For **OCR**

H

GCSE (9–1) Mathematics

Paper 4 (Higher Tier)

Churchill Paper 4D

Time allowed: 1 hour 30 minutes

You may use:
- A scientific or graphical calculator
- Geometrical instruments
- Tracing paper

Name	
Class	

INSTRUCTIONS

- Use black ink. You may use an HB pencil for graphs and diagrams.
- Write your name and class in the boxes above.
- Answer **all** the questions.
- Read each question carefully before you start your answer.
- Where appropriate, your answers should be supported with working. Marks may be given for a correct method even if the answer is incorrect.
- Write your answer to each question in the space provided.

INFORMATION

- The total mark for this paper is **100**.
- The marks for each question are shown in brackets **[ ]**.
- Use the π button on your calculator or take π to be 3.142 unless the question says otherwise.

Churchill Maths

Written by Shaun Armstrong

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Answer **all** the questions

1 A box contains coloured discs.

The table shows how many of each colour are in the box.

Colour	Red	Blue	Green	Yellow
Number	10	5	3	2

(a) A disc is picked at random from the box.

Find the probability that it is **not** blue.

(a) .... **[2]**

Some more discs are put in the box.

The ratio of red to green discs is now 3 : 1

(b) Work out the least number of discs that could have been put in the box.

(b) .... **[2]**

2 It took 3 people 5 hours to build a garden wall.

Another garden wall is to be built.
The new wall is the same length but twice as high as the first wall.

(a) How long will it take 5 people to build the new wall?

(a) .... hours **[2]**

(b) Write down two assumptions that you made in your calculation for part **(a)**.

....

....

....

.... **[2]**
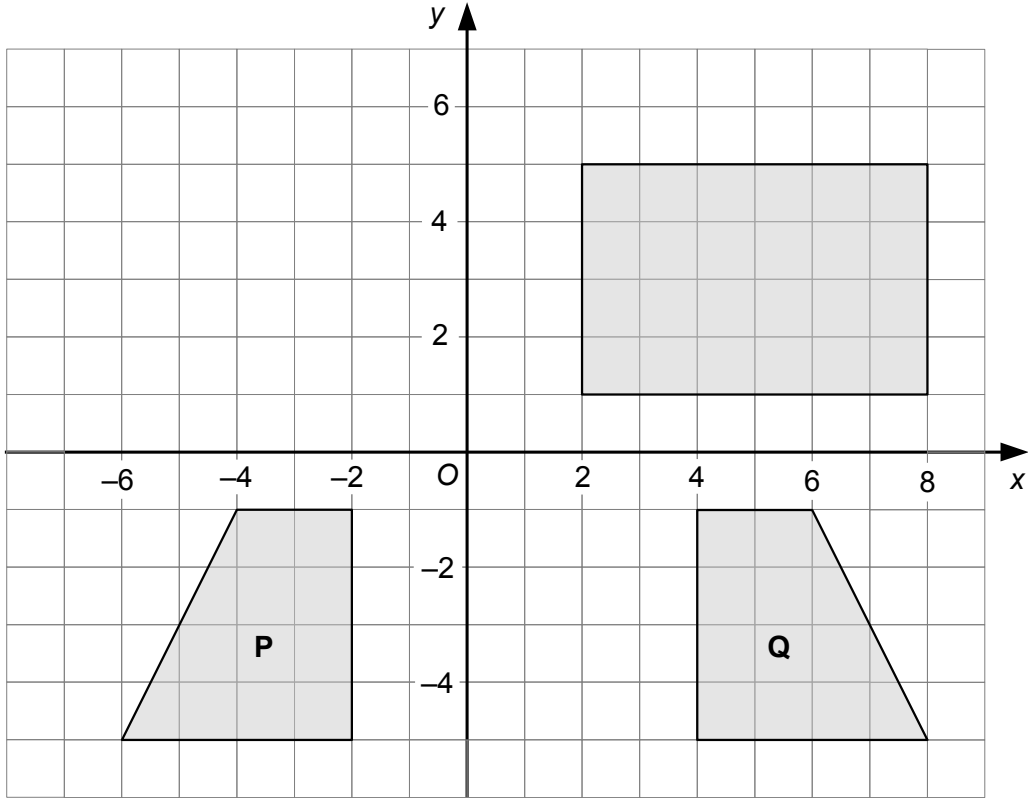
3 A rugby union squad consists of 22 players.
15 of these players start the match and the other 7 are substitutes.

The mean height of a squad is 183.6 cm.
The mean height of the substitutes in the squad is 180.4 cm.

Work out the mean height of the players in the squad who start the match.

.... cm **[3]**

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4

(a) Describe fully the single transformation that maps shape **P** onto shape **Q**.

....

.... **[2]**

Shape **P** is translated to give shape **R**.

Shape **P** is rotated to give shape **S**.

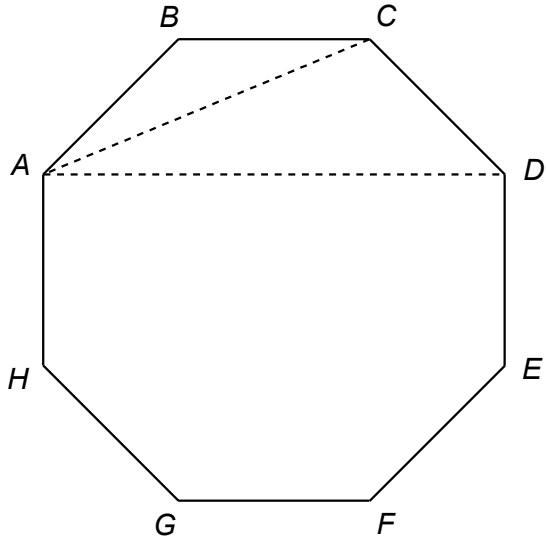Together, **R** and **S** form the shaded rectangle on the grid.

(b) **(i)** Write down the vector that represents the translation from **P** to **R**.

(b)(i) .... **[2]**

(ii) Describe fully the rotation that transforms **P** to **S**.

....

.... **[2]**

5

ABCDEFGH is a regular octagon.

Prove that AC bisects angle BAD.

[5]

6   A company has two offices – one in Portlee and one in Queentown.

The ratio of the number of employees at Portlee to the number at Queentown is 3 : 4

20% of the employees at Portlee are part-time.
25% of the employees at Queentown are part-time.
Altogether the company has 32 part-time employees.

Work out the total number of employees the company has.

.... **[5]**

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7 **(a)** Simplify $\sqrt{x^4}$

(a) .... [1]

(b) Simplify fully

$$\frac{4(3x+5)-3(5-x)}{5}$$

(b) .... [3]

(c) $p = 2\sqrt{q}$

$q = 3\sqrt{r}$

Find an expression for r in terms of p.

(c) .... [3]

8

Bag-less Hoover!

£7.25 per month
for 13 months

Compact Hoover!
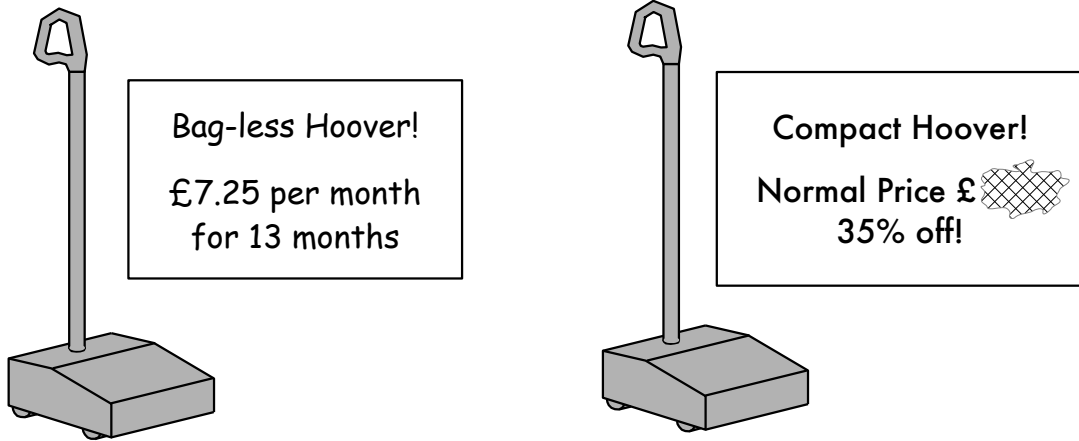
Normal Price £▨
35% off!

Two shops are selling the same hoover.

In the first shop, the customer pays £7.25 per month for 13 months.
In the second shop, the customer gets a 35% discount on the shop's normal price.

With these offers, the customer pays the same amount in total for the hoover.

Work out the normal price in the second shop.

£ .... **[4]**

9 A group of pupils had to choose to do either tennis or badminton.

There were 10 more girls than boys in the group.

30 girls chose tennis.

$\frac{3}{4}$ of the boys chose tennis.

$\frac{2}{3}$ of the pupils who chose badminton were girls.

Complete the frequency tree for this information.
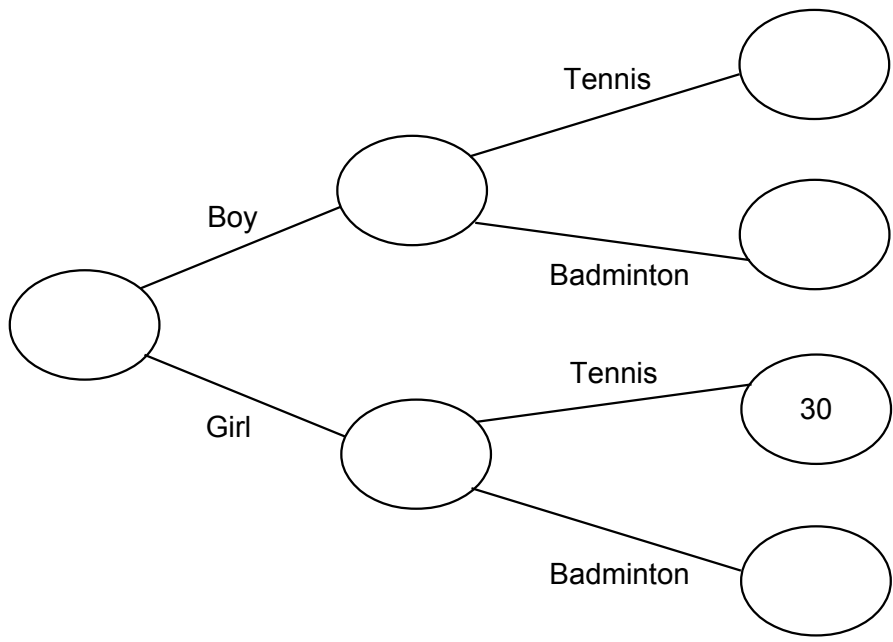
[4]

10 A school holds a maths competition.

The competition consists of 25 multiple choice questions.
Pupils score 4 points for each correct answer but lose 1 point for each incorrect answer.
If they don't answer a question they score 0 points on that question.

(a) Find out which total scores between 80 and 100 are impossible to achieve.

(a) .... **[2]**

This table summarises the scores of the 84 pupils who entered the competition.

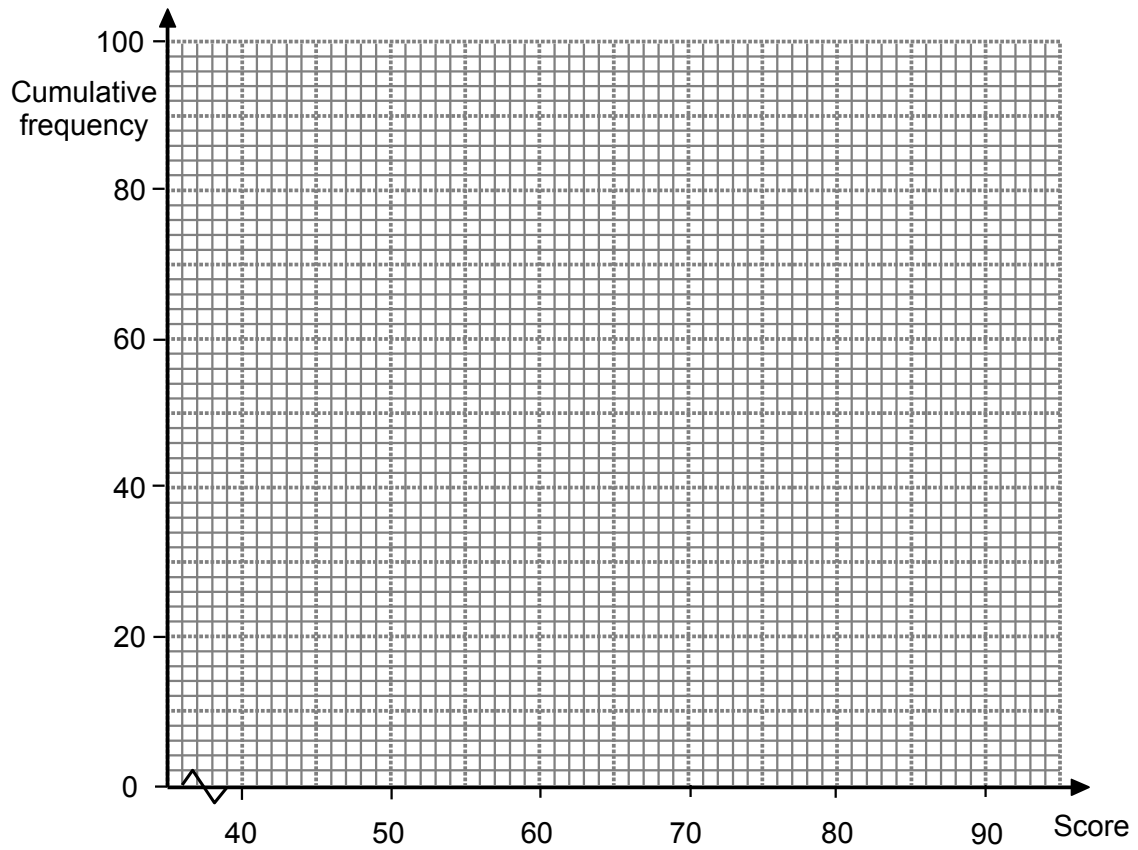| Score (S)	Number of pupils
$S < 40$	0
$40 \le S < 50$	6
$50 \le S < 60$	21
$60 \le S < 70$	28
$70 \le S < 80$	17
$80 \le S < 90$	12
$S > 90$	0

(b) Complete this cumulative frequency table.

Score (S)	Cumulative frequency
$0 \le S < 40$	
$0 \le S < 50$	
$0 \le S < 60$	
$0 \le S < 70$	
$0 \le S < 80$	
$0 \le S < 90$	

[1]

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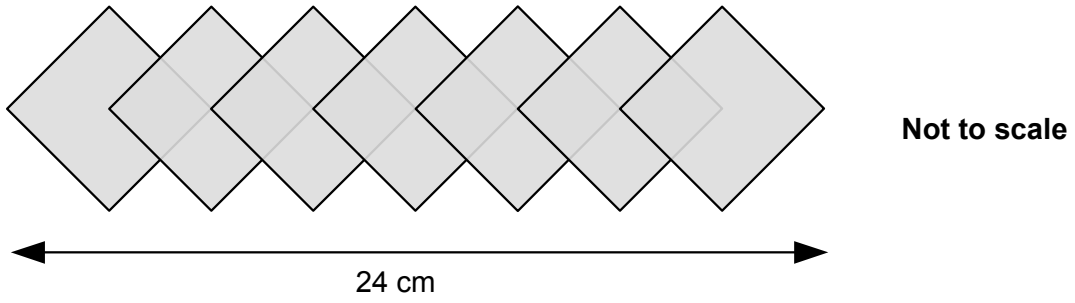**(c)** Draw a cumulative frequency graph on the grid.

[2]

Pupils who scored above 75 were given a prize.
Pupils who scored between 55 and 75 were given a certificate.

(d) Use your graph to estimate the number of pupils who got a certificate.

(d) .... **[2]**

11

Not to scale

24 cm

Seven identical squares are arranged in a row to form a design as shown.

Adjacent squares overlap such that a corner of each one is at the middle of the other square.

The width of the design is 24 cm.

Work out the area of the design.

.... cm² **[6]**

12
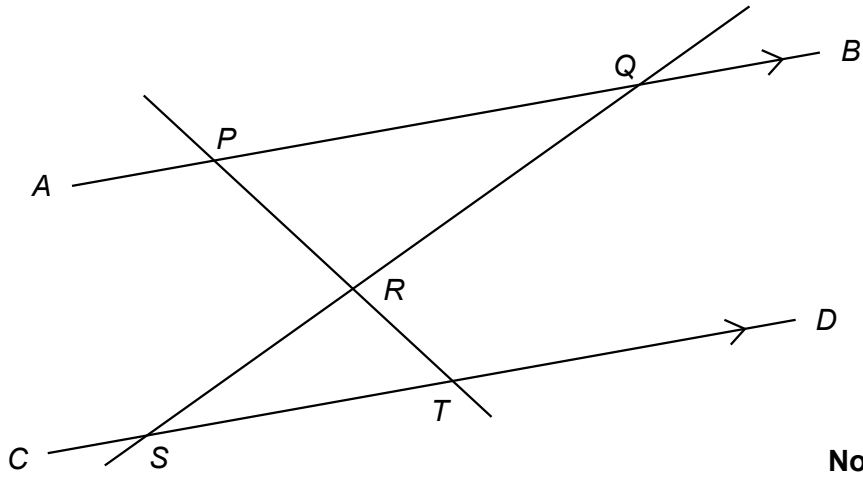
Not to scale

The straight lines *AB* and *CD* are parallel.

PR = 7.3 cm, *PT* = 10.9 cm and *RS* = 9.1 cm.

Work out the length of *QR*.

.... cm **[3]**

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13 **(a)** Find the integer n such that

$$0.4\dot{3} < \frac{n}{25} < 0.\dot{4}$$

(a) .... **[2]**

(b) **(i)** Prove algebraically that the recurring decimal $0.\dot{4}$ has the value $\frac{4}{9}$.

[2]

(ii) Using the fact that

$$0.\dot{4} = \frac{4}{9}$$

show that $0.0\dot{8}$ has the value $\frac{4}{45}$.

[2]

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14

Squash it in!
4 cm
£2.19

SQUIRT IT
5 cm
3 cm
Not to scale
£2.99
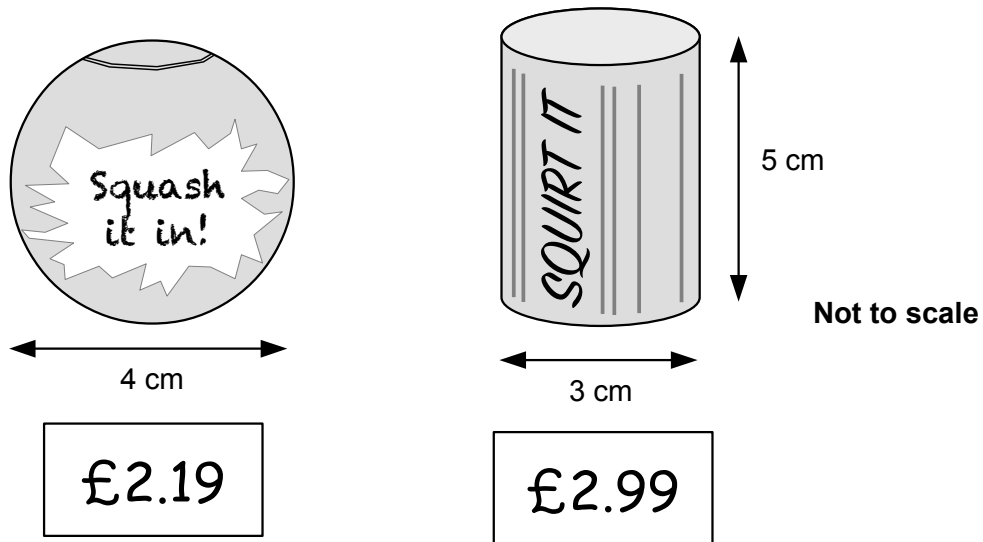
A supermarket sells two brands of concentrated squash.

Squash it in! comes in a container in the shape of a sphere.

Squirt it comes in a container in the shape of a cylinder.

[The volume of a sphere of radius r is $\frac{4}{3}\pi r^3$]

(a) Work out which brand offers better value.

(a) .... **[5]**

(b) Describe an assumption you made in your calculations in part **(a)** and explain how it may have affected your answer.

....

....

.... **[1]**

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15
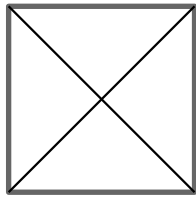
Pattern 1   Pattern 2   Pattern 3   Pattern 4
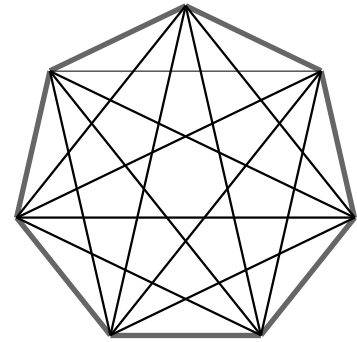
Each pattern above is a regular polygon with one more side than the pattern before it.
All the diagonals of each polygon are shown.

(a) Complete this table showing the number of diagonals in each pattern.
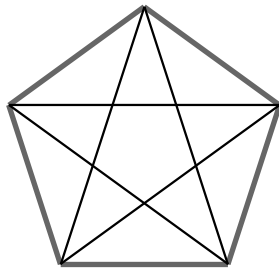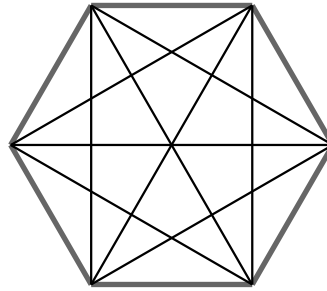
Pattern Number	1	2	3	4
Number of Diagonals	2	5		14

[1]

(b) The number of diagonals in the patterns form a quadratic sequence.

Explain how the numbers in the table suggest this is the case.

....

.... [1]

(c) Find an expression for the number of diagonals in pattern n.

(c) .... [3]

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(d) Using your answer to part **(c)**, or otherwise, find an expression for the number of diagonals a regular polygon with s sides has.

(d) .... **[2]**

16 (a) Describe fully how the graph of $y = x^2$ is transformed to give the graph of $y = (x + 4)^2$.

....

.... **[2]**

(b) The graph of $y = f(x)$ has one turning point with coordinates $(-3, 5)$.

Find the coordinates of the turning point of the graph of $y = -f(x) + 2$.

(......... , ...) **[2]**

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17
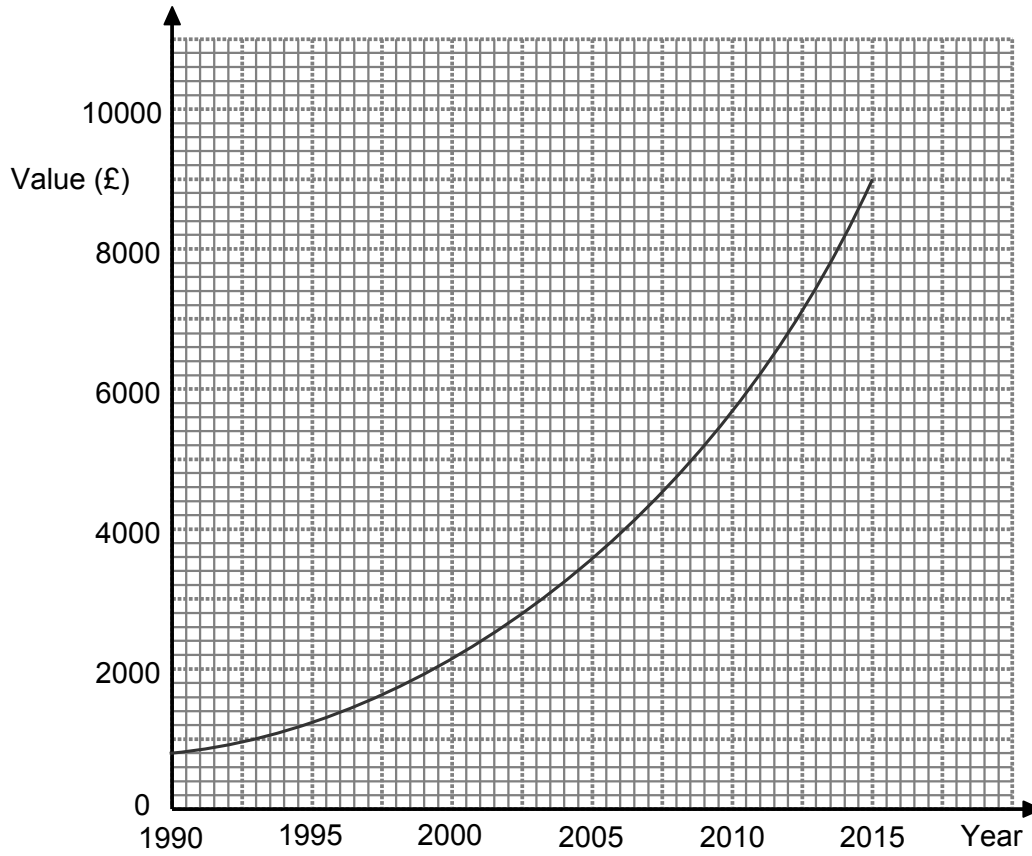
The graph shows how the value of a rare coin has changed between 1990 and 2015.

(a) How much did the value of the coin increase by from 1995 to 2003?

(a) £ .... **[1]**

(b) Find the rate of change in the value of the coin in 2008.

State the units of your answer.

(b) .... **[3]**

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Duncan says

> The gradient of the graph is increasing over time which means the annual percentage increase in the value of the coin keeps going up.

(c) Duncan is not correct.

Explain why.

....

....

....

.... **[2]**

18 **(a)** A time, t, is stated as 18.3 s, truncated to 1 decimal place.

Complete this error interval for the value of t.

(a) .... $\leq t <$ .... **[1]**

(b) Mick and Patti are measuring the height of tins in a shop.

The largest height recorded by Mick is 16 cm, rounded to the nearest centimetre.
The largest height recorded by Patti is 15 cm, truncated to the nearest centimetre.

Neil says   The tallest tin that Patti found could be taller than the tallest tin that Mick found.

Is Neil correct?

Justify your answer.

....

....

.... **[2]**

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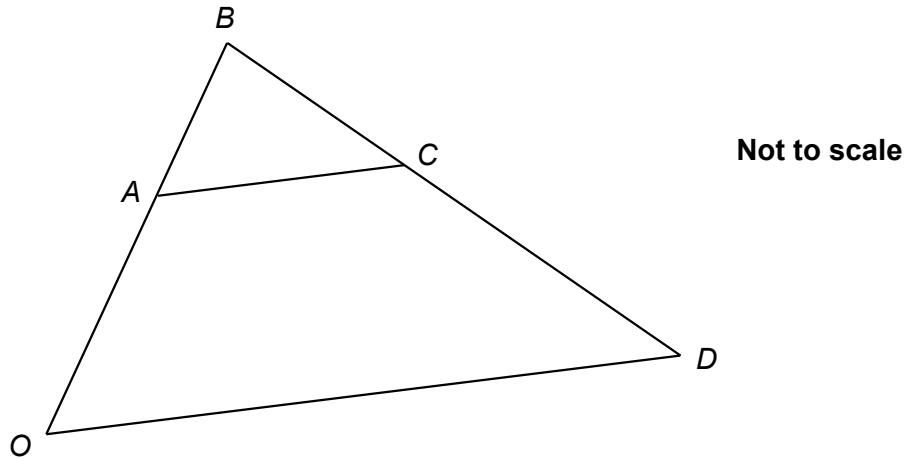Licensed to Thomas Telford School

19 The line L_1 has equation $x - 2y - 4p = 0$.

The line L_2 has equation $px - y + 9 = 0$.

p is a constant.

Given that lines L_1 and L_2 are perpendicular, find the coordinates of the point where they intersect.

(........ , ...) **[5]**

20

Not to scale

OBD is a triangle.

A lies on *OB* and *C* lies on *BD*.

AC is parallel to *OD*.

$\overrightarrow{OA}$ = 4**p**, $\overrightarrow{OB}$ = 7**p** and $\overrightarrow{AC}$ = 3**q**.

(a) Explain why $\overrightarrow{OD}$ = *k***q** where *k* is a scalar quantity.

....

.... **[1]**

(b) Use vectors to find the value of *k*.

(b) .... **[4]**

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