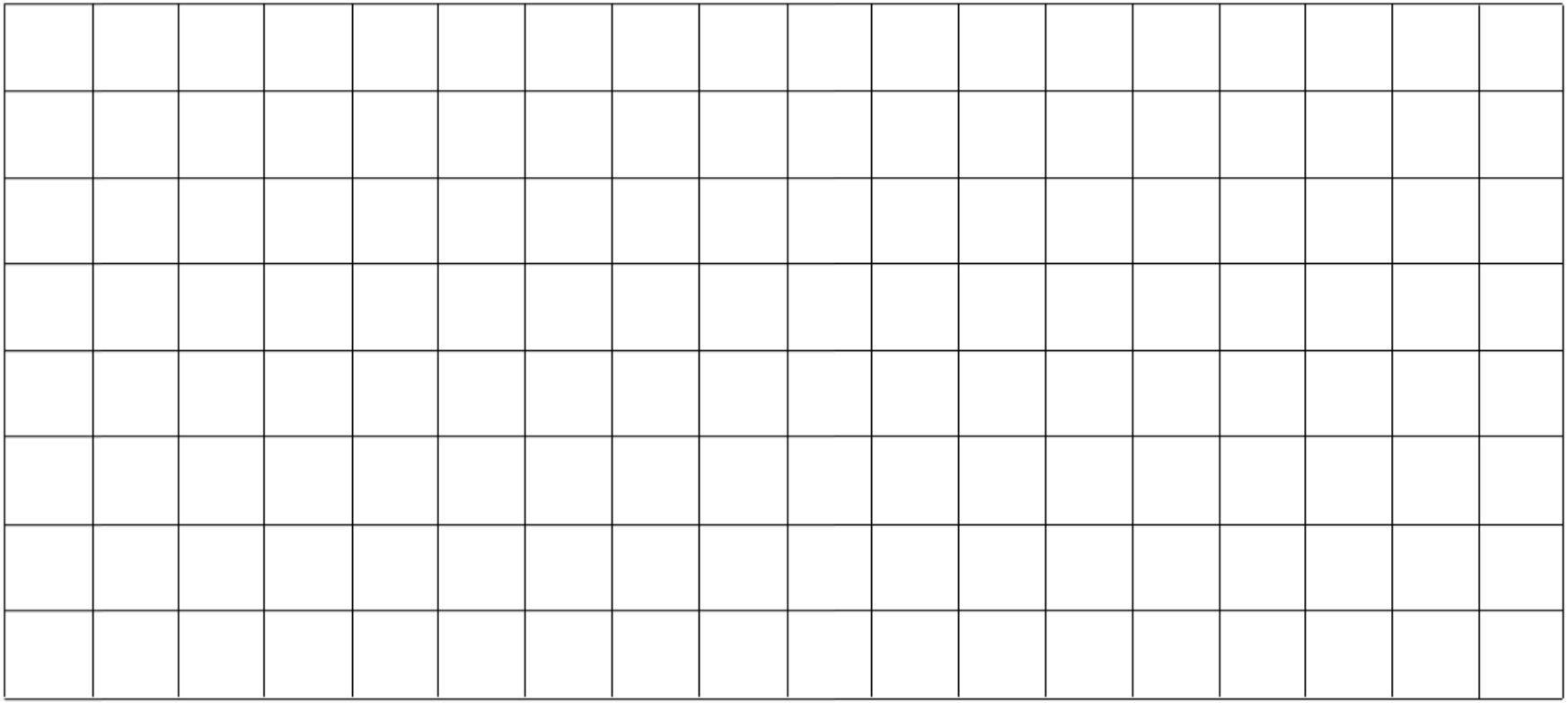
Pentominoes

Pentominoes are shapes made from 5 squares.

Fit some (or all) of the pentominoes given to you to make the largest rectangle (or square) that you can.

The pentominoes must not overlap, and there must not be any gaps.

Stick the pentominoes onto this grid. The larger the area, the more points you will score.



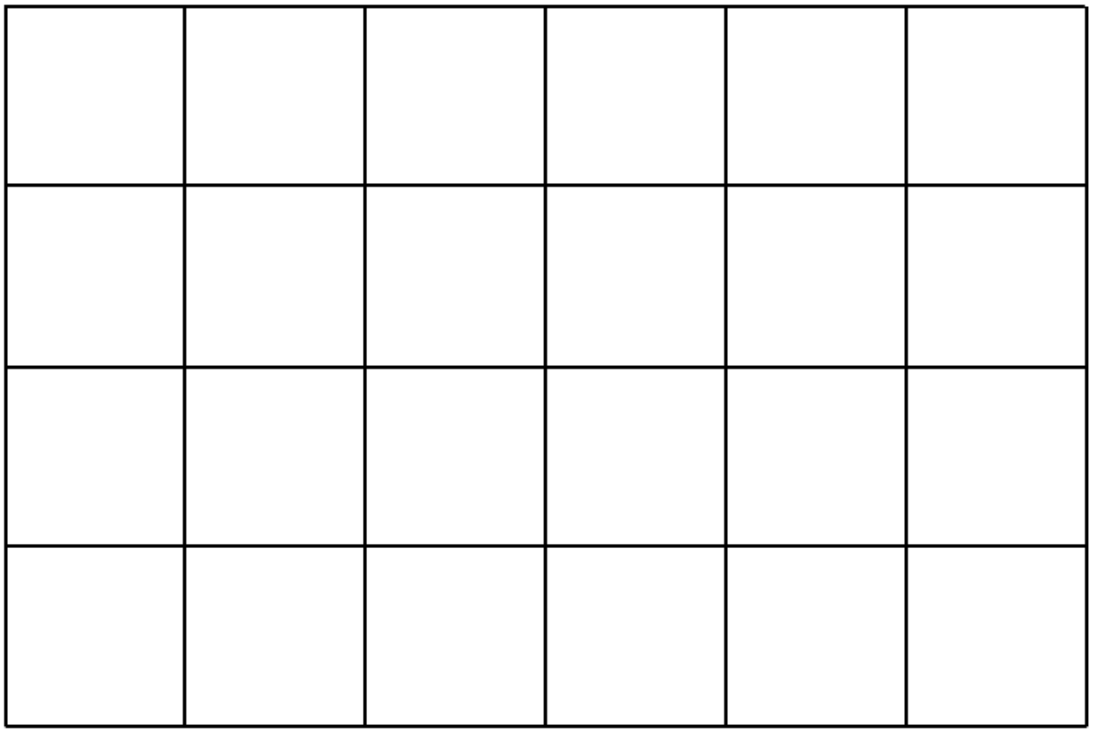
Round 3

Bottles in a crate

The diagram shows a milk crate.

It has 4 rows and 6 columns.

Show how **18 bottles** can be placed in the crate so that each row and each column has an **even** number of bottles.



Round 3

Fractions Puzzle

You have cards numbered 1 to 9.

Use the cards to complete the following fraction calculations.

(Stick the cards onto this sheet.)

$$\frac{3}{4} - \frac{\square}{8} = \frac{5}{\square}$$

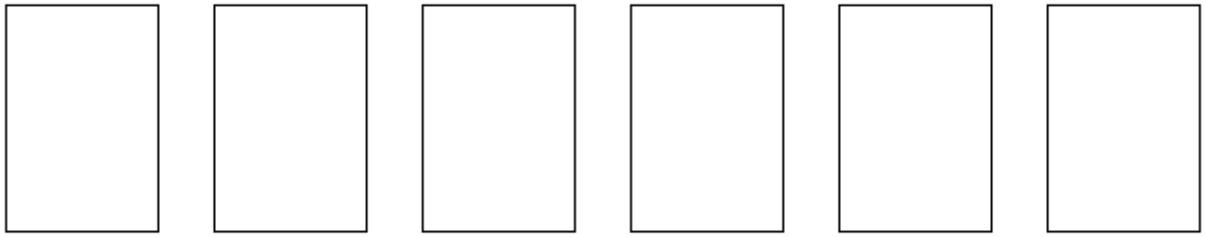
$$2\frac{1}{\square} = \frac{\square}{4}$$

$$\frac{\square}{\square} \times \frac{\square}{\square} = \frac{\square}{35}$$

Round 3

Number detective

Use the clues to work out the values of these six numbers:



- They are all integers.
- The mode of the numbers is **7**.
- The median of the numbers is **8½**.
- The range of the numbers is **20**.
- The mean of the numbers is **12½**.
- One of the numbers is **three times** one of the other numbers.

Write your answers in the boxes.

Round 3

Truth and Lies

Mr Smith has five students in detention in his classroom.

On the teacher's desk, there is a jar of sweets.

Mr Smith leaves the classroom for a few minutes.
On his return, he finds that several of the sweets have been eaten while he was out of the room.

He questions the students.

- The students who **ate** the sweets **lied**.
- The students who **didn't eat** them **told the truth**.

Student 1 said: "Only one person ate the sweets."

Student 2 said: "Two people ate the sweets."

Student 3 said: "Three people ate the sweets."

Student 4 said: "Four people ate the sweets."

Student 5 said: "All five of us ate the sweets."

How many students ate the sweets?

Round 3

1 to 10

In this task,	$a = 4$	$b = 5$	$c = 9$

Write an expression which gives each of the numbers between 1 and 10 inclusive.

- Each expression must use **all three** letters, a, b and c.
- You may not use any of the letters more than once.
- Your expressions must **not** use **any numbers**.
  (For example, $3a - b - c$ is not allowed, as it uses a '3'.)
- You may use any of the following:

add subtract multiply divide square root brackets.

- Indices may be used as long as you don't use numbers in them.
  (So b^2 is not allowed, but b^a is allowed.)
- Expressions must be **written correctly** (e.g. ab, not $a \times b$).

One expression in each box; one mark for each.

Round 3 Answers

Pentominoes

Pentominoes are shapes made from 5 squares.

Fit some (or all) of the pentominoes given to you to make the largest rectangle (or square) that you can.

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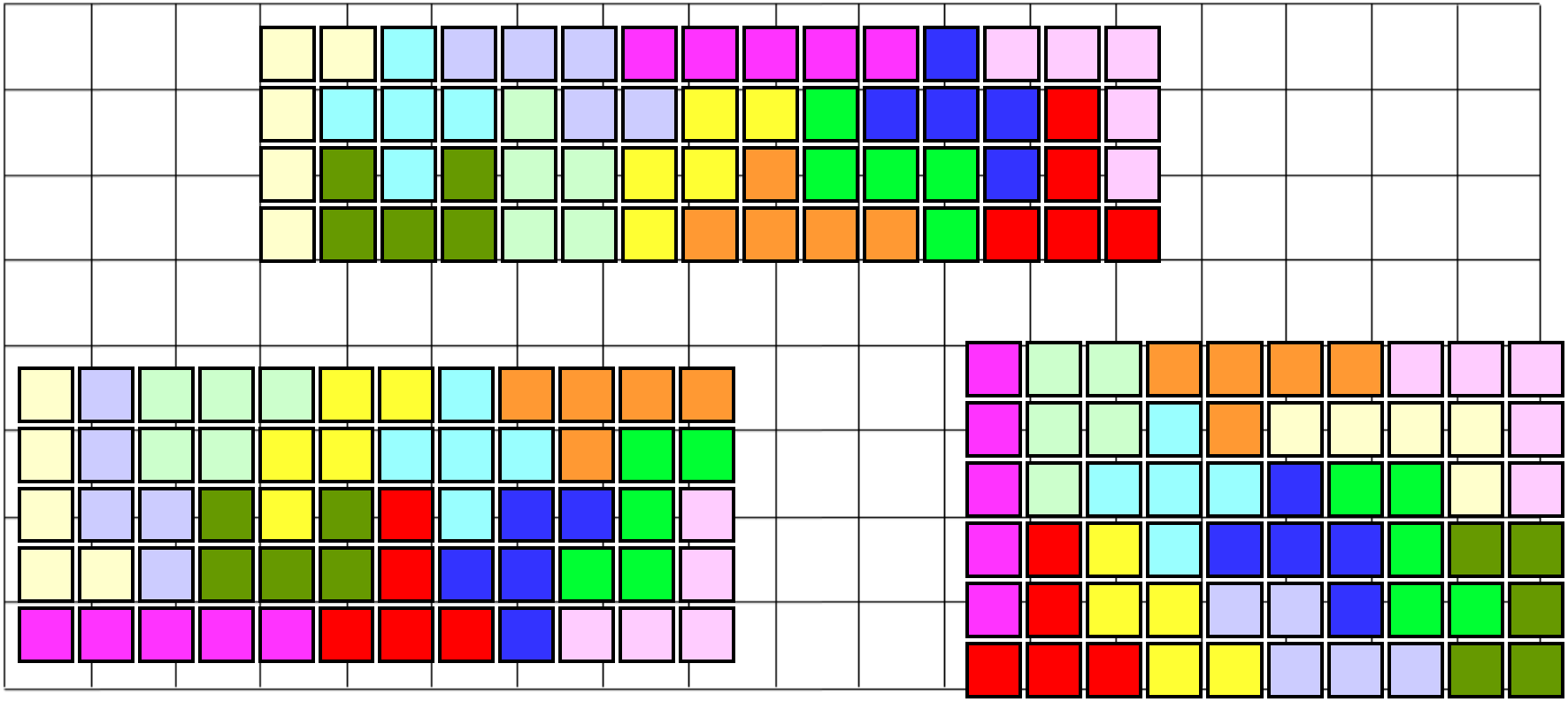
Stick the pentominoes onto this grid. The larger the area, the more points you will score.



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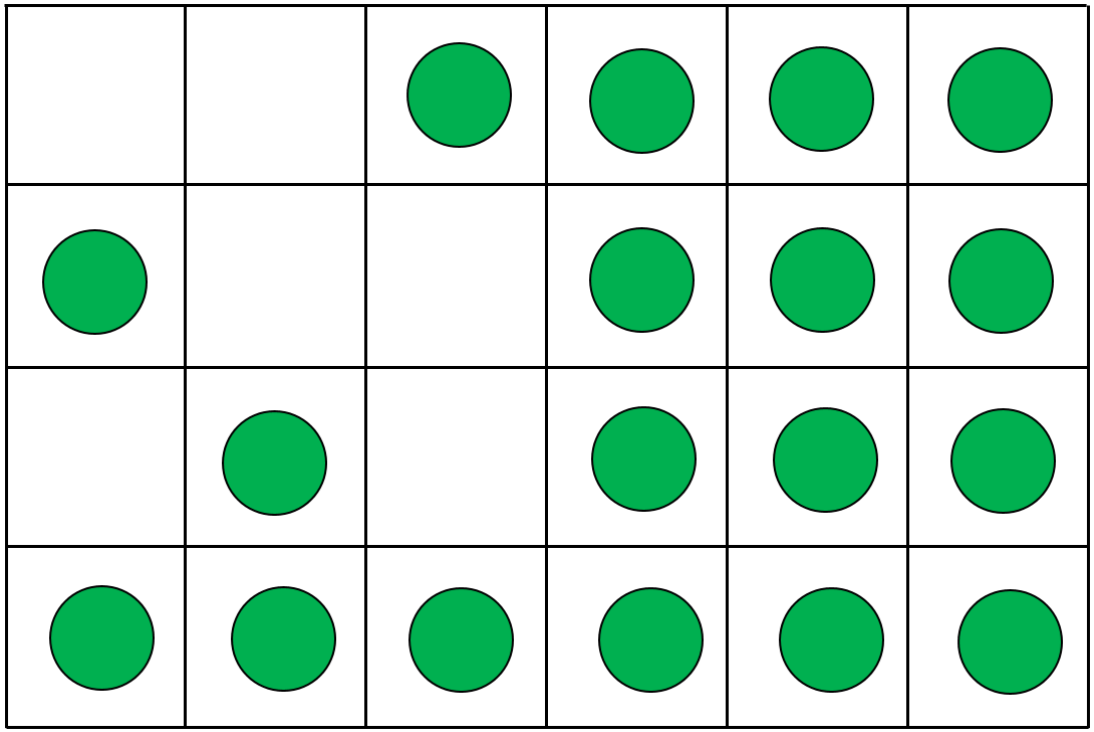

Round 3 Answers

Fractions Puzzle

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Use the cards to complete the following fraction calculations.

(Stick the cards onto this sheet.)

$$\frac{3}{4} - \frac{1}{8} = \frac{5}{8}$$

$$2\frac{1}{4} = \frac{9}{4}$$

$$\frac{2}{7} \times \frac{3}{5} = \frac{6}{35}$$

Round 3 Answers

Number detective

Use the clues to work out the values of these six numbers:

	7	7	8	9	17	27
or	5	7	7	10	21	25

- They are all integers.
- The mode of the numbers is **7**.
- The median of the numbers is **8½**.
- The range of the numbers is **20**.
- The mean of the numbers is **12½**.
- One of the numbers is **three times** one of the other numbers.

Write your answers in the boxes.

Round 3 Answers

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Student 5 said: "All five of us ate the sweets."

4

How many students ate the sweets?

Round 3 Answers

1 to 10

In this task $a = 4$ $b = 5$ $c = 9$

1	$b\sqrt{a} - c$	$\frac{\sqrt{a}+\sqrt{c}}{b}$
2	$c - b - \sqrt{a}$	$\frac{c-b}{\sqrt{a}}$
3	$\frac{a+b}{\sqrt{c}}$	$\frac{c}{b-\sqrt{a}}$
4	$\sqrt{a}\sqrt{c-b}$	$\sqrt{b^{\sqrt{a}} - c}$
5	$b(\sqrt{c}-\sqrt{a})$	$\sqrt{b(c-a)}$

6	$b+\sqrt{c}-\sqrt{a}$	$c-b+\sqrt{a}$
7	$\frac{b+c}{\sqrt{a}}$	$\sqrt{bc+a}$
8	$a+c-b$	$\sqrt{a}(c-b)$
9	$c(b-a)$	$\sqrt{c}(b-\sqrt{a})$
10	$b+c-a$	$\sqrt{a}+b+\sqrt{c}$

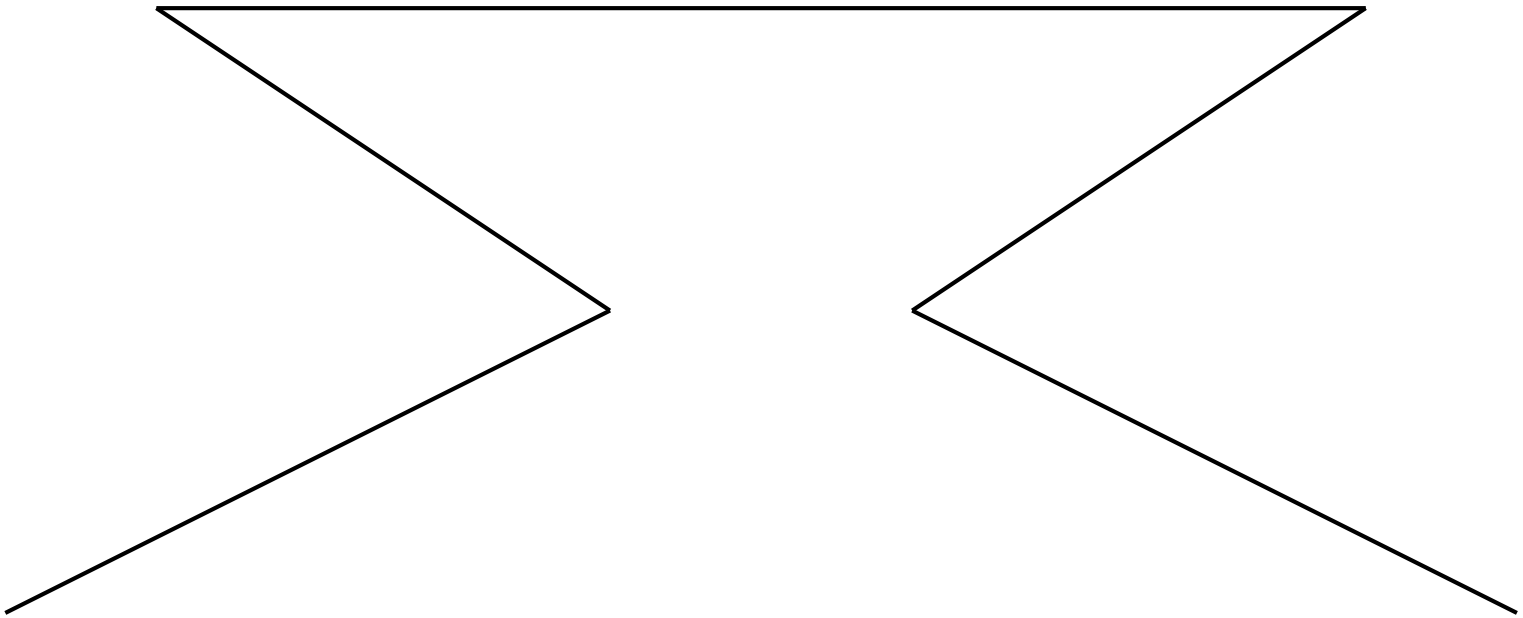
One expression in each box, one mark for each.

Round 4

Estimation Round

Round 4 **Question 1**

Estimate the sum of the four reflex angles in this symmetrical diagram.



Round 4

Question 2

Estimate the mass of the battery.

Round 4

Question 3

Estimate the number of baseballs in this pyramid.

Round 4

Question 4

Estimate the area of Luxembourg.

(You may choose which units to use.)

Round 4

Question 5

Estimate how many spoonfuls of water it would take to fill this cup.

Round 4

Question 6

Estimate how long it has been since you saw this picture of the clown.

Round 4: Answers

(Equivalent answers in alternative units accepted)

Q1	1200° to 1300°
Q2	60 to 70 grams
Q3	2840 to 2900
Q4	2457 to 2715 km² 960 to 1060 sq miles
Q5	35 to 45
Q6	TBD

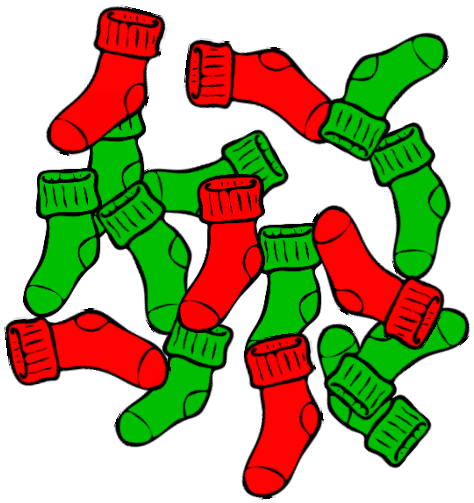
Round 5

General Mathematics Questions

Herts for Learning

Round 5

Question 1



In my sock drawer, there are 6 red socks and 10 green socks. They are all mixed up.

Apart from their colour, all the socks are identical.

The room is in pitch darkness, so I can't tell which sock is which. I want to pick out two matching socks.

What is the smallest number of socks I must take out of the drawer to be certain of getting a pair that match?

Round 5 **Question 2**

The number 24 is an **abundant number**. It is less than the sum of its proper factors.

Proper factors of 24: 1, 2, 3, 4, 6, 8, 12

1 + 2 + 3 + 4 + 6 + 8 + 12 = **36**

What is the <u>smallest</u> abundant number?

Round 5 **Question 3**

Adam earns £600 per week.

He asks to work shorter hours.
His pay is reduced by 20%.

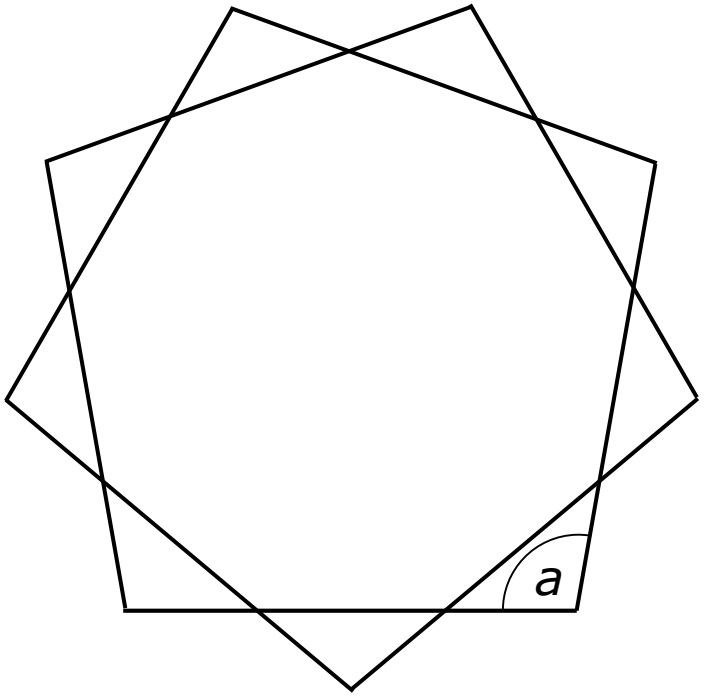
A few weeks later, he starts working normal hours again. His pay goes back up to £600.

When his pay goes back up, what is the percentage increase?

Round 5

Question 4

This pattern is made from nine straight lines.



It has rotation symmetry order 9.

Work out the size of the angle marked *a*.

Round 5 **Question 5**

n is an integer greater than zero.

$n^2 + n + 11$ is not a prime number.

What is the smallest possible value of n?

Round 5

Question 6

This question can be answered without having to do any long and complicated calculation!

If you worked out

$$1 \times 2 \times 3 \times 4 \times \ldots \times 24 \times 25$$

how many zeroes would there be at the end of the answer?

Round 5: Answers

Q1	3
Q2	12
Q3	25%
Q4	100°
Q5	10
Q6	6

Year 8 Mathematics Challenge Final

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William Thallon
Secondary Mathematics Adviser