# Herts for Learning

Herts for Learning is a not for profit company providing school improvement and business services. With over 500 shareholder schools, Herts for Learning is dedicated to improving standards of education in Hertfordshire and beyond.

**www.hertsforlearning.co.uk**

@HertsLearning  Herts for Learning  Herts for Learning  blogs.hertsforlearning.co.uk

# Year 8 Mathematics Challenge Final

Hertfordshire Development Centre

Wednesday 19th June 2019

@HfLSecMaths

William Thallon
Secondary Mathematics Adviser

Herts for Learning

# Preliminaries

- If there is more than one team from your school, decide who will be Team A and who will be 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 Problems and Puzzles

**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**

A set of cards is numbered from 1 to 9 inclusive. Odd numbers are printed on red cards, even numbers on green.

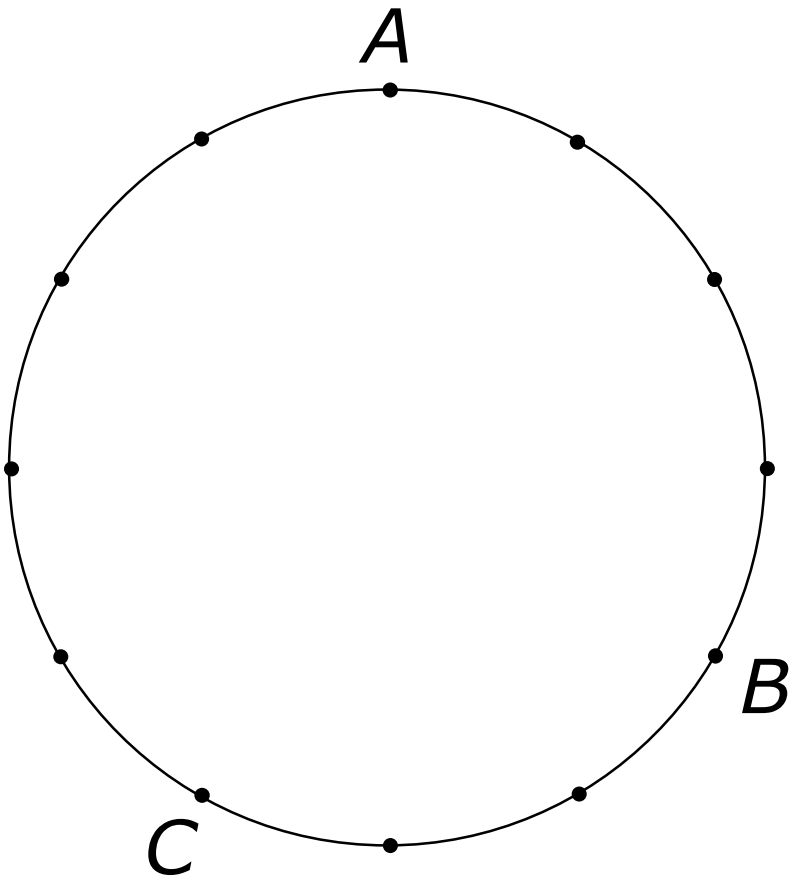

A red card and a green card are chosen at random, and the numbers are added together.

What is the probability that the answer is a prime number?

**Round 1**

**Question 2**

This diagram shows a circle with 12 equally spaced points around the circumference.




Work out the size of angle *ABC*.

**Round 1** **Question 3**

$$a^3 + b^3 = (a + b)(a^2 - ab + b^2)$$

This may help you to work out the answer to

$$8\,000\,343 \div 207$$


Boris
JOHNSON

**Round 1** **Question 4**

The tables below show the ratios between two sets of numbers. (The table on the left is given as an example.)

| | 6 | 15 |
|---|---|---|
| 12 | 2:1 | 4:5 |
| 9 | 3:2 | 3:5 |

| | $r$ | $s$ |
|---|---|---|
| $p$ | 3:1 | 8:15 |
| $q$ | 5:2 | 4:9 |

Work out possible values for the integers $p$, $q$, $r$ and $s$.

**Round 1** **Question 5**

**This sentence contains the letter ‘e’ _____ times.**

How many of the words below could fill the gap and make the sentence true?

| | | | |
|---|---|---|---|
| one | two | three | four |
| five | six | seven | eight |
| nine | ten | eleven | twelve |

Find **different** positive integers $a$ and $b$ which satisfy

$$\frac{1}{a} + \frac{1}{b} = \frac{1}{6}$$

# End of Round 1

# Round 1
# ANSWERS

Herts for Learning

# Round 1

## Question 1

A set of cards is numbered from 1 to 9 inclusive. Odd numbers are printed on red cards, even numbers on green.


A red card and a green card are chosen at random, and the numbers are added together.

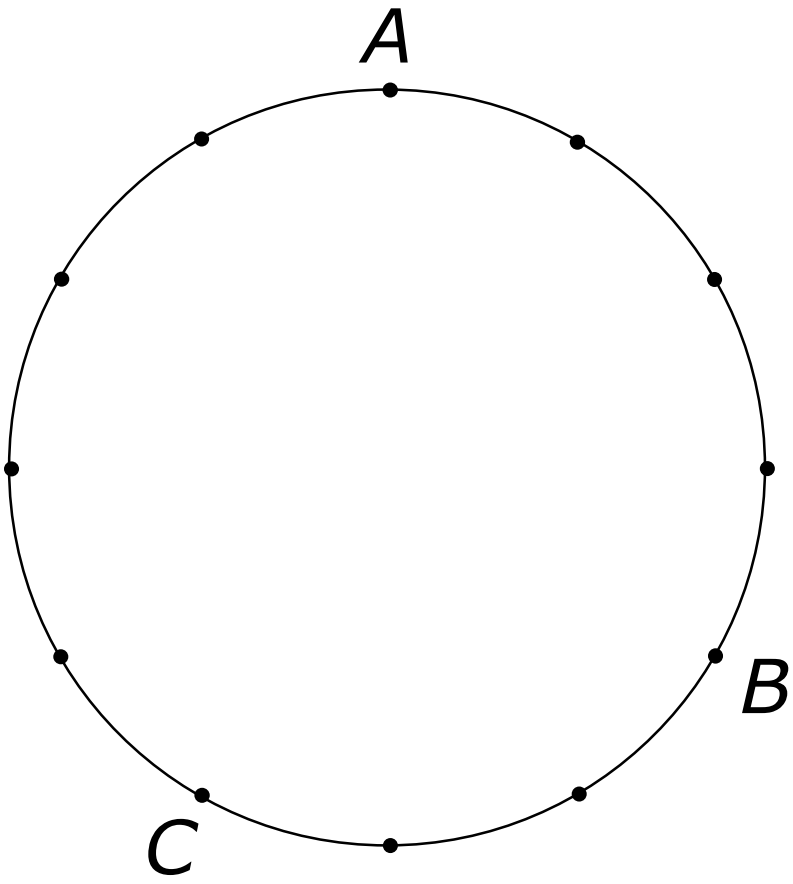
What is the probability that the answer is a prime number?

**Answer:** $\frac{7}{10}$

**Round 1**

**Question 2**

This diagram shows a circle with 12 equally spaced points around the circumference.




Work out the size of angle *ABC*.

**Answer: 75°**

**Round 1** **Question 3**

$$a^3 + b^3 = (a + b)(a^2 - ab + b^2)$$

This may help you to work out the answer to

$$8\,000\,343 \div 207$$

**Answer: 38 649**

# Round 1

# Question 4

The tables below show the ratios between two sets of numbers. (The table on the left is given as an example.)

| | 6 | 15 |
|---|---|---|
| 12 | 2:1 | 4:5 |
| 9 | 3:2 | 3:5 |

| | **8** | **45** |
|---|---|---|
| **24** | 3:1 | 8:15 |
| **20** | 5:2 | 4:9 |

Work out possible values for the integers $p$, $q$, $r$ and $s$.

**Answer: 24, 20, 8, 45**

**Round 1** **Question 5**

**This sentence contains the letter ‘e’ _____ times.**

How many of the words below could fill the gap and make the sentence true?

| | | | |
|---|---|---|---|
| one | two | three | four |
| five | six | seven | eight |
| nine | ten | eleven | twelve |

**Answer: 2**

Find **different** positive integers $a$ and $b$ which satisfy

$$\frac{1}{a} + \frac{1}{b} = \frac{1}{6}$$

**Possible answers:** **15 and 10**
**18 and 9**
**24 and 8**
**42 and 7**

# 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 and anything else you might need;
- decide on tactics!

# Round 2

# Memory Round

# Round 2
# ANSWER

# Memory Round

## Se7en

### Powers of 7

$7^1 = 7$
$7^2 = 49$
$7^3 = 343$
$7^4 = 2{,}401$
$7^5 = 16{,}807$
etc

There is a pattern in the final digit: 7, 9, 3, 1, 7, 9, 3, 1, etc

When two dice are rolled, there are six ways to get a total of 7:

1 and 6
2 and 5
3 and 4
4 and 3
5 and 2
6 and 1

7 is the most likely score to get with two dice.

A 7-sided polygon is called a **heptagon**.
Any heptagon can be divided into 5 triangles.

Angle sum of a heptagon = $5 \times 180 = 900°$.


The interior angle of a regular heptagon is 128.6° (to one decimal place).

7 is the only single-digit integer which is not a factor of 360.

7 is the fourth prime number.

It is the first prime number which is one more than a multiple of 6.

It is the lowest number which cannot be written as the sum of three square numbers.

$999{,}999 \div 7 = 142{,}857$

The same pattern is found when $\frac{1}{7}$ is written as a decimal.

$\frac{1}{7} = 0.142857\ 142857\ 142857$ ... etc
$\frac{2}{7} = 0.285714\ 285714\ 285714$ ... etc

### Divisibility test for 7

Double the units digit.
Subtract this from the rest of the number.
See if you get a multiple of 7.

Example: 203

$2 \times 3 = 6$
$20 - 6 = 14$, which is a multiple of 7

### Squares and Cubes in Base 7

The first ten square numbers in base 7 are:

1, 4, 12, 22, 34, 51, 100, 121, 144, 202

The first five cube numbers are:

1, 11, 36, 121, 236

# Round 3

# Problems and Puzzles

# Round 3

You should have:

- Six problems, printed on white paper
- Some yellow sheets for rough working out
- Six colouring pencils (six different colours)

# Round 3

You have six different problems

Solve as many as you can in 20 minutes.

Write your final answers on the white problem sheets;  use the yellow sheets for any rough working out.

There are 10 points for each problem.  Partly correct solutions may also gain points.

# Round 3

# Problems and Puzzles

# Round 3

Put your six white problem sheets back into the plastic wallet.

Please put them in order, from 1 to 6.

Write your team name clearly on the top sheet, and hand your solutions in.

# End of Round 3

# End of Round 3

# BREAK

# Round 4

# Estimation Round

**Round 4**

**Question 1**

Estimate the total floor area of this room, in $m^2$.

**Round 4**

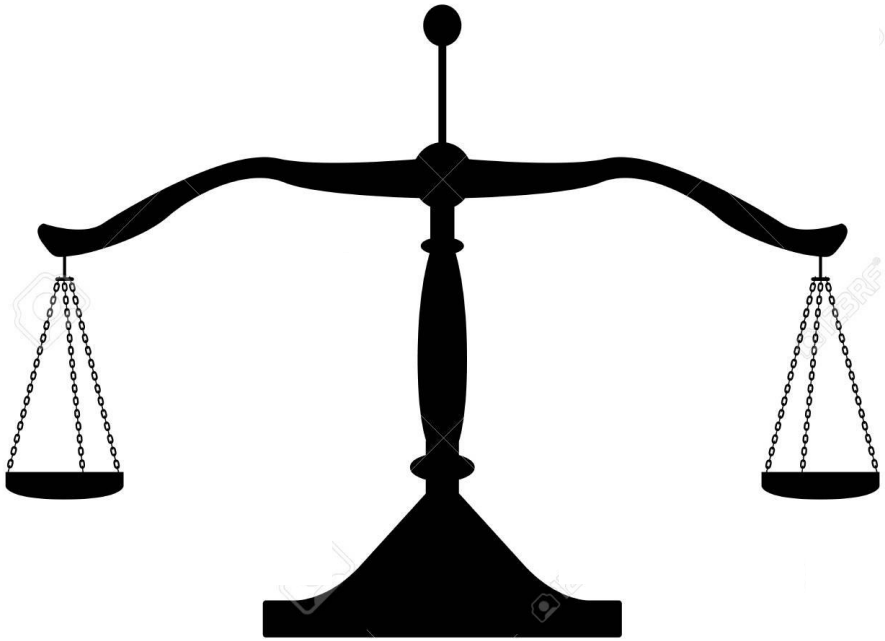
**Question 2**

Estimate the volume of the paper cup, in $cm^3$.

# Round 4

## Question 3

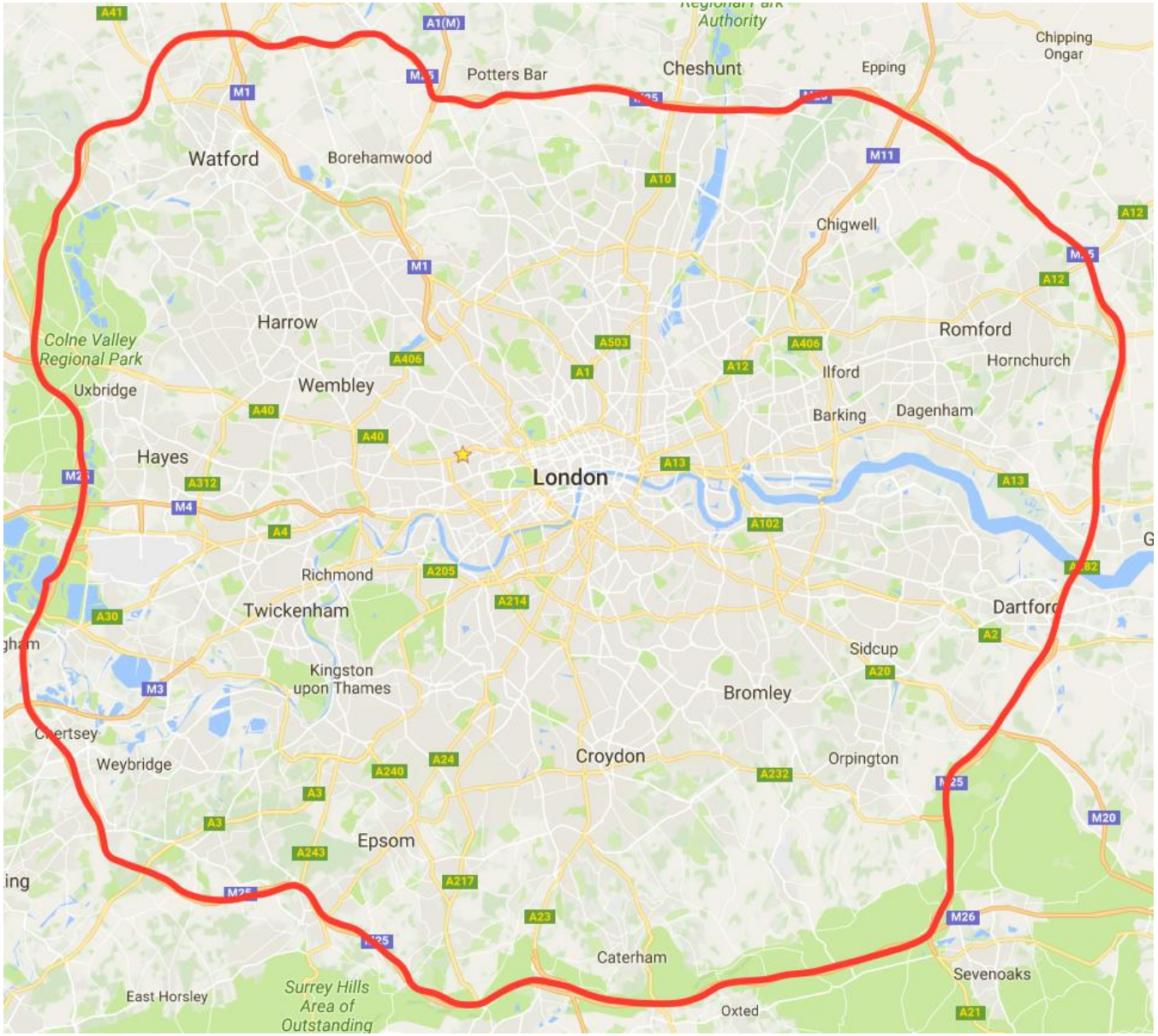
If placed on a set of scales, how many plastic forks would it take to balance the tin?



# Round 4

# Question 4

Estimate how many minutes it would take for a car to go all the way round the M25, travelling at a constant speed of 70 miles per hour.


Watford
Borehamwood
Potters Bar
Cheshunt
Epping
Chipping Ongar
Chigwell
Romford
Hornchurch
Ilford
Barking
Dagenham
Harrow
Wembley
Uxbridge
Colne Valley Regional Park
Hayes
London
Richmond
Twickenham
Kingston upon Thames
Bromley
Sidcup
Dartford
Croydon
Orpington
Weybridge
Epsom
Caterham
Sevenoaks
Oxted
East Horsley
Surrey Hills Area of Outstanding
A41
A1(M)
M1
M11
A10
A12
A406
A503
A1
A13
A102
A40
A312
M4
A4
A205
A214
A30
M3
A24
A240
A232
A3
A243
A217
A23
M26
M20
A2
A20
A21
miles
0
10

# Round 4

# Estimation Round

**Round 4** **Question 5**

Estimate the answer to this calculation, to the nearest integer.

$$\frac{184\,575 \times 0.88}{3319}$$

**Round 4**

**Question 6**

How long is it since this picture was displayed on the screen?

# End of Round 4

# Round 4
# ANSWERS

Herts for Learning

**Round 4**

**Question 1**

Estimate the total floor area of this room, in $m^2$.

**Answer: 340 $m^2$**

**Round 4**

**Question 2**

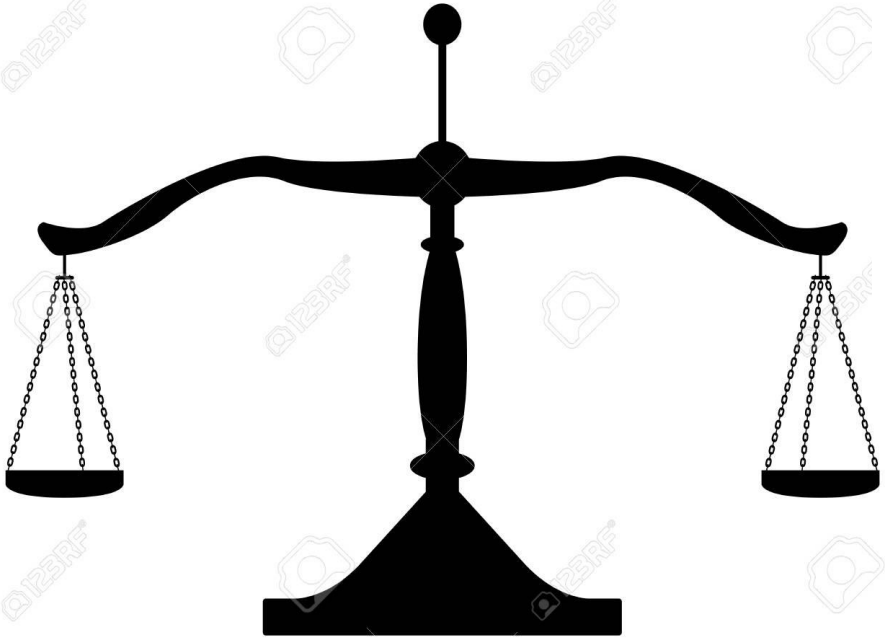
Estimate the volume of the paper cup, in $cm^3$.

**Answer: 280 $cm^3$**

**Round 4**

**Question 3**

If placed on a set of scales, how many plastic forks would it take to balance the tin?



**Answer: 34-35**

# Round 4

# Question 4

Estimate how many minutes it would take for a car to go all the way round the M25, travelling at a constant speed of 70 miles per hour.


**Answer: 100 minutes**

**Round 4** **Question 5**

Estimate the answer to this calculation, to the nearest integer.

$$\frac{184\,575 \times 0.88}{3319}$$

**Answer: 49**

**Round 4**

**Question 6**

How long is it since this picture was displayed on the screen?


**Answer: ??**

# Round 5

# General Mathematics Questions

Herts for Learning

**Round 5** **Question 1**

Joseph scores 42 out of 60 on Section A of a test.

On Section B, he scores full marks.

His total mark, when Sections A and B are added together, and converted to a percentage, is 75%.

How many marks were there on Section B?

**Round 5** **Question 2**

20 people – adults, children and OAPs – go on a coach trip.

Adults pay £30 each.

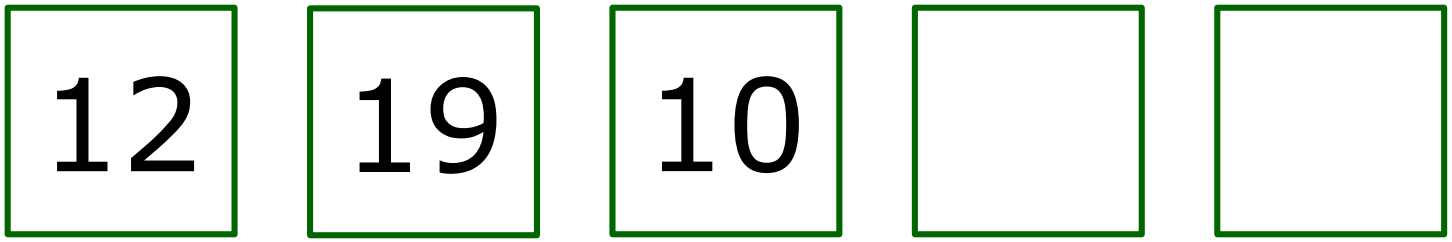
Children pay £5 each.

OAPs pay £15 each.

Altogether, they pay a total of £200.

How many of each go on the coach trip?

**Round 5** **Question 3**




The mean of these five numbers is **13**.

The range of the numbers is **12**.

Work out the two missing numbers.

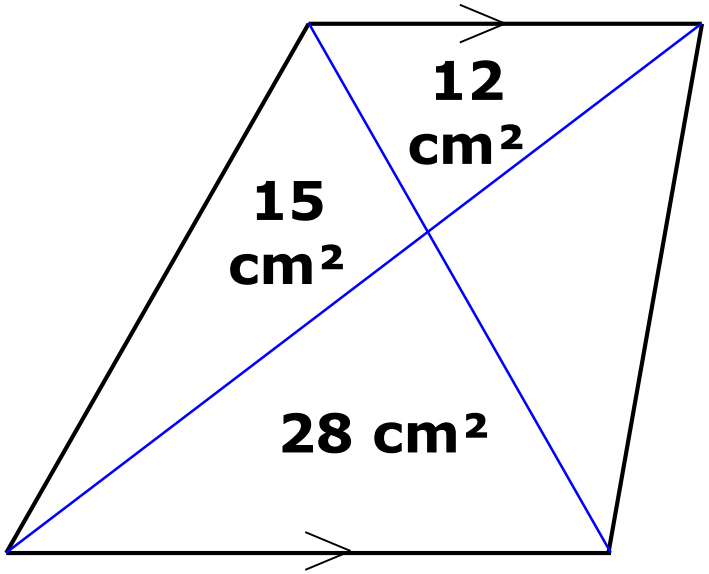
# Round 5

# Question 4

The diagram shows a trapezium.

The two diagonals divide the trapezium into four triangles.

The areas of three of the triangles are shown.




What is the total area of the trapezium?

# Round 5

# Question 5

Here is the rule for a number sequence:

- Start with a two-digit number
- To work out the next number, find the product of the digits
- Stop when you reach a number less than 10.

Example: **77** **49** **36** **18** **8**

Find **five** starting numbers whose sequences eventually end in **4**.

**Round 5** **Question 6**

$1^2 = 1$ is a cube number as well as a square number.

The same is true for 8.
$8^2 = 64$ is a cube number as well as a square number.

Find another number with the same property.

$\square^2$ is a cube number as well as a square number.

# End of Round 5

# Round 5
# ANSWERS

Herts for Learning

**Round 5** **Question 1**

Joseph scores 42 out of 60 on Section A of a test.

On Section B, he scores full marks.

His total mark, when Sections A and B are added together, and converted to a percentage, is 75%.

How many marks were there on Section B?

**Answer: 12**

**Round 5** **Question 2**

20 people – adults, children and OAPs – go on a coach trip.

Adults pay £30 each.

Children pay £5 each.

OAPs pay £15 each.

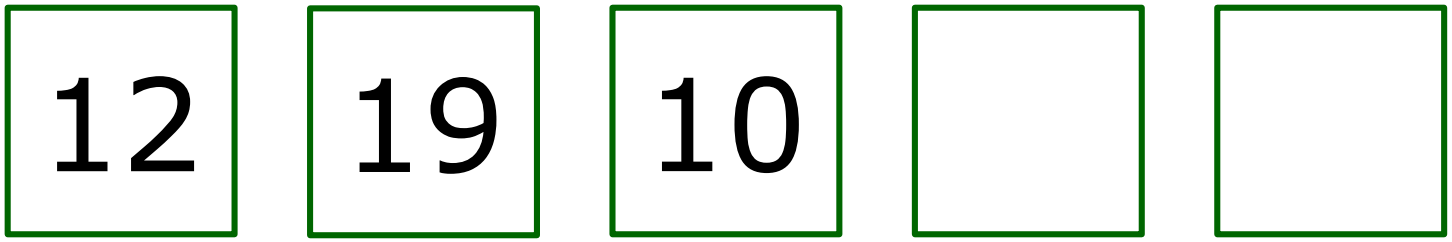
Altogether, they pay a total of £200.

How many of each go on the coach trip?

**Answer: 2, 13, 5**

**Round 5**

**Question 3**




The mean of these five numbers is **13**.

The range of the numbers is **12**.

Work out the two missing numbers.

**Answer: 17 and 7**

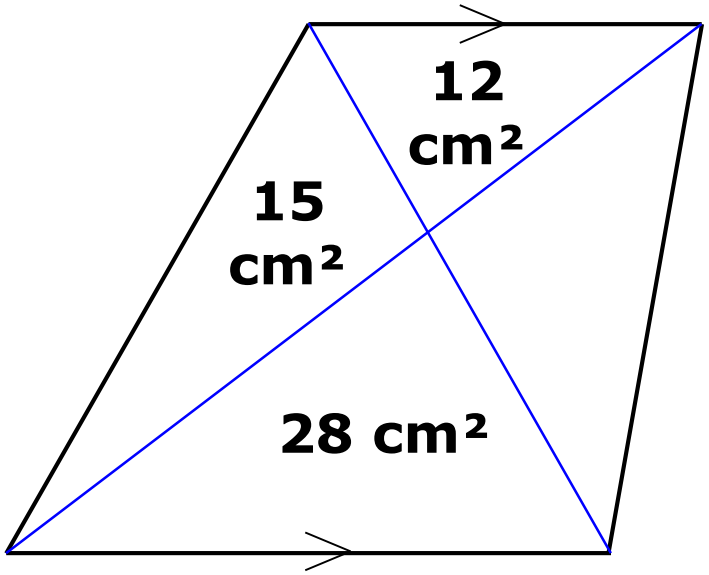
# Round 5

## Question 4

The diagram shows a trapezium.

The two diagonals divide the trapezium into four triangles.

The areas of three of the triangles are shown.




What is the total area of the trapezium?

**Answer: 70 cm²**

# Round 5

# Question 5

Here is the rule for a number sequence:

- Start with a two-digit starting number
- To work out the next number, find the product of the digits
- Stop when you reach a number less than 10.

Example: **77 49 36 18 8**

Find **five** starting numbers whose sequences eventually end in **4**.

**Answers: any five from:**

**14 41 22 27 72 89 98 39 93**

**Round 5** **Question 6**

$1^2 = 1$ is a cube number as well as a square number.

The same is true for 8.
$8^2 = 64$ is a cube number as well as a square number.

Find another number with the same property.

$\square^2$ is a cube number as well as a square number.

**Possible answers: 27, 64, …**

# Well done to all

# Year 8 Mathematics Challenge Final

Hertfordshire Development Centre

Wednesday 19th June 2019

@HfLSecMaths

William Thallon
Secondary Mathematics Adviser

**This presentation was brought to you by Herts for Learning**.

To find out about other Herts for Learning training courses
or events please visit: **www.hertsforlearning.co.uk/booking**

Visit our online shop to order additional resources
at **shop.hertsforlearning.co.uk**