Year 8 Mathematics Challenge 2022

Heat 3, Thursday 28th April 2022

via *Livestorm*

William Thallon

Teaching and Learning Adviser (Secondary Maths)

David Cook

Lead Teaching and Learning Adviser (Primary Maths)

Format of Challenge

Round 1 General Maths questions

Round 2 Memory Round

Round 3 Estimation Round

Round 4 General Maths questions

60 marks for each round.

Year 8 Challenge

This is the last of three heats, the first two having taken place on Monday and Tuesday.

The top 12 (or so) teams from across all the heats will be invited to take part in the Final. This will be a face-to-face event, to be held at Marriotts School in Stevenage on Thursday 19th May.

Preliminaries

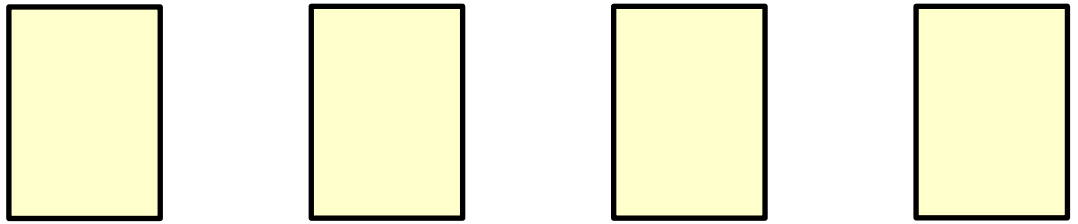
- You should have pens or pencils, rubbers, and rough working out paper only.
- No calculators, no measuring equipment, and no use of computers, phones, Internet etc!
- Your teacher has been sent a spreadsheet to record your answers. This should be returned by e-mail at the end.

Round 1

General Mathematics Questions

Round 1

Question 1



Here is some information about four numbers.

- They are all integers.
- The lowest number is 5.
- The median is one more than the mode.
- The mean is one more than the median.

What are the four numbers?

Round 1

Question 2

All the students in a school support their local football team, a Premiership team, or both.

375 students support their local team.

420 support a Premiership team.

105 students support both their local team and a Premiership team.

How many students are there in the school?

Round 1

Question 3

Some students from Years 7 and 8, and some staff, go on a coach trip

The ratio of staff : students is 1 : 6.

The ratio of Year 7 students to Year 8 students is 1 : 2.

What **fraction** of the people on the trip are Year 8 students?

(Do not include the coach driver.)

Round 1

Question 4

This equation is (hopefully) not as bad as it looks!

$$\frac{1}{7}\left[3 + 6\left(1 + \frac{54}{x^2 + 2}\right)\right] = 3$$

Find the positive value of x.

Round 1

Question 5

$22\frac{1}{2}$ % of a number is 35.

What is 9% of the number?

Round 1

Question 6

The **digit sum** of a number means the sum of its digits. For example:

- the digit sum of 22 is **4**
- the digit sum of 45 is **9**

Notice that the digit sums of 22 and 45 are both square numbers.

How many two-digit numbers have a digit sum which is a square number?

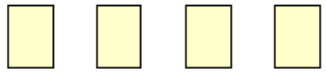
(The two-digit numbers may not start with a zero.)

End of Round 1

Round 1

ANSWERS

Round 1 **Question 1**



Here is some information about four numbers.

- They are all integers.
- The lowest number is 5.
- The median is one more than the mode.
- The mean is one more than the median.

What are the four numbers?

5, 5, 7, 11

Round 1 **Question 2**

All the students in a school support their local football team, a Premiership team, or both.

375 students support their local team.

420 support a Premiership team.

105 students support both their local team and a Premiership team.

How many students are there in the school?

690

Round 1 **Question 3**

Some students from Years 7 and 8, and some staff, go on a coach trip

The ratio of staff : students is 1 : 6.

The ratio of Year 7 students to Year 8 students is 1 : 2.

What **fraction** of the people on the trip are Year 8 students?

(Do not include the coach driver.)

$\frac{4}{7}$ oe

Round 1 **Question 4**

This equation is (hopefully) not as bad as it looks!

$$\frac{1}{7}\left[3 + 6\left(1 + \frac{54}{x^2 + 2}\right)\right] = 3$$

Find the positive value of x.

5

Round 1 **Question 5**

$22\frac{1}{2}$ % of a number is 35.

What is 9% of the number?

14

Round 1 **Question 6**

The **digit sum** of a number means the sum of its digits. For example:

- the digit sum of 22 is **4**
- the digit sum of 45 is **9**

Notice that the digit sums of 22 and 45 are both square numbers.

How many two-digit numbers have a digit sum which is a square number?

(The two-digit numbers may not start with a zero.)

16

Round 2

Memory Round

Memory Round

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.

Memory Round

The poster will be shown on the screen. The scribes must go into a different room, so they cannot see it.

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.

Memory Round

Note to supervising teachers

Each showing of the poster will be preceded by a 30-second warning, so that the observers can get themselves into position.

At the end, the finished poster should be photographed or scanned and sent in by e-mail.

(E-mail address to follow at end of round.)

Memory Round

Pencils and rubbers only. No rulers or other drawing equipment.

You now have one minute to decide who will be the observers and who will be the scribes … and to get into position!

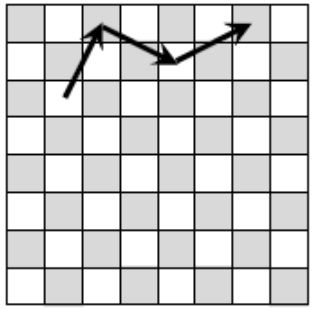
Memory Round

Poster about to be displayed for the first time.

Famous Puzzles and Problems in Mathematics

Knight's tour

Can a Knight tour a chess board, visiting every square exactly once?

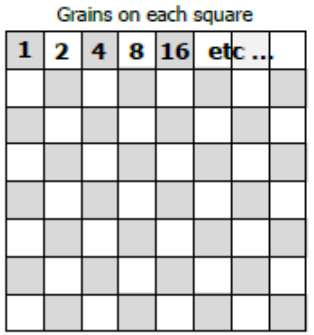


Rope around the Earth

Raise the rope by 1 metre

How much extra rope is needed?

Rice on a chessboard



How many grains of rice will there be in total?

36 soldiers

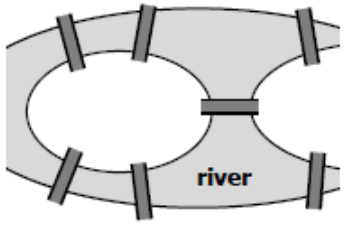
A1	A2	A3	A4	A5	A6
B1	B2	B3	B4	B5	B6
C1	C2	C3	C4	C5	C6
D1	D2	D3	D4	D5	D6
E1	E2	E3	E4	E5	E6
F1	F2	F3	F4	F5	F6

Rearrange so that each row and column contains one of each letter and one of each number.

How many different magic squares are there?

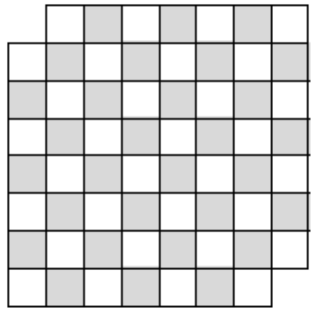
2	**7**	**6**	15
9	**5**	**1**	15
4	**3**	**8**	15
15	15	15	15

Bridges of Königsberg



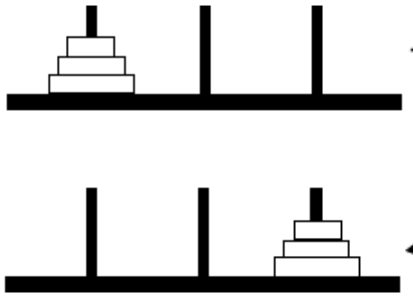
Plan a route which crosses each of the seven bridges exactly once

Mutilated chessboard



Can this be completely tiled with **31 dominoes**?

Tower of Hanoi



as few moves as possible

Round 2

Memory Round

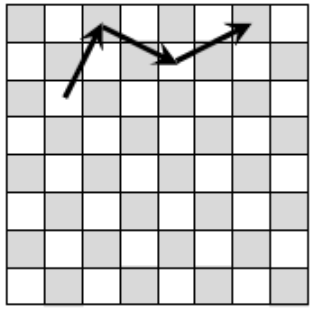
Memory Round

Second viewing of poster coming up!

Famous Puzzles and Problems in Mathematics

Knight's tour

Can a Knight tour a chess board, visiting every square exactly once?

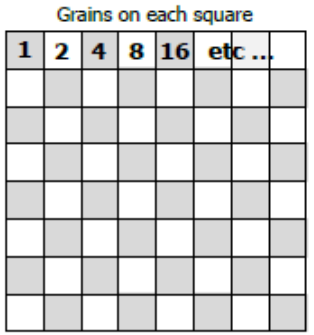


Rope around the Earth

Raise the rope by 1 metre

How much extra rope is needed?

Rice on a chessboard



How many grains of rice will there be in total?

36 soldiers

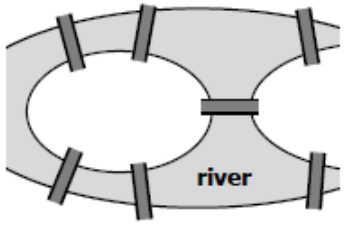
A1	A2	A3	A4	A5	A6
B1	B2	B3	B4	B5	B6
C1	C2	C3	C4	C5	C6
D1	D2	D3	D4	D5	D6
E1	E2	E3	E4	E5	E6
F1	F2	F3	F4	F5	F6

Rearrange so that each row and column contains one of each letter and one of each number.

How many different magic squares are there?

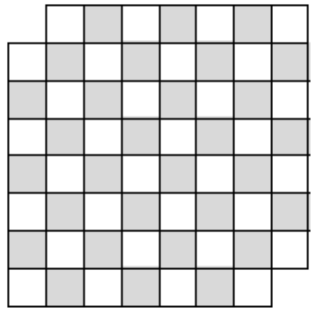
2	**7**	**6**	15
9	**5**	**1**	15
4	**3**	**8**	15
15	15	15	15

Bridges of Königsberg



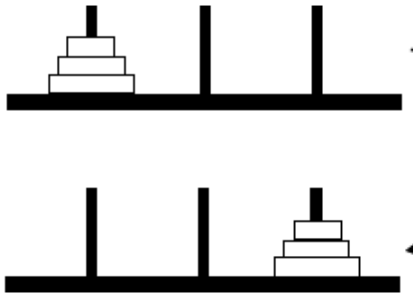
Plan a route which crosses each of the seven bridges exactly once

Mutilated chessboard



Can this be completely tiled with **31 dominoes**?

Tower of Hanoi



as few moves as possible

Round 2

Memory Round

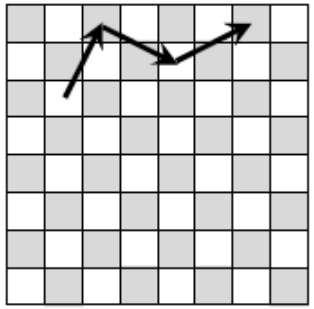
Memory Round

Third viewing of poster coming up!

Famous Puzzles and Problems in Mathematics

Knight's tour

Can a Knight tour a chess board, visiting every square exactly once?

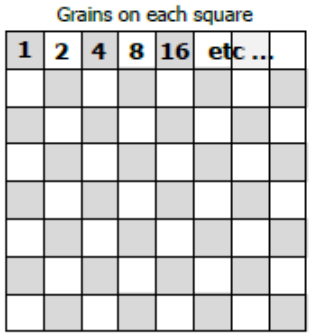


Rope around the Earth

Raise the rope by 1 metre

How much extra rope is needed?

Rice on a chessboard



How many grains of rice will there be in total?

36 soldiers

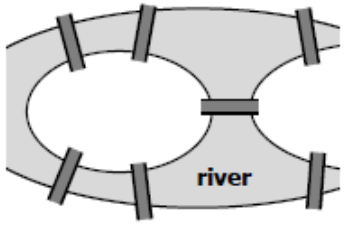
A1	A2	A3	A4	A5	A6
B1	B2	B3	B4	B5	B6
C1	C2	C3	C4	C5	C6
D1	D2	D3	D4	D5	D6
E1	E2	E3	E4	E5	E6
F1	F2	F3	F4	F5	F6

Rearrange so that each row and column contains one of each letter and one of each number.

How many different magic squares are there?

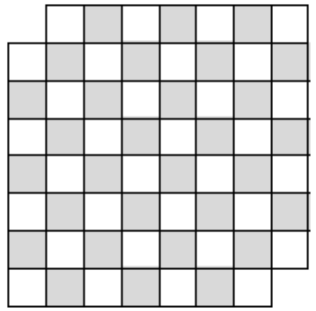
2	**7**	**6**	15
9	**5**	**1**	15
4	**3**	**8**	15
15	15	15	15

Bridges of Königsberg



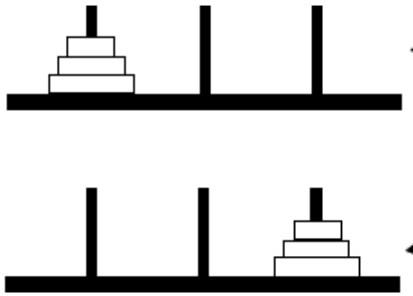
Plan a route which crosses each of the seven bridges exactly once

Mutilated chessboard



Can this be completely tiled with **31 dominoes**?

Tower of Hanoi



as few moves as possible

Round 2

Memory Round

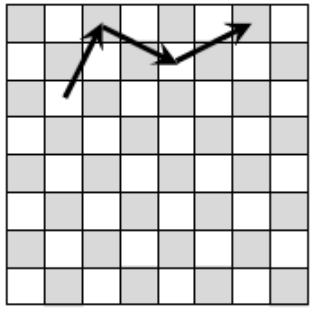
Memory Round

Fourth and final viewing of poster coming up!

Famous Puzzles and Problems in Mathematics

Knight's tour

Can a Knight tour a chess board, visiting every square exactly once?

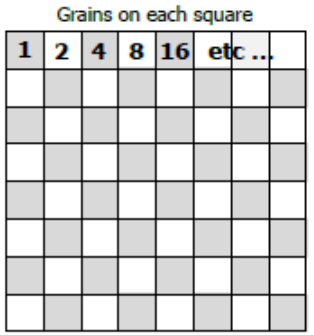


Rope around the Earth

Raise the rope by 1 metre

How much extra rope is needed?

Rice on a chessboard



How many grains of rice will there be in total?

36 soldiers

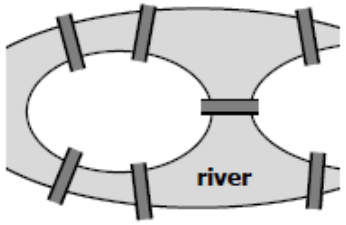
A1	A2	A3	A4	A5	A6
B1	B2	B3	B4	B5	B6
C1	C2	C3	C4	C5	C6
D1	D2	D3	D4	D5	D6
E1	E2	E3	E4	E5	E6
F1	F2	F3	F4	F5	F6

Rearrange so that each row and column contains one of each letter and one of each number.

How many different magic squares are there?

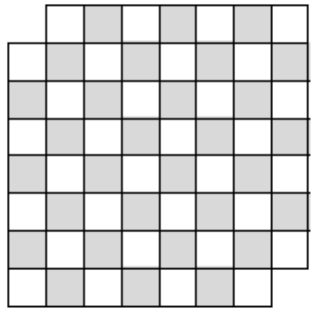
2	**7**	**6**	15
9	**5**	**1**	15
4	**3**	**8**	15
15	15	15	15

Bridges of Königsberg



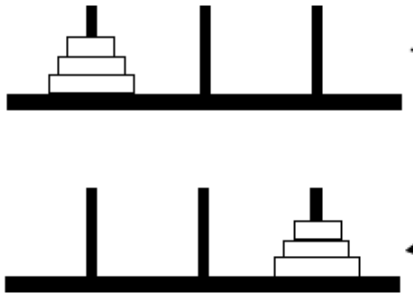
Plan a route which crosses each of the seven bridges exactly once

Mutilated chessboard



Can this be completely tiled with **31 dominoes**?

Tower of Hanoi



as few moves as possible

Round 2

Memory Round

Memory Round

Time's up!

Everyone should now come back into the main room.

Please photograph or scan the finished poster, and e-mail it to:

david.cook@hertsforlearning.co.uk

End of Round 2

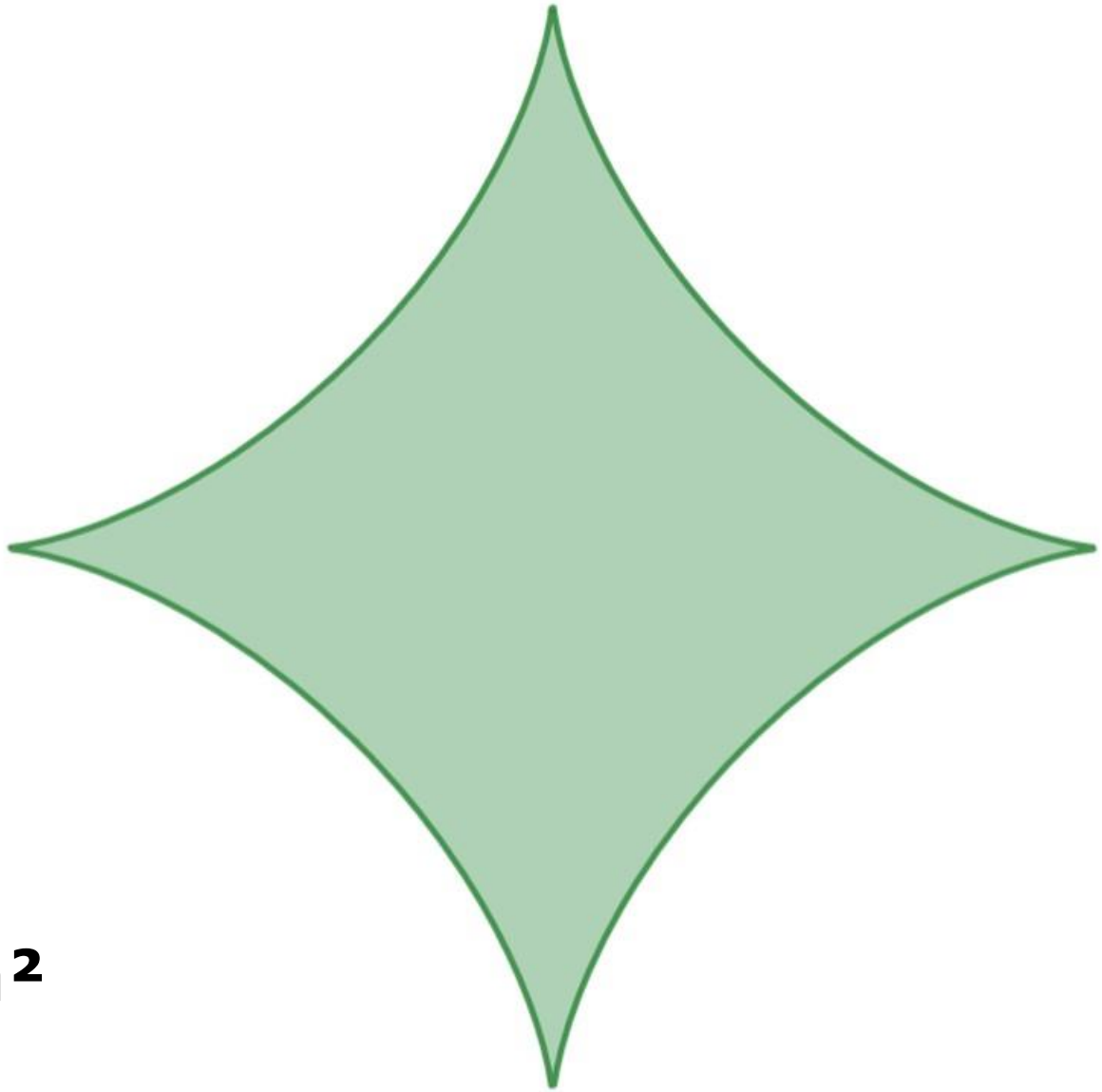
Round 3

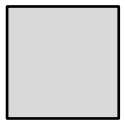
Estimation Round

Round 3

Question 1

Estimate the area of the green shape.



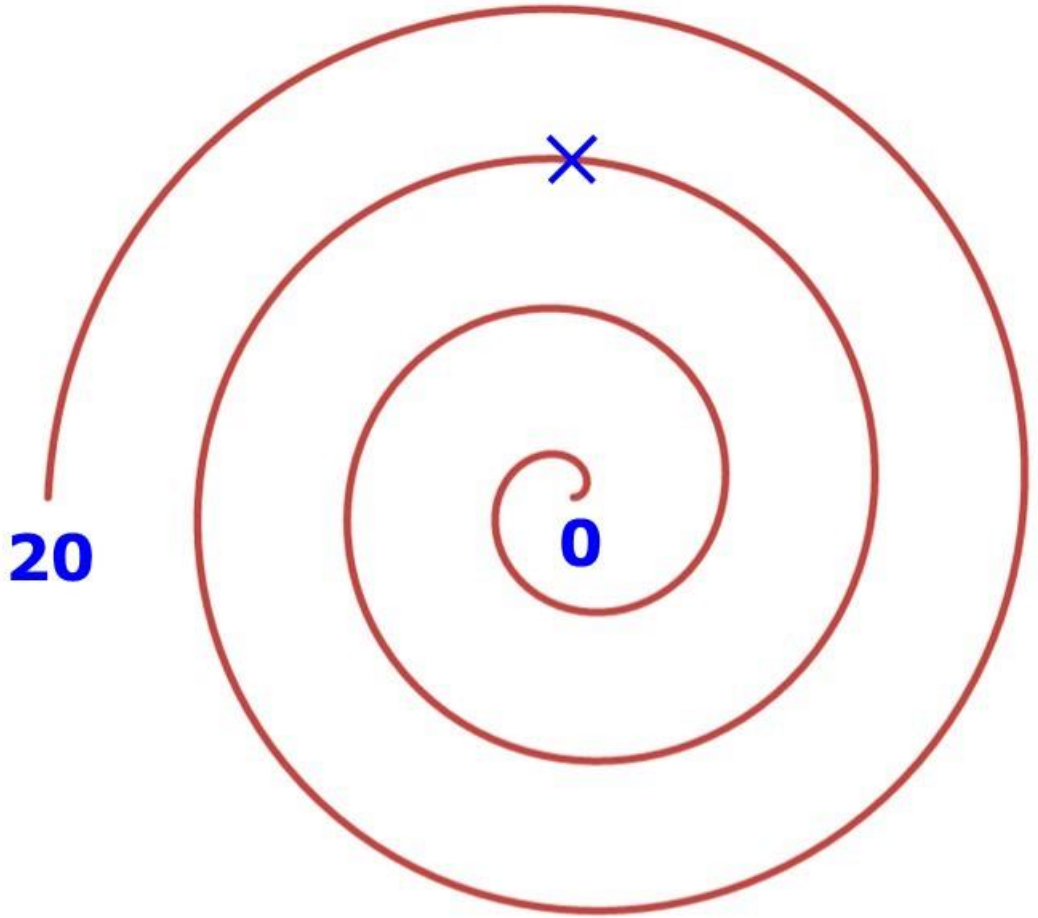


1 cm²

Round 3

Question 2

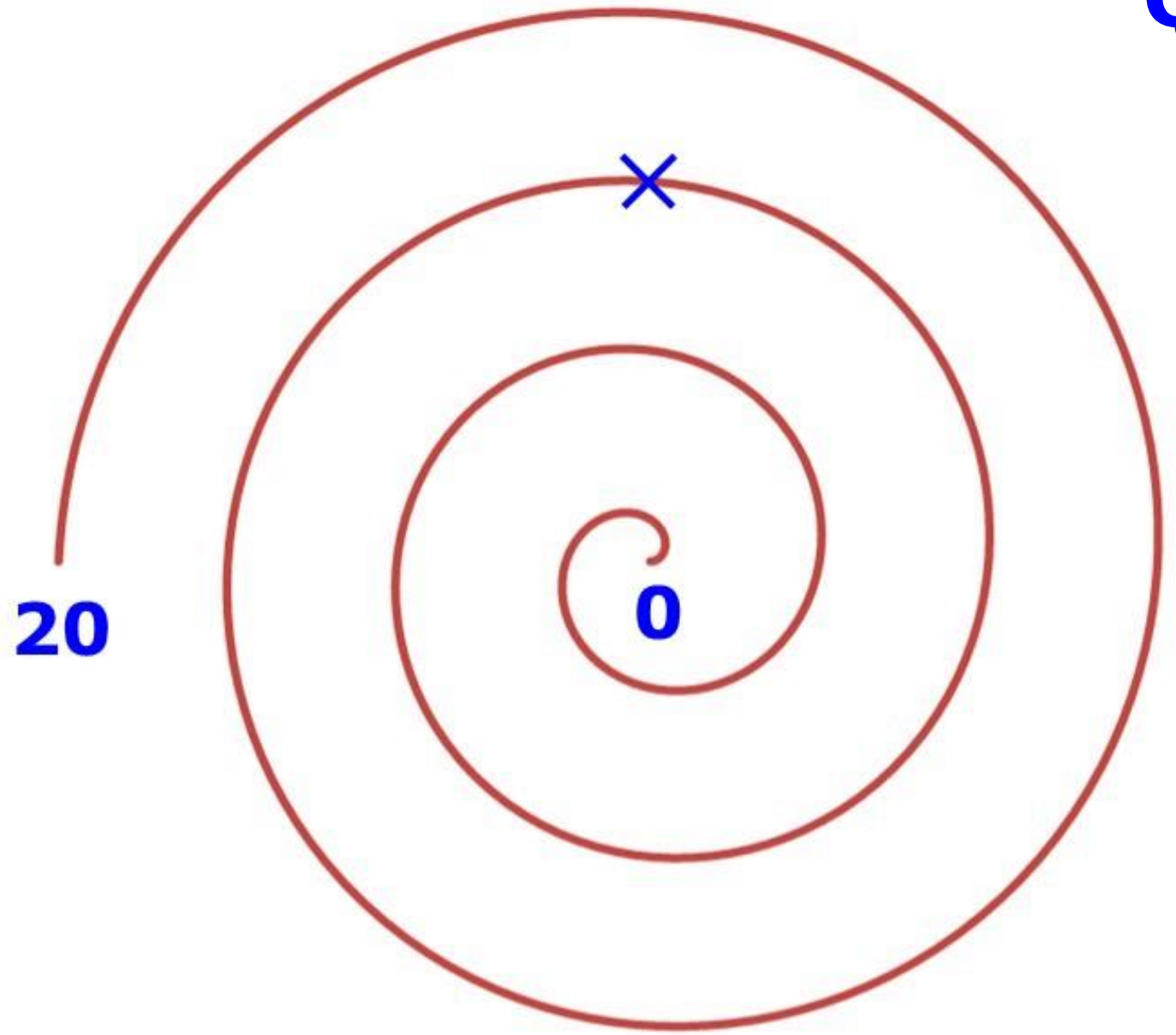
Here is a ‘number line’ from 0 to 20.



Estimate the number marked with a cross.

Round 3

Question 2



Round 3

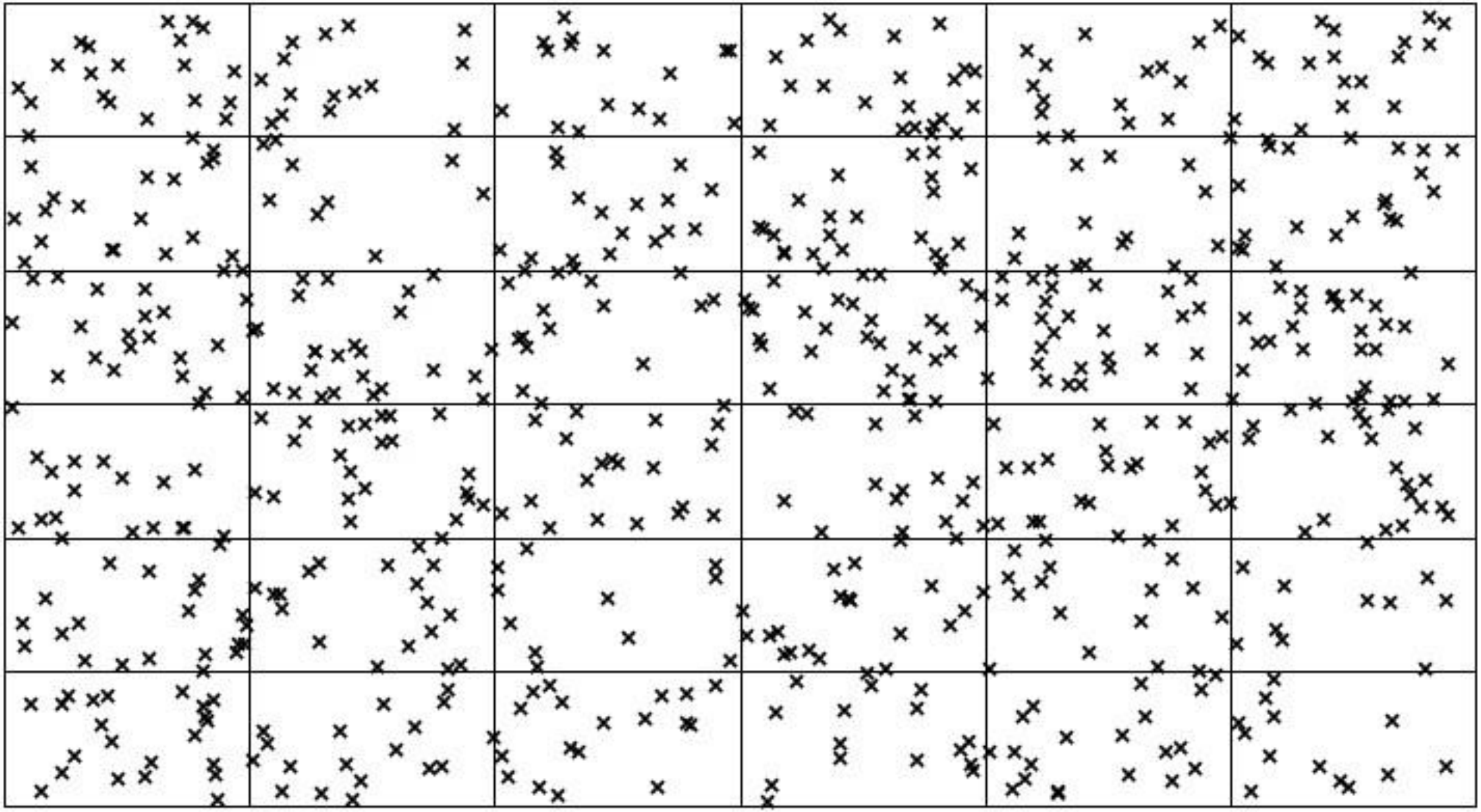
Question 3

On the next slide, there are some crosses on a grid.

Your task is to estimate the number of crosses.

You will first be given a glimpse for 5 seconds. You will then get 30 seconds to devise a strategy for estimating the answer.

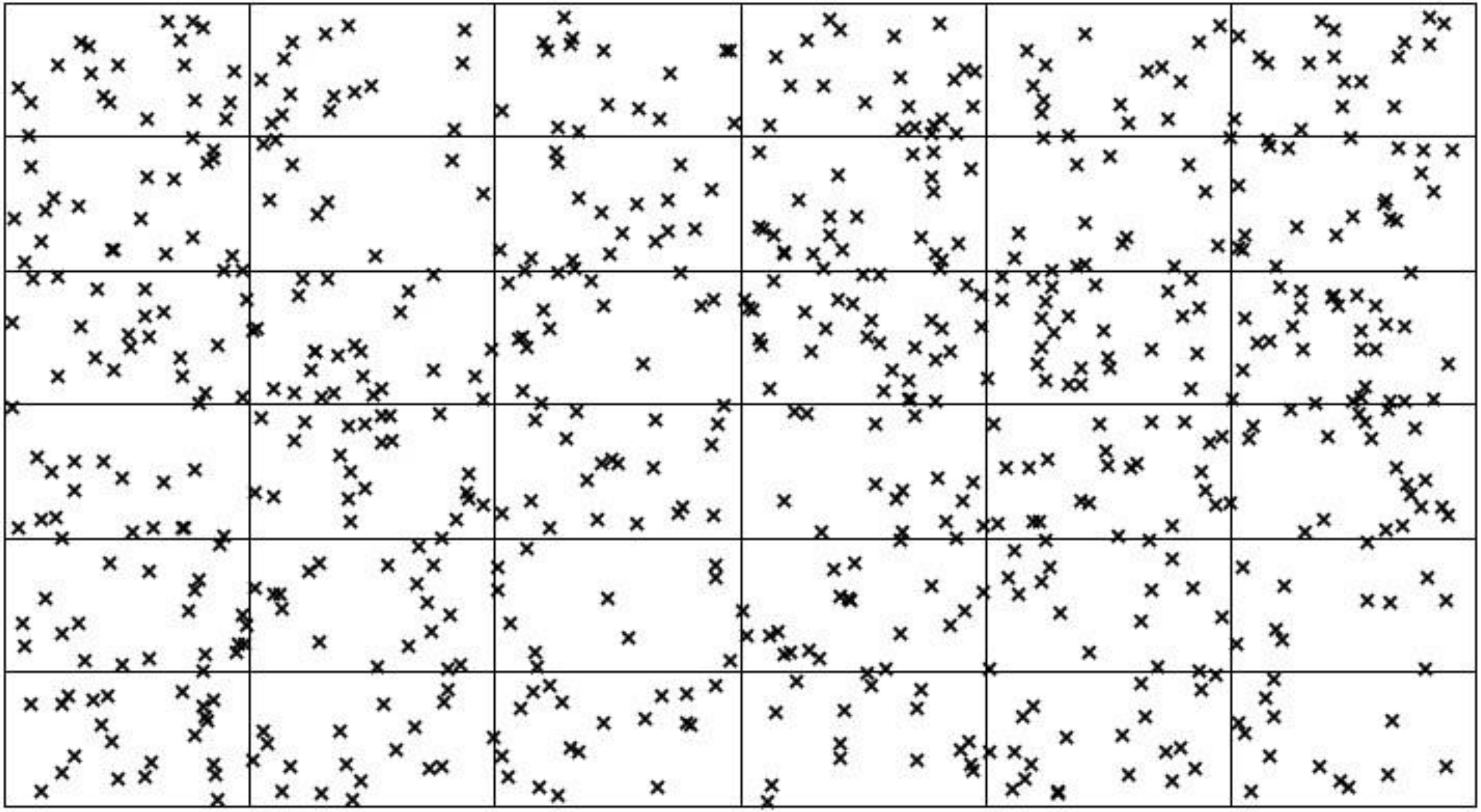
You will then be given 30 seconds, as a team, to agree your estimate.



Round 3

Question 3

Decide on your strategy.



Round 3

Question 3

30 seconds to agree on your estimate.

Round 3

Question 4

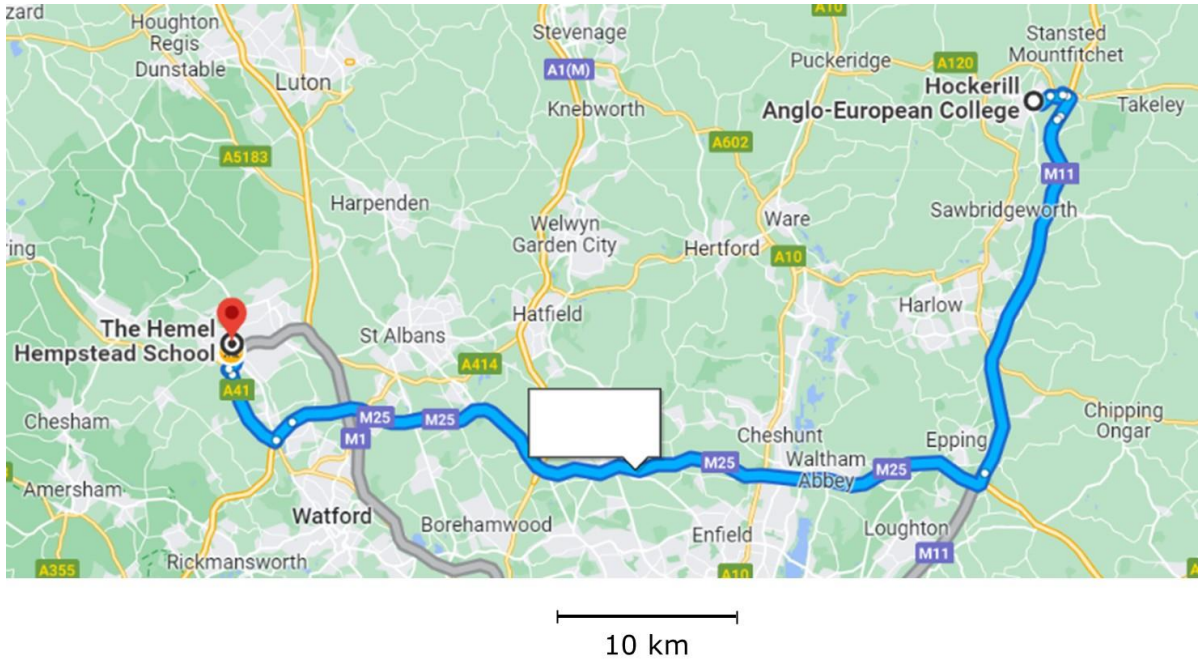
Estimate the answer to this calculation.

$$\frac{11.84}{3.42 \times 17.5}$$

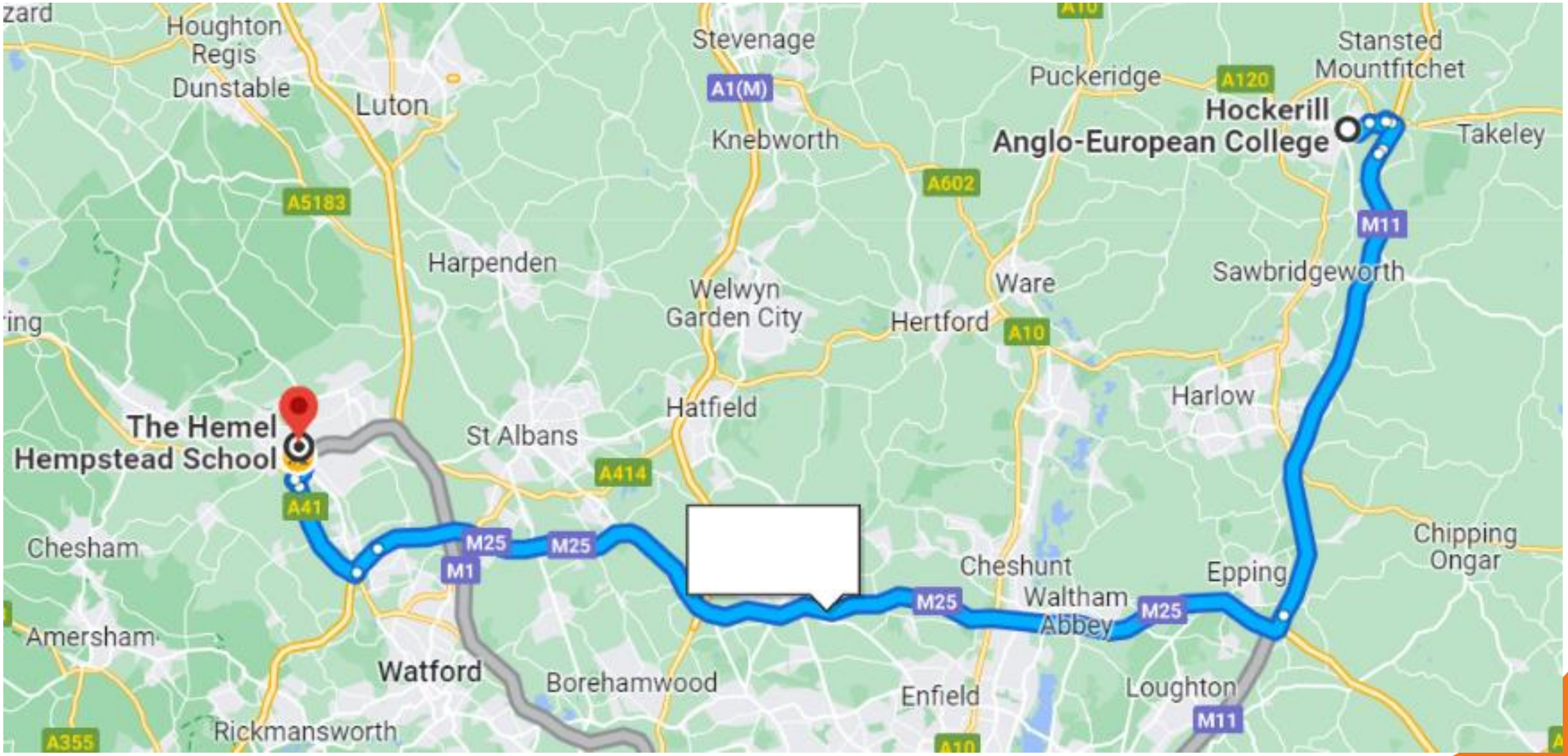
Round 3

Question 5

The map shows the quickest route between two schools taking part in this year's challenge.



Estimate the length of the blue route, in km.

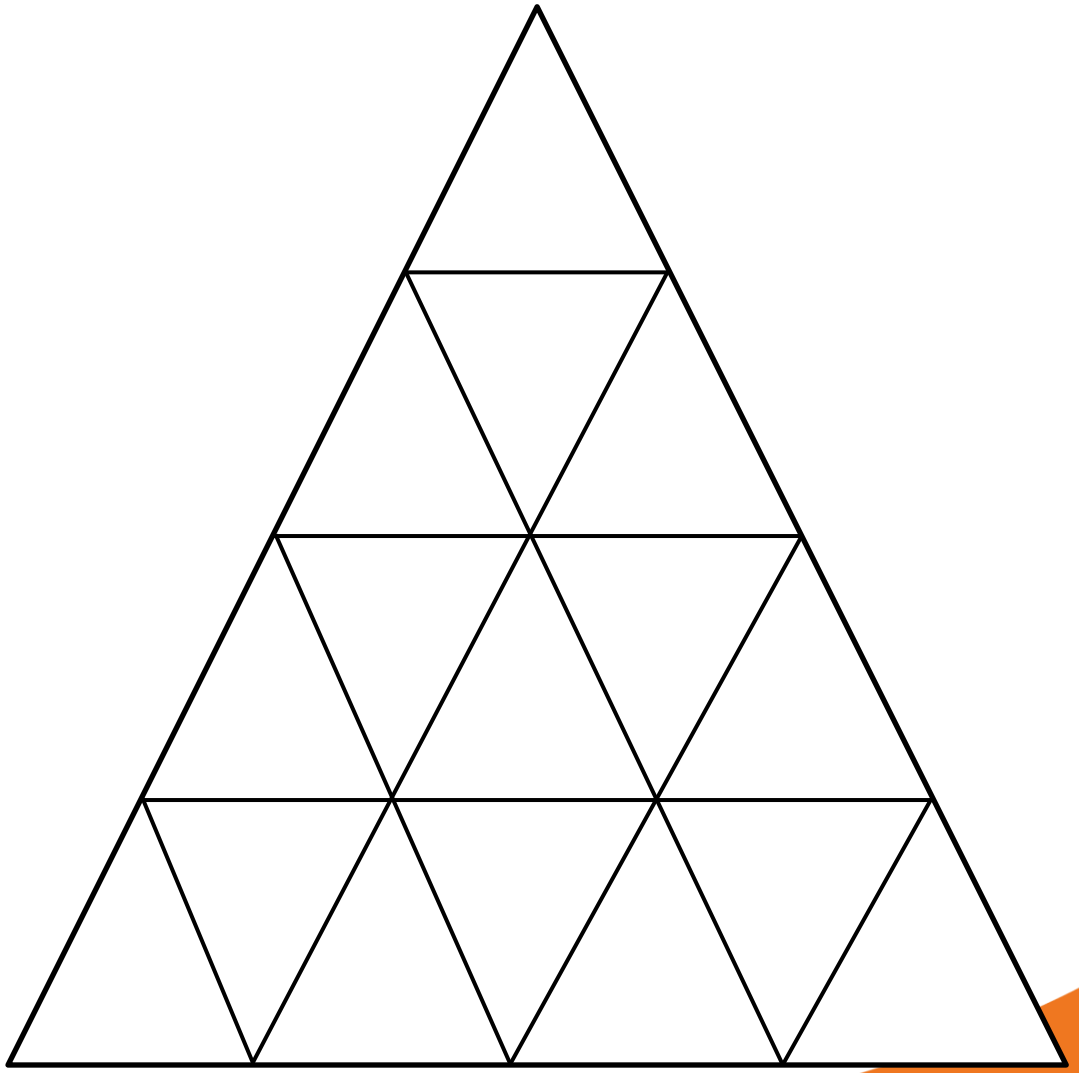

Houghton Regis
Dunstable
Luton
Stevenage
A1(M)
Knebworth
Puckeridge
A120
Stansted Mountfitchet
Hockerill Anglo-European College
Takeley
A602
A5183
Harpenden
Welwyn Garden City
Ware
Hertford
A10
M11
Sawbridgeworth
The Hemel Hempstead School
Hatfield
St Albans
A414
Harlow
A41
Chesham
M25
M1
M25
Cheshunt
Waltham Abbey
M25
Epping
Chipping Ongar
Amersham
Watford
Borehamwood
Enfield
Loughton
M11
Rickmansworth
A355
10 km

Round 3

Question 6

How many triangles are there in this diagram?

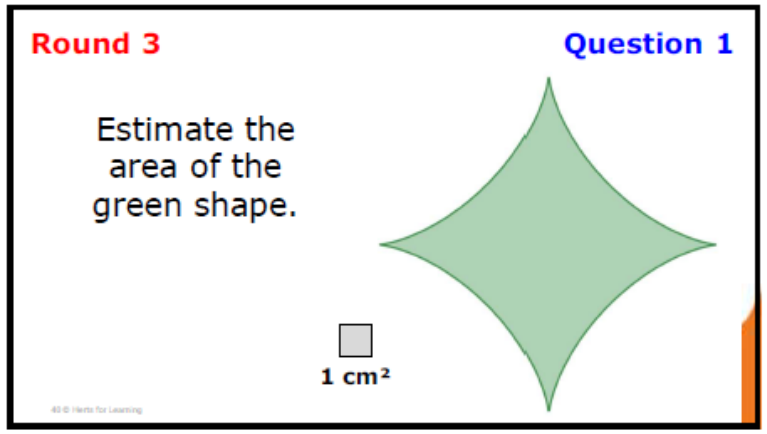
(Hint: there are more than 16.)



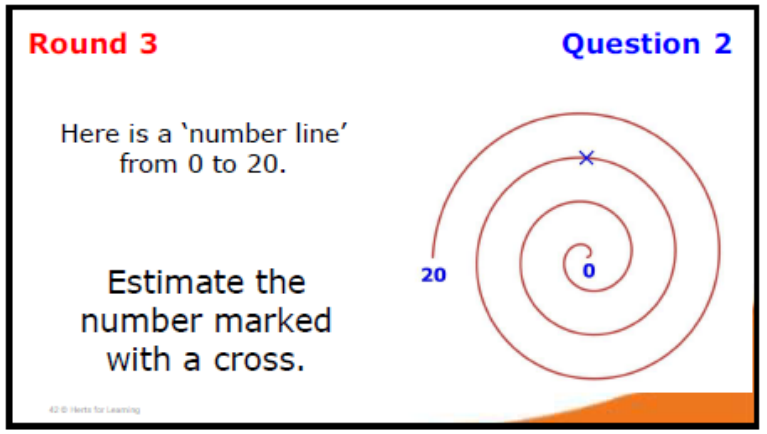
End of Round 3

Round 3

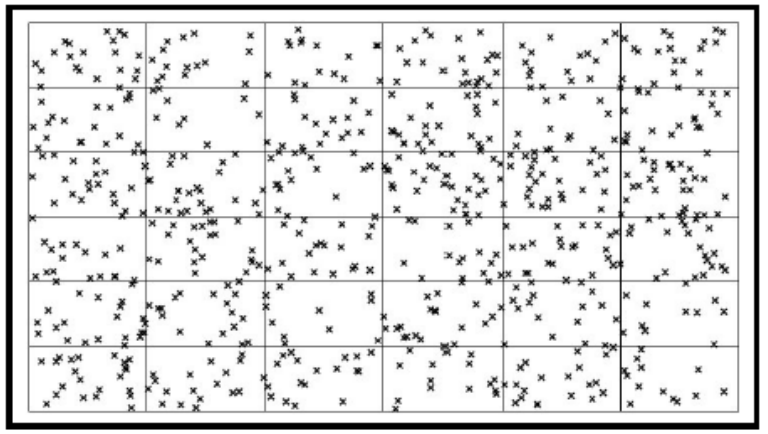
ANSWERS



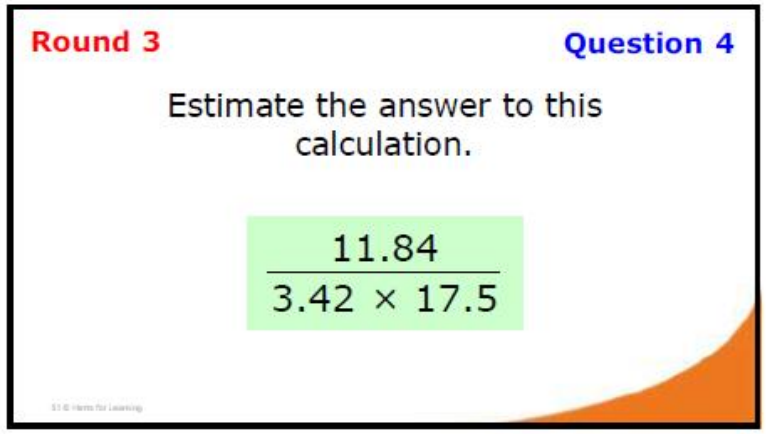
28 to 31 cm²



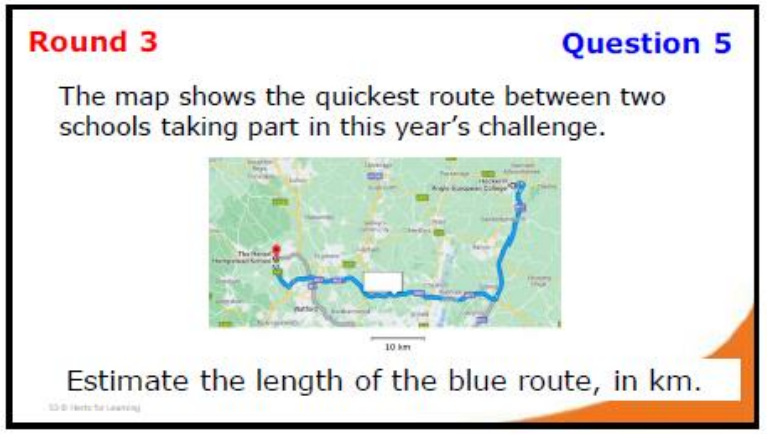
8.1 to 8.6



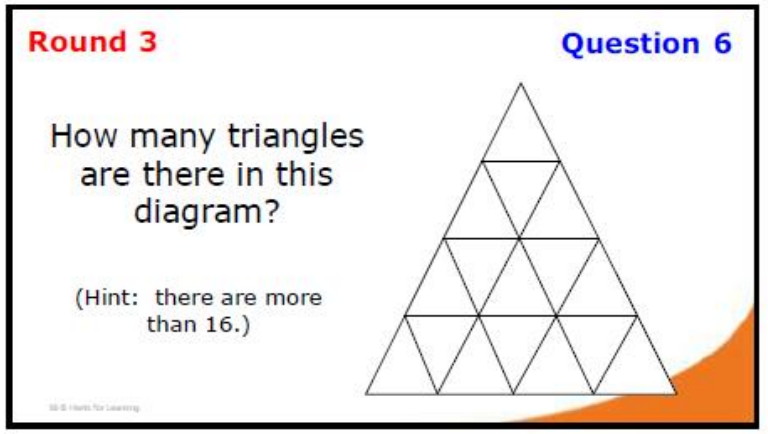
670 to 706



0.19 to 0.21



71.9 to 81.9 km



27

Round 4

General Mathematics Questions

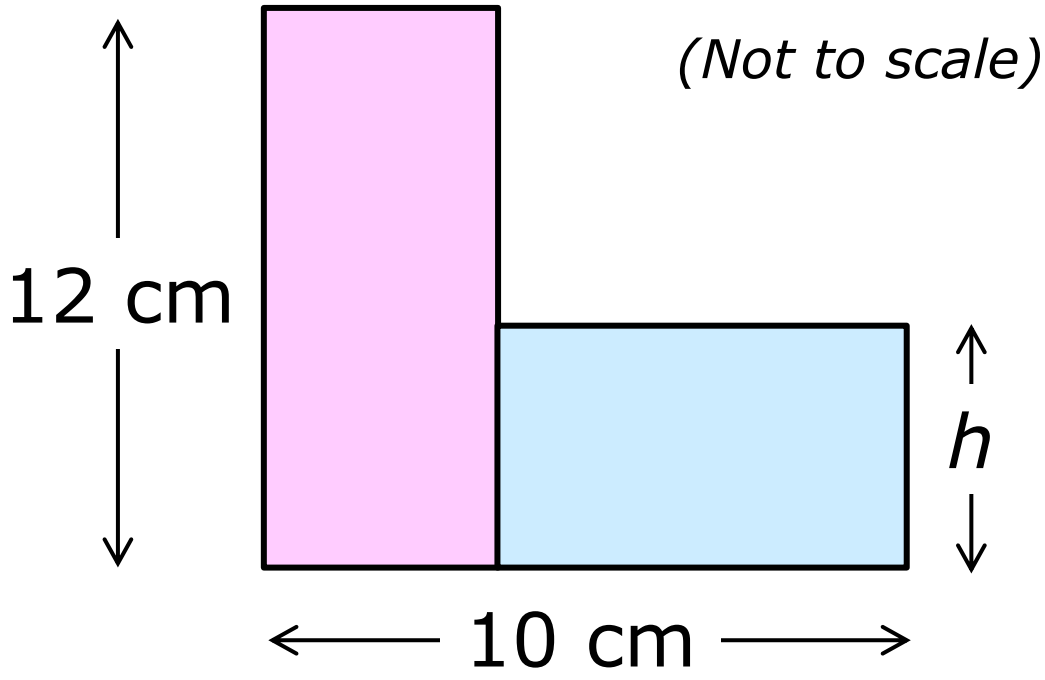
Round 4

Question 1

The pink and blue rectangles are joined to make an L-shape.

The area of each rectangle is **30 cm²**.

Two lengths are given in the diagram.



Work out the length marked *h*, in cm.

Round 4

Question 2

In this multiplication, *A*, *B*, *C*, *D* and *E* represent **different** digits from 1 to 5 inclusive.

$$\begin{array}{rr} & \mathbf{A}\ \mathbf{B} \\ \times & \quad\ \mathbf{C} \\ \hline & \mathbf{D}\ \mathbf{E} \\ \hline \end{array}$$

What are the digits *A*, *B*, *C*, *D* and *E*?

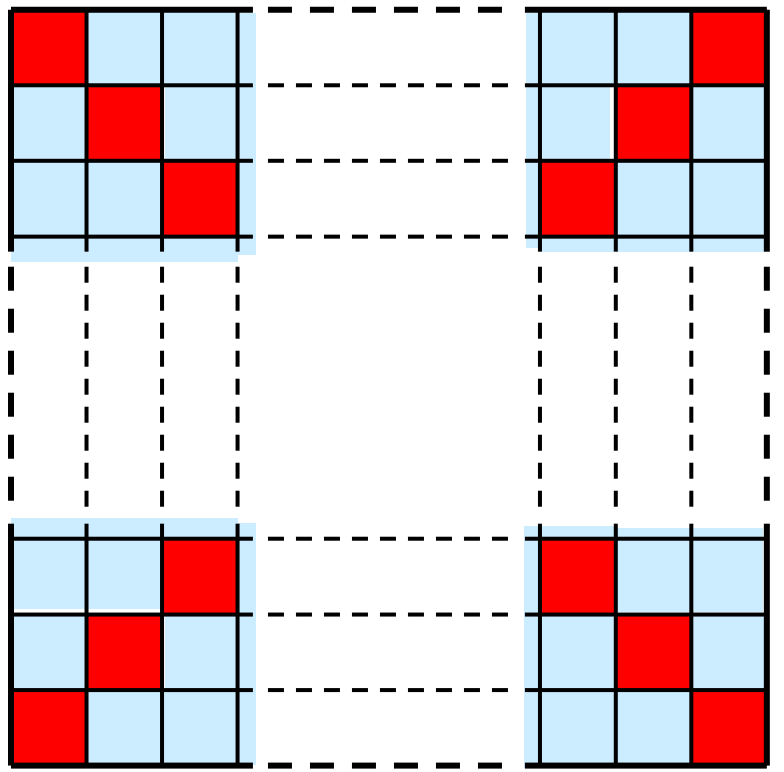
Round 4

Question 3

A large square terrace is tiled with square tiles, each measuring 10 cm by 10 cm.

The tiles are all blue, except for the tiles along the two diagonals, which are red.

There are 2,024 red tiles.



What is the perimeter of the square terrace, in **metres**?

Round 4

Question 4

	Car length		Single	Return
Car	Compact	Up to 4.75 m	£70	£130
	Mid-size	4.75 to 5.05 m	£80	£140
	Large	5.05 m or more	£90	£150
Caravan			£60	£110
Adults (aged 18+)			£30	£50
Children (aged 4 to 17)			£15	£25
Children (aged 0 to 3)			free	free
20% discount off passenger costs for groups of 4 or more				
Discount does not apply to prices for cars or caravans				

A family of five is planning a cross-channel crossing:

- two adults
- children aged 2, 5 and 7
- a car 5.1 metres in length
- towing a caravan
- return journey

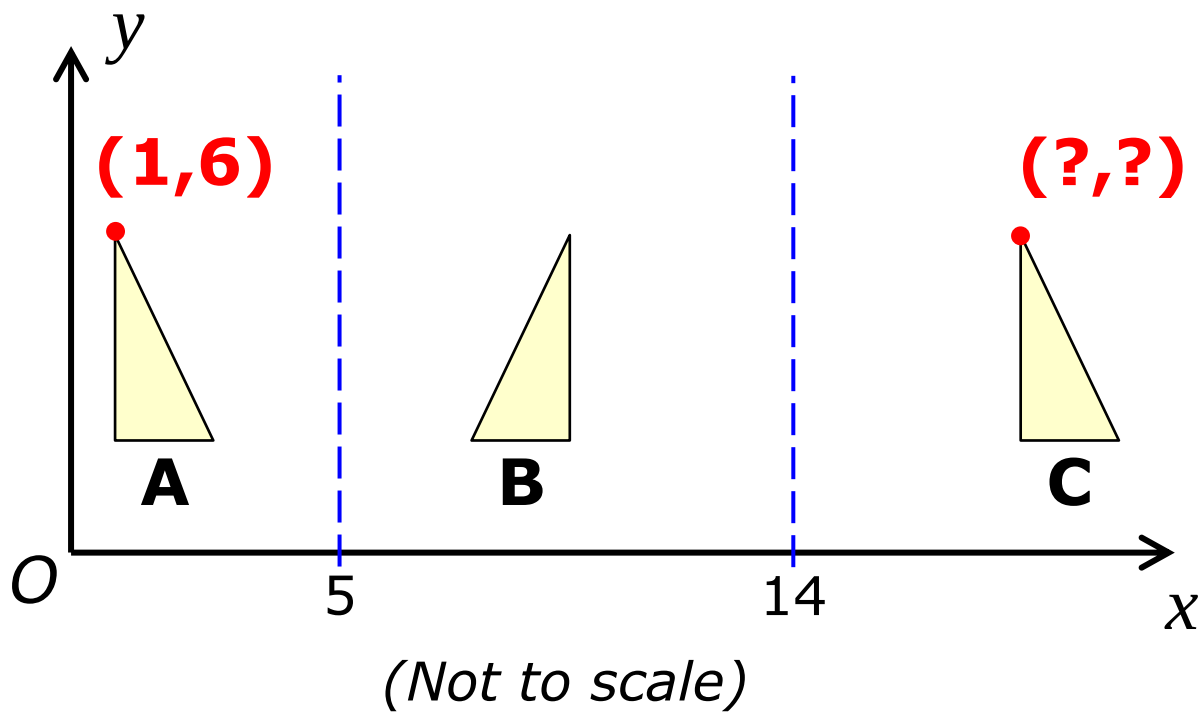
Calculate the total cost.

Round 4

Question 5

Triangle **A** is reflected in the line $x = 5$ to give Triangle **B**.

Triangle **B** is reflected in the line $x = 14$ to give Triangle **C**.



(Not to scale)

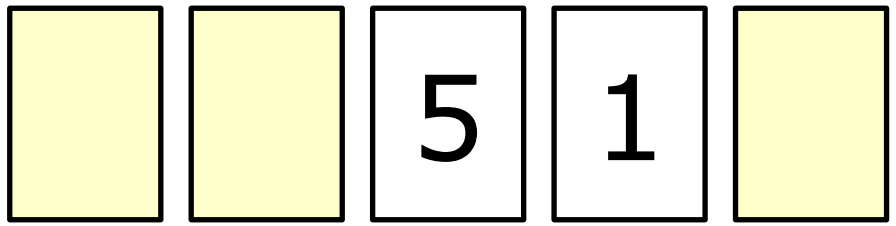
The top vertex of Triangle **A** has co-ordinates (1 , 6).

What are the coordinates of the top vertex of Triangle **C**?

Round 4

Question 6

Here is a five-digit number with three digits missing:



The three missing digits are all the same as each other.

The five-digit number is a multiple of **18**.

What is the missing digit?

End of Round 4

Year 8 Mathematics Challenge 2022
Heat 3

Please finalise your answer spreadsheet as quickly as possible.

Please include the school/team name in the file name, and e-mail it to:

william.thallon@hertsforlearning.co.uk

Round 4

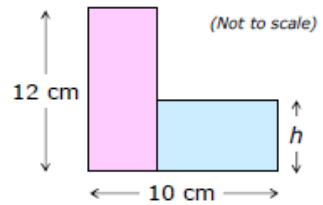
ANSWERS

Round 4 **Question 1**

The pink and blue rectangles are joined to make an L-shape.

The area of each rectangle is **30 cm²**.

Two lengths are given in the diagram.



Work out the length marked *h*, in cm.

4 cm

Round 4 **Question 2**

In this multiplication, *A*, *B*, *C*, *D* and *E* represent **different** digits from 1 to 5 inclusive.

$$\begin{array}{r} A\ B \\ \times\quad C \\ \hline D\ E \\ \hline \end{array}$$

What are the digits *A*, *B*, *C*, *D* and *E*?

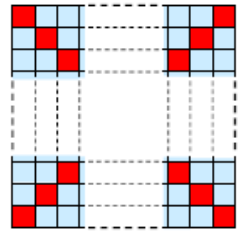
$A = 1$, $B = 3$, $C = 4$, $D = 5$, $E = 2$

Round 4 **Question 3**

A large square terrace is tiled with square tiles, each measuring 10 cm by 10 cm.

The tiles are all blue, except for the tiles along the two diagonals, which are red.

There are 2,024 red tiles.



What is the perimeter of the square terrace, in **metres**?

404.8 cm³

Round 4 **Question 4**

	Car length		Single	Return
Car	Compact	Up to 4.75 m	£70	£130
	Mid-size	4.75 to 5.05 m	£80	£140
	Large	5.05 m or more	£90	£150
Caravan			£60	£110
Adults (aged 18+)			£30	£50
Children (aged 4 to 17)			£15	£25
Children (aged 0 to 3)			free	free
20% discount off passenger costs for groups of 4 or more				
Discount does not apply to prices for cars or caravans				

A family of five is planning a cross-channel crossing:

- two adults
- children aged 2, 5 and 7
- a car 5.1 metres in length
- towing a caravan
- return journey

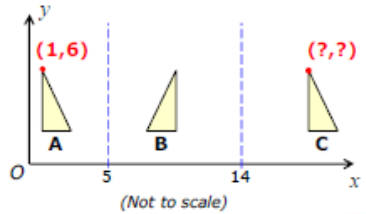
Calculate the total cost.

£380

Round 4 **Question 5**

Triangle **A** is reflected in the line $x = 5$ to give Triangle **B**.

Triangle **B** is reflected in the line $x = 14$ to give Triangle **C**.



The top vertex of Triangle **A** has co-ordinates (1, 6).

What are the coordinates of the top vertex of Triangle **C**?

(19, 6)

Round 4 **Question 6**

Here is a five-digit number with three digits missing:

The three missing digits are all the same as each other.

The five-digit number is a multiple of **18**.

What is the missing digit?

4

Well done to all

Year 8 Mathematics Challenge 2022

Heat 3, Thursday 28th April 2022

via *Livestorm*

William Thallon

Teaching and Learning Adviser (Secondary Maths)

David Cook

Lead Teaching and Learning Adviser (Primary Maths)

