For **OCR**

H

GCSE (9–1) Mathematics

Paper 4 (Higher Tier)

Churchill Paper 4E

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.
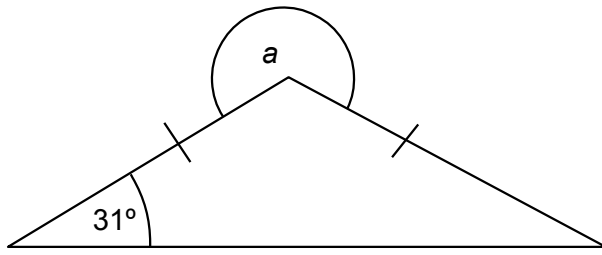
Churchill Maths

Written by Shaun Armstrong

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1 **(a)**

Not to scale

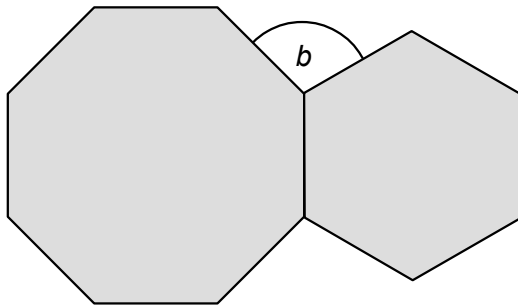Work out the size of angle *a*.

(a) .... ° **[2]**

(b)

Not to scale

The diagram shows two regular polygons.

Work out the size of angle *b*.

(b) .... ° **[3]**

2 Jamal and Kevin share some money in the ratio 5 : 8

Kevin then gives $\frac{1}{3}$ of his share to Lennie.

Given that Lennie receives £36, how much did Jamal get?

£ .... **[3]**

3 Luther wants to buy 3 packets of his favourite snack, Kryptonbix.

There are 2 local shops that usually sell Kryptonbix for the same price.

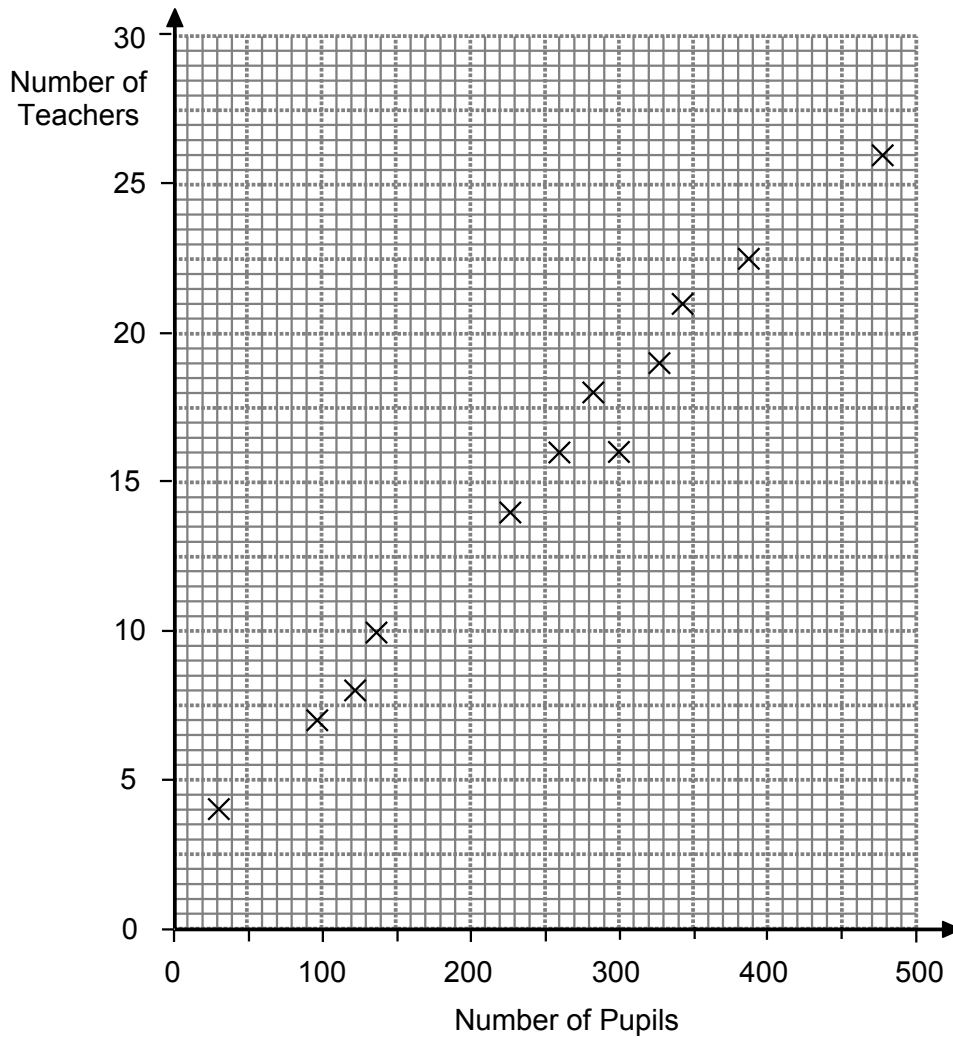Today one of the shops is offering 20% off.
Also today, the other shop is offering "Buy 2 get 1 half price".

Which offer gives Luther better value?

You must justify your answer.

.... **[3]**

4 Meg collected information on the number of pupils and the number of teachers at some primary schools near her home. Her results are shown on the scatter diagram.

(a) Two of the schools had the same number of teachers.

Work out the difference between the number of pupils in these two schools.

(a) .... **[1]**

(b) Another primary school near Meg's home has 180 pupils.

Use a line of best fit to estimate the number of teachers at this school.

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

(c) Find the gradient of your line of best fit.

(c) .... **[2]**

(d) Explain what the gradient found in part **(c)** tells us.

....

.... **[1]**

5 **(a)** Simplify $\left(2p^3\right)^2$

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

(b) Expand and simplify $(x - 5)(x - 1)$

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

(c) Factorise $m^2 + 3m - 10$

(c) .... **[2]**

6
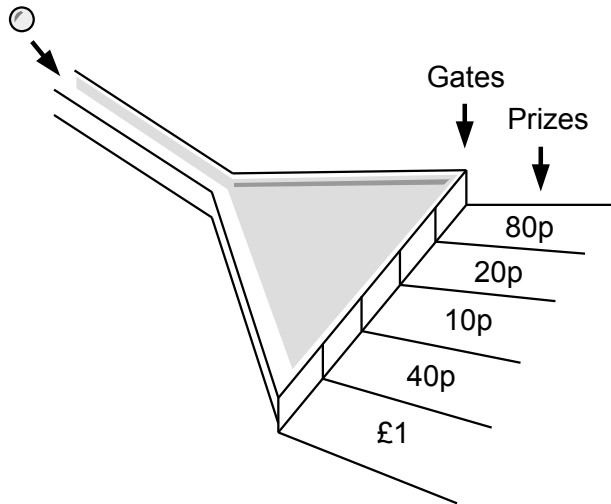
In a fairground game, a ball is rolled down a slope. The slope becomes wider and the ball goes through one of five gates.

The prize you win depends on which gate the ball goes through, as shown above.
The gates are all the same size.

The boy running the game says

> The average prize is 50p but it only costs you 40p for a roll!

(a) Which average, the mode, the mean or the median, is the boy talking about?
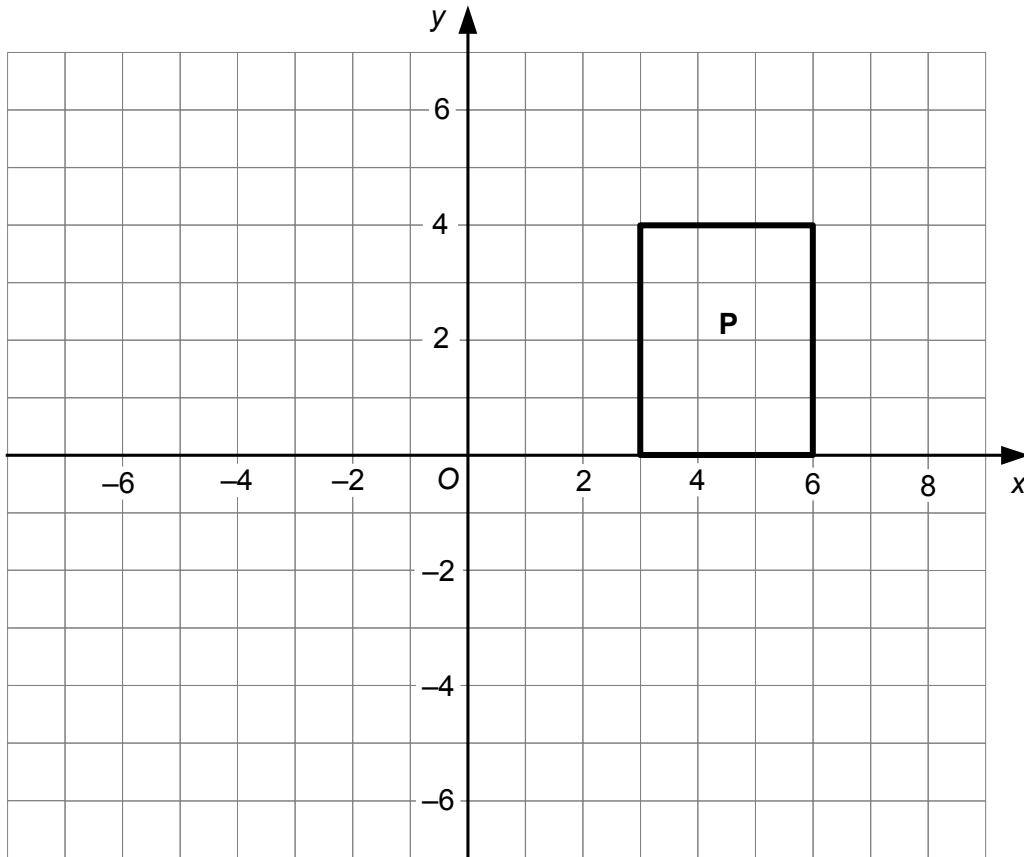
Explain how you know.

....

....

.... **[2]**

(b) What assumption has he made in claiming the average prize is 50p.

....

.... **[1]**

(c) Comment on the boy's assumption and how it affects his claim.

....

....

.... **[2]**

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7

The rectangle **P** is shown on the grid above.

(a) Reflect **P** in the line $y = x$.

Label the image **Q**.

[2]

(b) Write down the coordinates of any points on **P** that are invariant when it is reflected in the line $y = x$ to give **Q**.
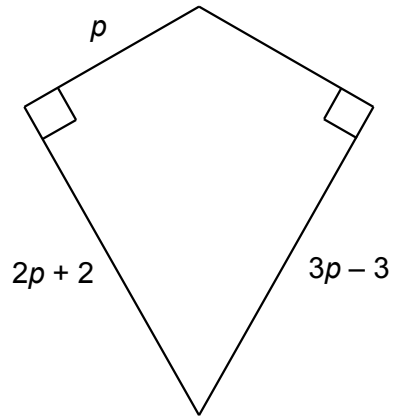
(b) .... [1]

(c) **Q** is translated by the vector $\begin{pmatrix} 0 \\ -9 \end{pmatrix}$ to give the rectangle **R**.

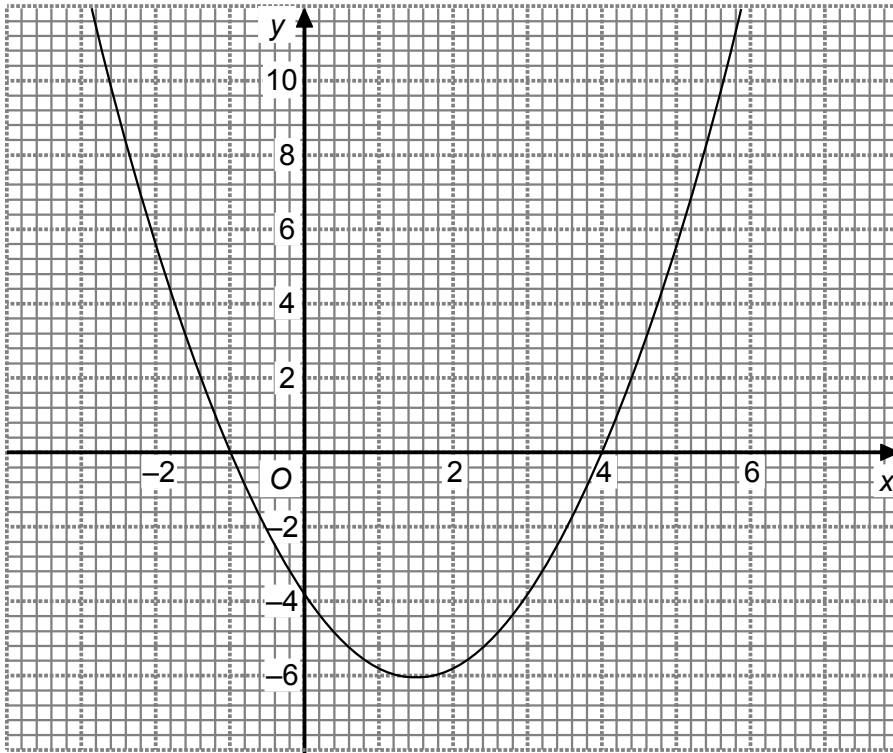Describe fully the single transformation that maps **P** onto **R**.

....

.... [3]

8

Not to scale

The diagram shows a kite.
Three of the side lengths are shown in centimetres.

Show that the area of the kite is 60 cm^2.

[4]

9

Part of the graph of $y = f(x)$ is shown on the grid.

(a) Use the graph to write down the value of f(x) when $x = 3$.

(a) .... **[1]**

(b) Use the graph to find the roots of f(x) = 0.

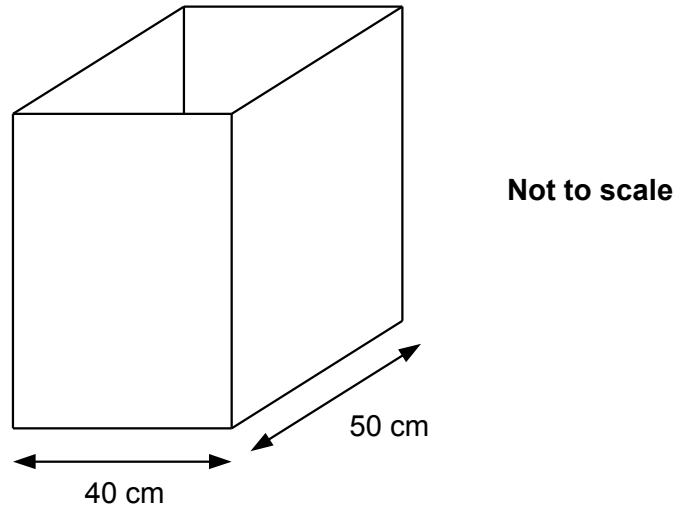(b) .... **[1]**

Gwen says

The curve looks like a quadratic of the form $f(x) = x^2 + bx + c$.

(c) Assuming Gwen is correct, find the values of the constants b and c.
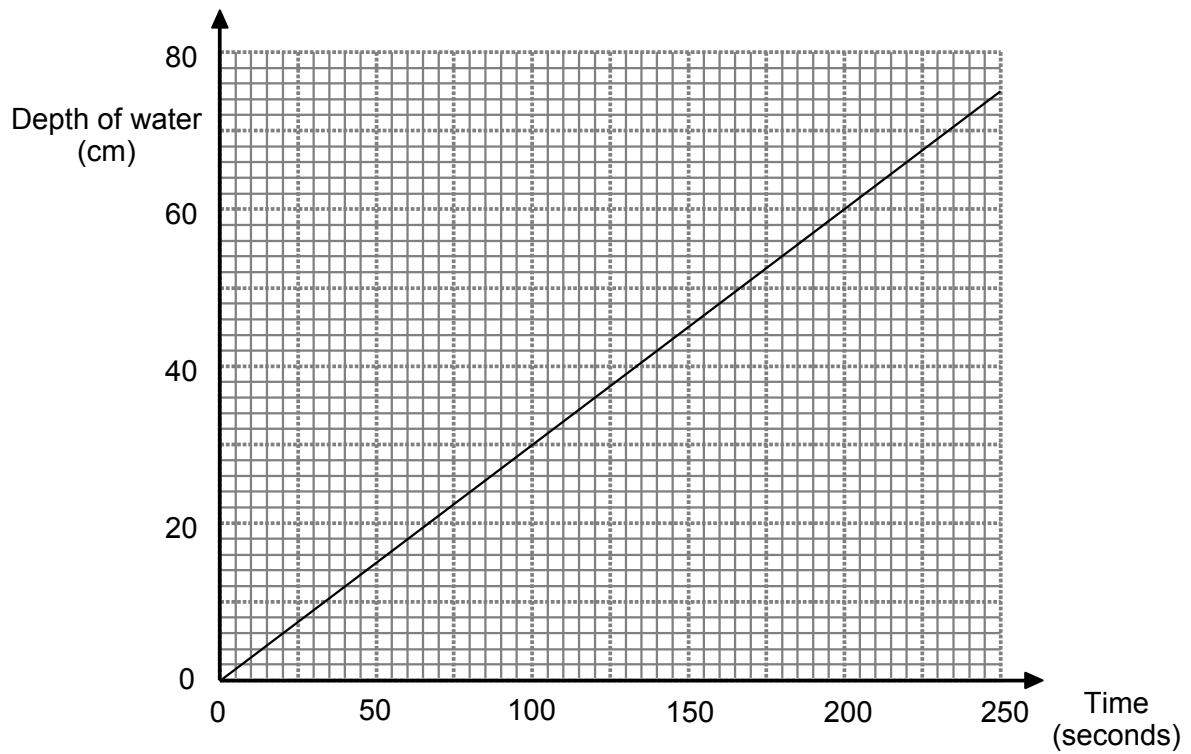
(c) b = ...

c = ... **[3]**

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10   An empty water tank is in the shape of a cuboid.
The base of the tank measures 40 cm by 50 cm.

Not to scale

50 cm

40 cm

A tap is used to fill the tank with water.

The graph shows how the depth of the water in the tank changes with time.

Depth of water (cm)

Time (seconds)

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(a) Use the graph to work out the rate at which water is supplied to the tank.

Give your answer in litres per hour.

(a) .... litres per hour **[4]**

(b) State an assumption you have made in your calculation in part **(a)** and explain how it has affected your answer.

....

....

.... **[2]**

11 **(a)** Find a fraction with a value between $\sqrt{0.59}$ and $\sqrt{0.6}$.

(a) .... **[3]**

(b) Work out $\sqrt[4]{\dfrac{(5.2)^3 + 9.6}{0.7 \times 0.88}}$.

Give your answer correct to 2 significant figures.

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

(c) Without using a calculator, prove that

$$\sqrt[4]{40\,000} = k\sqrt{2}$$

where k is an integer to be found.

(c) .... **[3]**

12   An alloy is made from a mixture of gold and silver.

The density of gold is 19.3 g/cm^3.
The density of silver is 10.5 g/cm^3.

(a)   Explain why the percentage of the mass of the alloy that is gold will be different from the percentage of the volume that is gold.
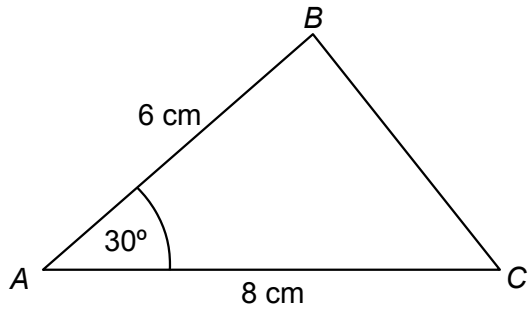
....

....

.... **[1]**

A ring is made from the alloy.
The mass of the ring is 10 g and its volume is 0.6 cm^3.

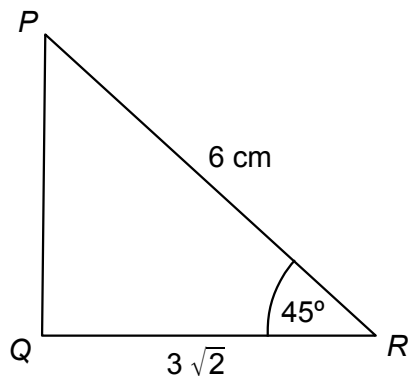**(b)**   Use algebra to show that about 70% of the volume of the ring is gold.

[5]

13 **(a)**

Not to scale

Find the area of triangle *ABC*.

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

(b)

Not to scale

Sam says

    PQR is a right-angled triangle.

Is Sam correct?

Show calculations to justify your answer.

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

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14   Solve algebraically the simultaneous equations

$$y = 3x^2 - x + 7$$
$$y = 9 - 6x$$

.... **[5]**

15   Dihya plays a pool game on his phone.

The app shows that he has played 523 games.
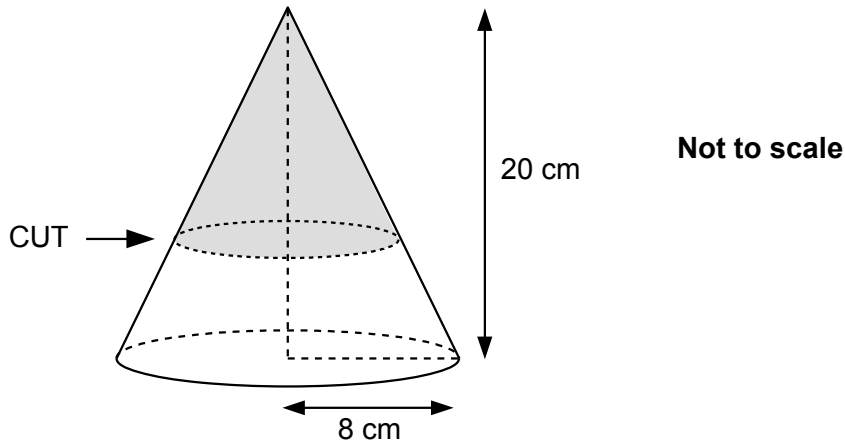It also shows that he has won 52% of the games he has played.
The win percentage shown by the app is rounded to the nearest whole number.

Dihya plays another 20 games and the app now shows that he has won 53% of all the games he has played.

Work out the smallest number of games that Dihya could have won out of the 20 games he has just played.

.... **[4]**

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16 Two friends have a shared birthday party.
The birthday cake is in the shape of a cone.

Not to scale

20 cm

CUT →

8 cm

The radius of the base of the cone is 8 cm and the height of the cone is 20 cm.
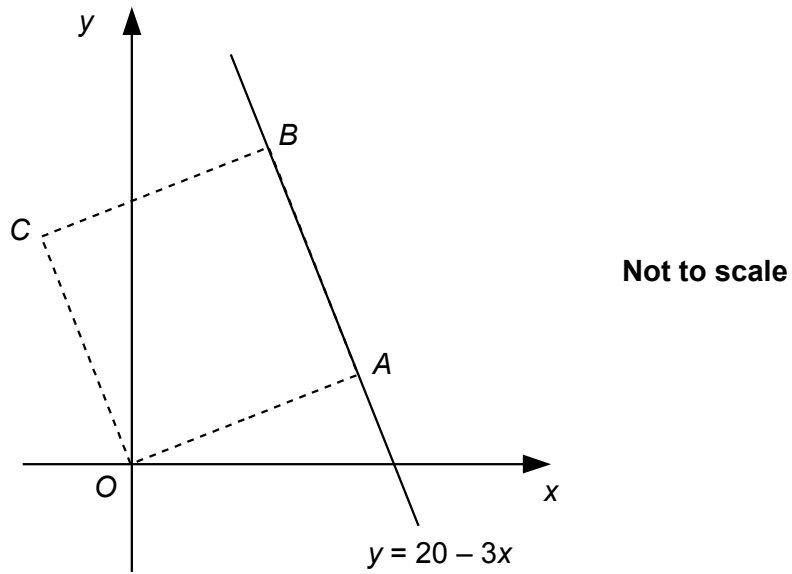
The cake is to be cut into two pieces of the same volume.
The cut is to be horizontal as shown in the diagram.

Calculate how high above the base the cut should be made.
Give your answer in centimetres correct to 1 decimal place.

[The volume V of a cone with base radius r and height h is $V = \frac{1}{3}\pi r^2 h$.]

.... cm **[5]**

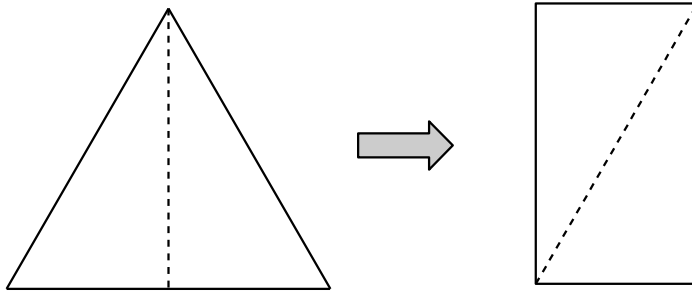**17**

$y = 20 - 3x$

Not to scale

O is the origin, (0, 0).

The points *A* and *B* lie on the line with equation $y = 20 - 3x$.

Given that *OABC* is a square, find a possible set of coordinates for point *C*.

(........ , ...) **[6]**

18

A piece of card in the shape of an equilateral triangle is cut in half.
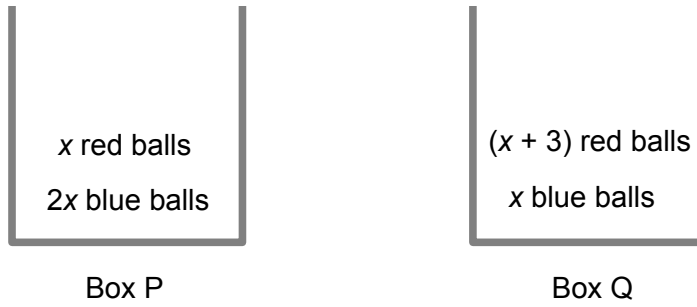The two pieces are then put together to make a rectangle as shown.

The perimeter of the rectangle is 20 cm.

Find the perimeter of the equilateral triangle.

Give your answer correct to 3 significant figures.

.... cm **[5]**

19

x red balls 2*x* blue balls	(*x* + 3) red balls *x* blue balls
Box P	Box Q

Box P contains *x* red balls and 2*x* blue balls.
Box Q contains (*x* + 3) red balls and *x* blue balls.

A ball is picked at random from box P and placed into box Q.
A ball is now picked at random from box Q.

The probability that both balls picked are red is $\frac{1}{4}$.

Work out the probability that both balls picked are blue.

.... **[6]**

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