Surname	Centre Number	Candidate Number
First name(s)		0

GCSE

C300UB0-1

A22-C300UB0-1

THURSDAY, 3 NOVEMBER 2022 – MORNING

MATHEMATICS – Component 2
Calculator-Allowed Mathematics
HIGHER TIER

2 hours 15 minutes

ADDITIONAL MATERIALS

An additional formulae sheet.

A calculator will be required for this examination.

A ruler, protractor and a pair of compasses may be required.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.
Do not use gel pen or correction fluid.

You may use a pencil for graphs and diagrams only.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** the questions in the spaces provided.

If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

Take π as 3·142 or use the π button on your calculator.

INFORMATION FOR CANDIDATES

You should give details of your method of solution when appropriate.

Unless stated, diagrams are not drawn to scale.

Scale drawing solutions will not be acceptable where you are asked to calculate.

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the need for good English and orderly, clear presentation in your answers.

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	5	
2.	4	
3.	2	
4.	4	
5.	7	
6.	7	
7.	6	
8.	8	
9.	7	
10.	4	
11.	5	
12.	4	
13.	4	
14.	6	
15.	8	
16.	4	
17.	3	
18.	5	
19.	4	
20.	10	
21.	6	
22.	7	
Total	120	

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Formula list

Area and volume formulae

Where r is the radius of the sphere or cone, l is the slant height of a cone and h is the perpendicular height of a cone:

Curved surface area of a cone = πrl

Surface area of a sphere = $4\pi r^2$

Volume of a sphere = $\frac{4}{3}\pi r^3$

Volume of a cone = $\frac{1}{3}\pi r^2 h$

Kinematics formulae

Where a is constant acceleration, u is initial velocity, v is final velocity, s is displacement from the position when $t = 0$ and t is time taken:

$$v = u + at$$

$$s = ut + \frac{1}{2}at^2$$

$$v^2 = u^2 + 2as$$

Examiner only

1. Nathan and Lucy make and sell wooden items for gardens.

(a) Nathan makes and sells benches, tables and tool sheds.
Last year, the profit he made from selling these items was in the following ratio.

benches	:	tables	:	tool sheds
2	:	3	:	7

(i) What fraction of his profit did Nathan make from selling benches and tables? [1]

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(ii) His total profit was £18 072.

How much profit did Nathan make from the sale of tool sheds? [2]

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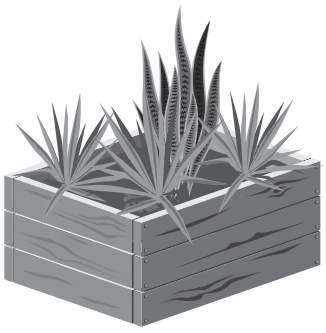
(b) Lucy makes and sells planters.
Each planter costs Lucy £32 to make.
Each one that she sells makes a **profit** of £80.



What is Lucy's profit from the sale of one planter as a percentage of the cost to make the planter? [2]

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2. The table gives a summary of the masses, m grams, of 30 buzzards.

Mass, m (grams)	$600 \leqslant m < 700$	$700 \leqslant m < 800$	$800 \leqslant m < 900$	$900 \leqslant m < 1000$
Frequency	8	7	4	11

(a) Moeen uses the midpoint of each group to calculate an estimate of the mean mass of these buzzards.
He does this correctly.

Calculate Moeen's answer. [3]

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(b) Deeta decides to estimate the mean mass of these buzzards.
She uses the values 600, 700, 800 and 900 rather than the midpoints.

Explain why her method is unlikely to give a good estimate of the mean mass. [1]

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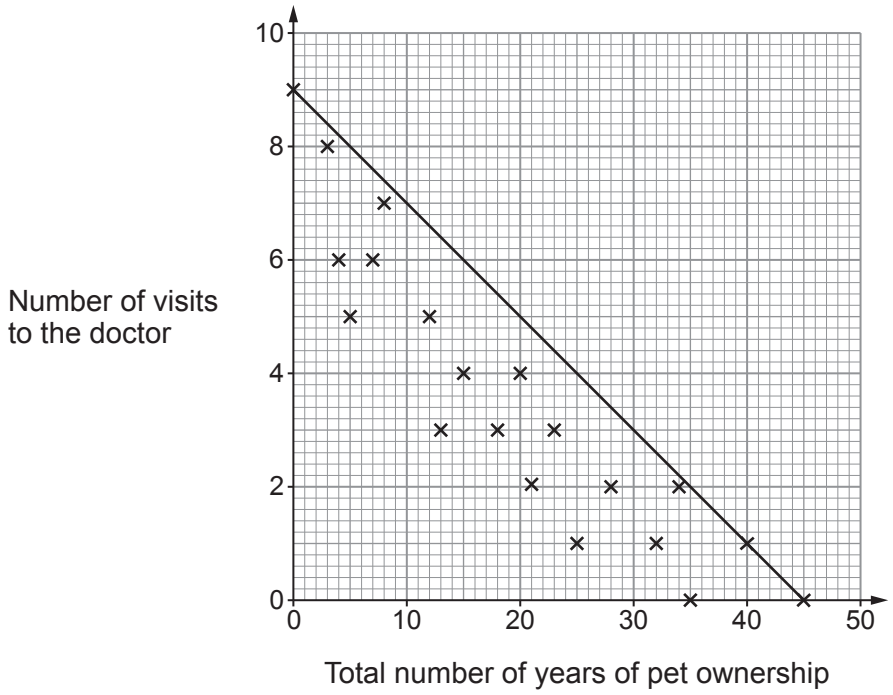
3. Debbie collects data about a group of 20 people.

Her data is:

- the total number of years for which they have owned a pet
- the number of visits they have each made to their doctor in the last year.

The scatter graph shows her results and her attempt to draw a line of best fit for the data.



(a) Make a criticism of Debbie's line of best fit. [1]

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(b) Debbie says,

Because there is a negative correlation, owning a pet for longer **causes** people to need to visit the doctor less often.

Is Debbie correct?

Yes ☐ No ☐

Explain how you decide. [1]

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Examiner only

4. Janet invests £5000 in a savings account for 9 years.
She makes no further payments into or out of her account in this time.

For the first 5 years, her investment earns 2% compound interest per year.
After this, the interest rate decreases to 1·3% compound interest per year.

How much is Janet's investment worth at the end of the 9 years? [4]

5. (a) Circle the correct conversion of 7 m^3 to cm^3. [1]

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(b) The diagram shows a shape made from a trapezium and a circle.

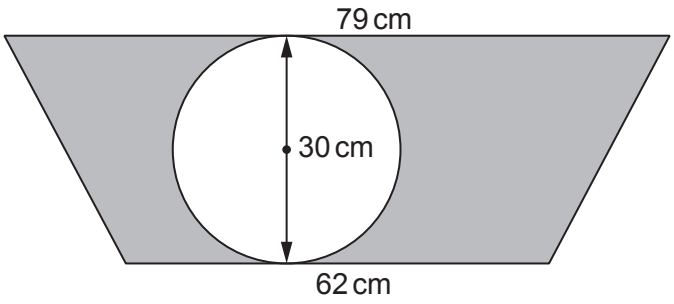

Diagram not drawn to scale

The parallel sides of the trapezium are tangents to the circle.
The diameter of the circle is 30 cm.

The ratio of the white area to the **shaded** area is as follows.

white area	:	shaded area
1	:	k

Find the value of k.
Show all your working and give your answer correct to 1 significant figure. [6]

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6. (a) Solve $5x + 4 = 2x + 6$. [2]

(b) Solve $4x - 3 > 17$. [2]

(c) Solve the following simultaneous equations. Use an algebraic (not graphical) method.

$$5x - 2y = 16$$

$$x - y = 5$$

You must show all your working. [3]

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7.

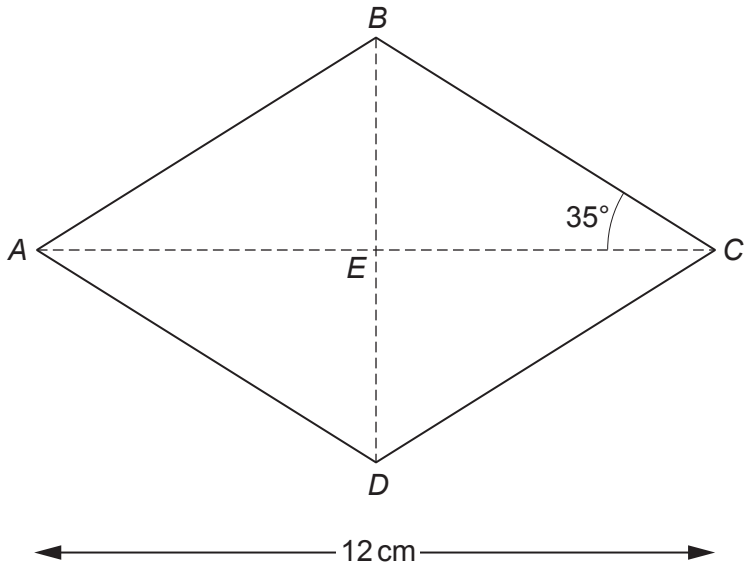

Diagram not drawn to scale

The diagram shows a rhombus, *ABCD*.
AC and *BD* intersect at *E*.
The length of *AC* is 12 cm.
$B\hat{C}E$ is 35°.

Find the perimeter of *ABCD*. [6]

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Perimeter of *ABCD* = ... cm

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8. The table shows some of the values of $h = -3(t+1)(t-4)$ for $0 \leqslant t \leqslant 5$.

t	0	1	2	3	4	5
$h = -3(t+1)(t-4)$		18	18		0	

(a) Complete the table above. [2]

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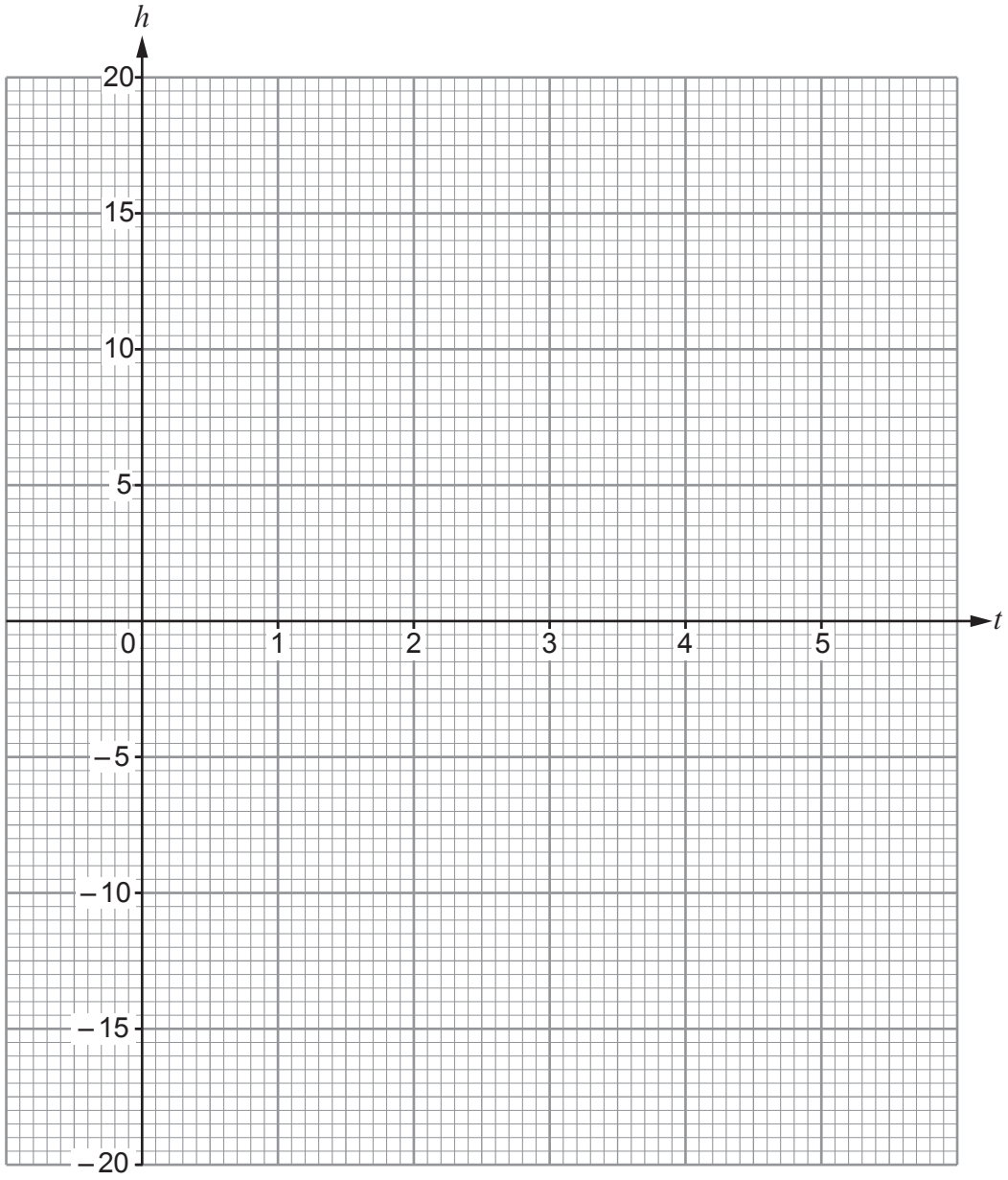
(b) On the graph paper below, draw the graph of $h = -3(t+1)(t-4)$ for $0 \leqslant t \leqslant 5$. [2]



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(c)

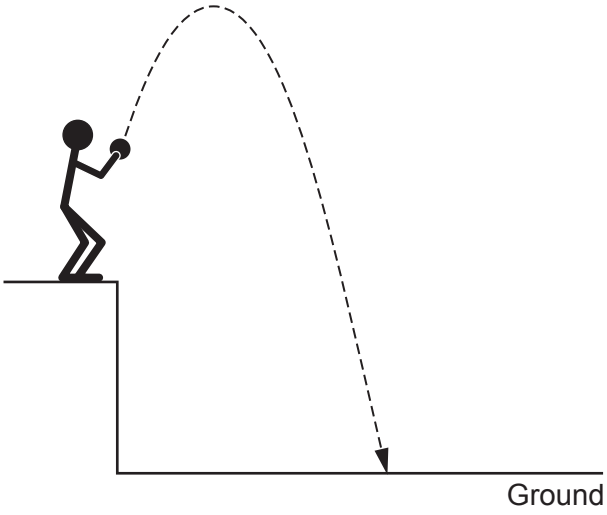

Diagram not drawn to scale

Derek throws a ball upwards from a point above horizontal ground.
The height, h metres, of the ball above the ground t seconds after Derek throws it is $h = -3(t+1)(t-4)$.

(i) What is the height of the ball above the ground at the start of Derek's throw? [1]

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(ii) How many seconds after Derek throws the ball does it first hit the ground? [1]

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(iii) How many seconds after Derek throws the ball is it at its maximum height? [1]

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(iv) What is the maximum height of the ball above the ground? [1]

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9. The diagram shows the interior length, width and height of a wooden crate.

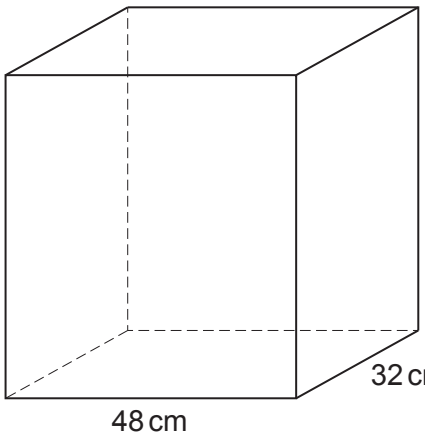

Diagram not drawn to scale

Jake fills the crate with solid beeswax cylinders. They each have a length of 32 cm.
The cylinders fit tightly in the crate with 8 cylinders in each row.
The first two rows are shown in the diagram.

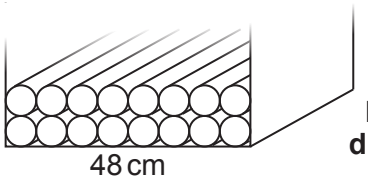

Diagram not drawn to scale

Jake continues to fill the crate in this way.

The density of the beeswax is $0{\cdot}961\,g/cm^3$.

Jake calculates the total mass of the cylinders to be more than 70 kg.
Is he correct?

Yes ☐ No ☐

Show how you decide. [7]

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10. Max bought a new computer.
In the first year, the value of Max's computer decreased by 19·8%.
In the second year, the value of Max's computer decreased by 6·5% of its value at the end of the first year.

Find the overall percentage decrease in the value of Max's computer at the end of the second year.
You must show all your working. [4]

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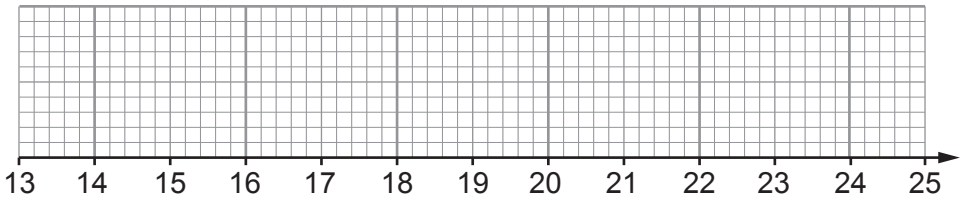
11. Two groups of people, *A* and *B*, take part in a fun run.
Everyone in the groups completes the run.

The table gives a summary of the times, t minutes, taken by group *A*.

Minimum	Maximum	Median	Lower Quartile	Inter-quartile range
15·2	23·2	19·4	16·8	4·2

(a) On the grid below, draw a box plot to represent this data. [3]



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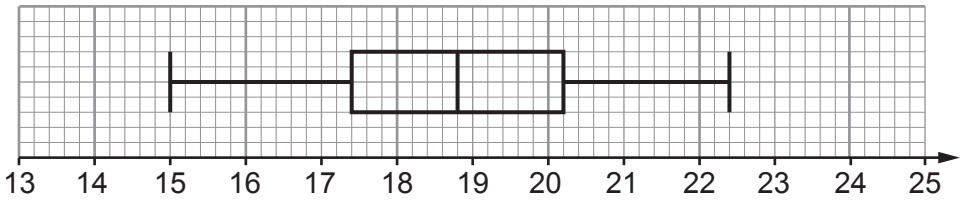
(b) The box plot below gives a summary of the times, t minutes, taken by group *B*.



Marcie makes two statements using information from the box plots.
Are Marcie's statements correct?
Explain how you decide.

(i) "On average, runners in group *B* ran faster than runners in group *A*." [1]

Correct ☐ Not correct ☐

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(ii) "There is a greater proportion of runners who took less than 17 minutes in group *B*." [1]

Correct ☐ Not correct ☐

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12. The equation $2x^3 + x^2 - 12 = 0$ has a solution between 1 and 2.

Use trial and improvement to find this solution correct to 1 decimal place. [4]

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13. (a) An architect measures the height of a wall.
She uses a laser measuring device.

The measurement is 2652 mm,
correct to the nearest 1·5 mm.

What is the lower bound of the height of the wall? [1]

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(b) A builder measures the lengths of two pieces of wood.
He uses a tape measure.

The lengths are 2·85 metres and 1·90 metres, both
correct to the nearest centimetre.

Calculate the greatest total length of the two pieces of wood.
Give your answer in metres. [3]

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Examiner only

14. Dora has two boxes, *A* and *B*.
The boxes contain beads which are identical in shape.

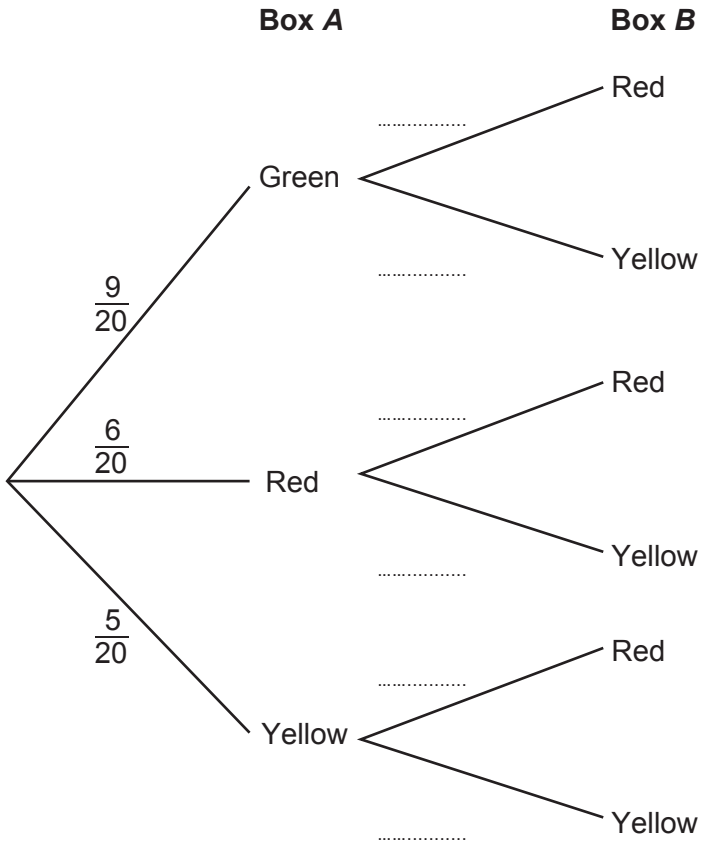
Box *A* contains 9 green, 6 red and 5 yellow beads.
Box *B* contains 12 red and 8 yellow beads.

Dora takes a bead at random from box *A*. If the bead is:

- green, she puts it back in box *A*
- red or yellow, she puts it in box *B*.

She then takes a bead at random from box *B*.

(a) Complete the tree diagram. [3]



(b) Find the probability that Dora takes two beads of the same colour. [3]

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Examiner only

15. In this question all lengths are in metres.

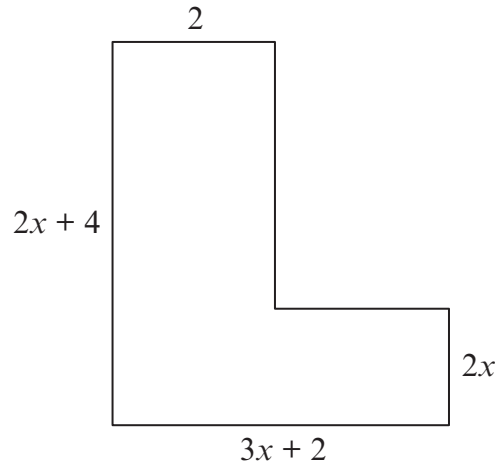

Diagram not drawn to scale

This shape is made from two rectangles.
The area of this shape is $10\,m^2$.

(a) Show that $3x^2 + 2x - 1 = 0$. [3]

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(b) Calculate the value of the perimeter of this shape.
You must show all your working. [5]

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16.

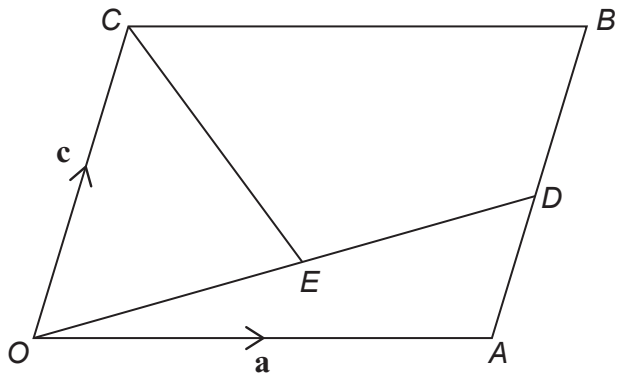

Diagram not drawn to scale

OABC is a parallelogram.
OA = **a** and **OC** = **c**.
D is the midpoint of *AB* and *E* is the midpoint of *OD*.

(a) Find **OD** in terms of **a** and **c**. [1]

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(b) Find **OE** in terms of **a** and **c**. [1]

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(c) Find **CE** in terms of **a** and **c**.
Give your answer in its simplest form. [2]

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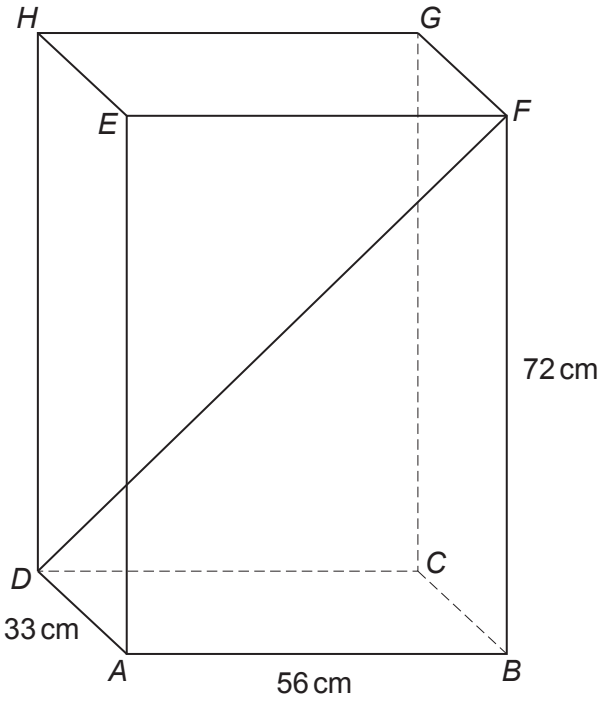

Diagram not drawn to scale

The diagram shows a cuboid, *ABCDEFGH*.

Calculate the length of the diagonal, *DF*. [3]

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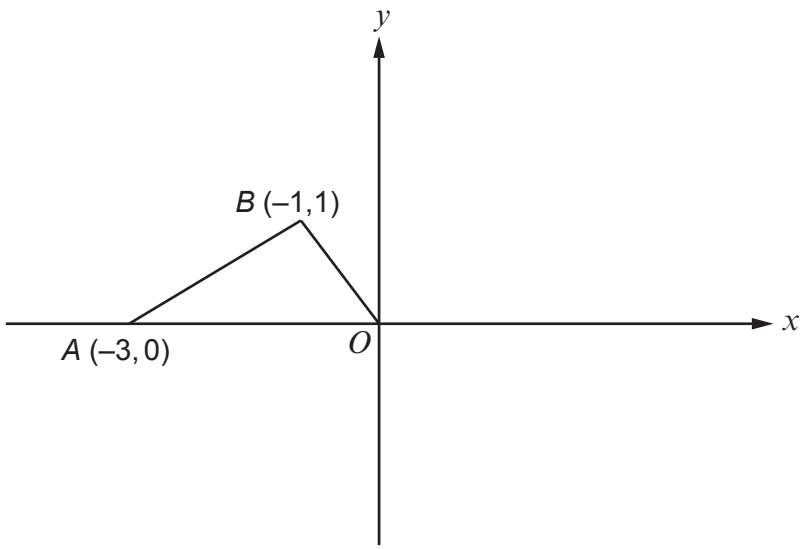
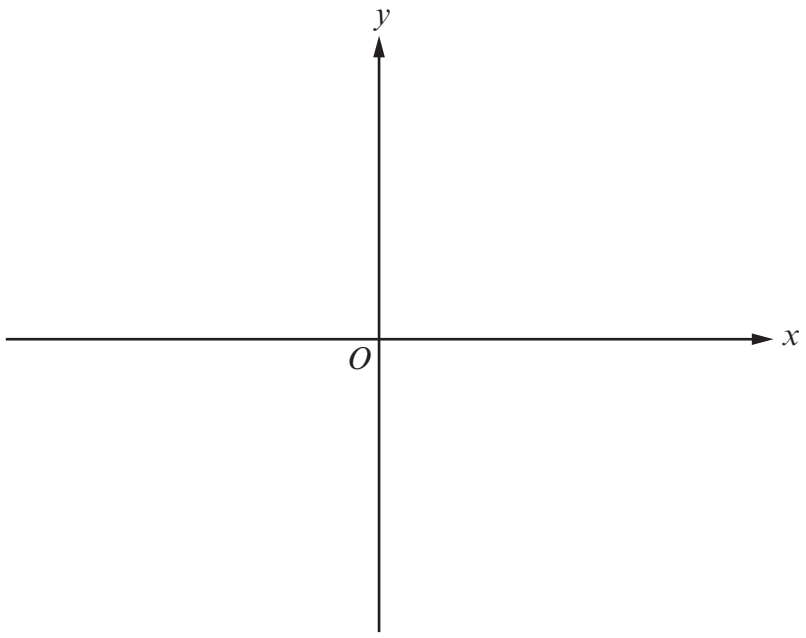
18. (a) The diagram shows a sketch of the graph of $y = f(x)$.
The point A has coordinates $(-3, 0)$, the point B has coordinates $(-1, 1)$.



(i) Sketch the graph of $y = f(-x)$ on the axes below.
You must indicate the coordinates of the new positions of the points A and B. [2]



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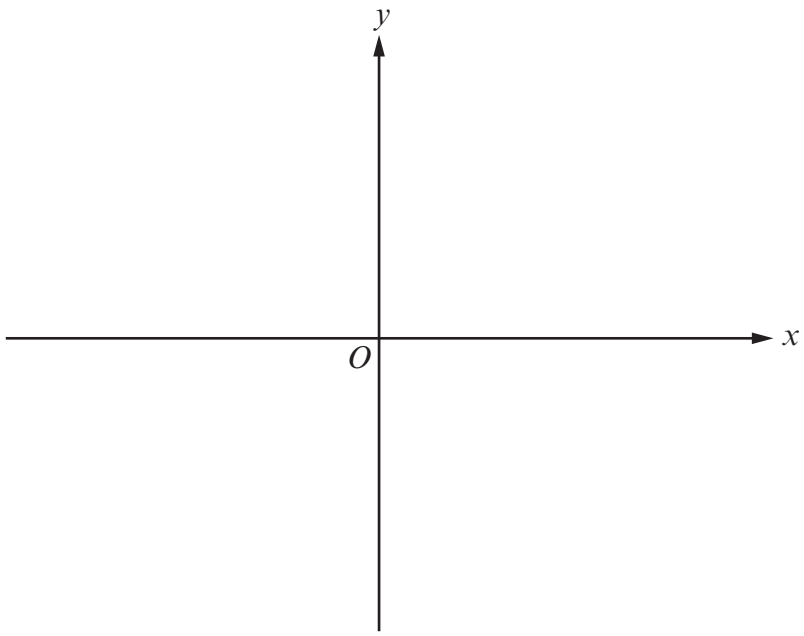
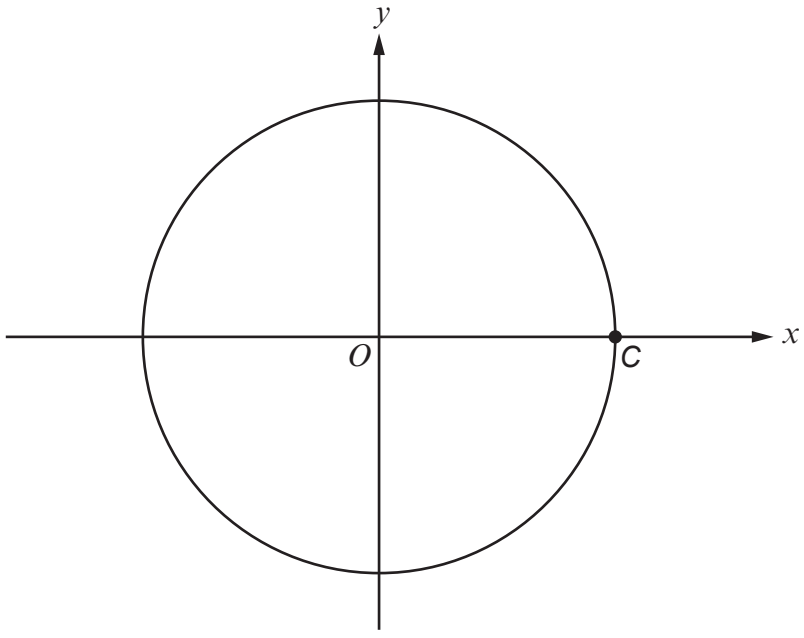
(ii) Sketch the graph of $y = f(x) + 2$ on the axes below.
You must indicate the coordinates of the new positions of the points *A* and *B*. [2]



(b) The diagram shows a sketch of the circle with equation $x^2 + y^2 = 289$.



Write down the coordinates of point *C*. [1]

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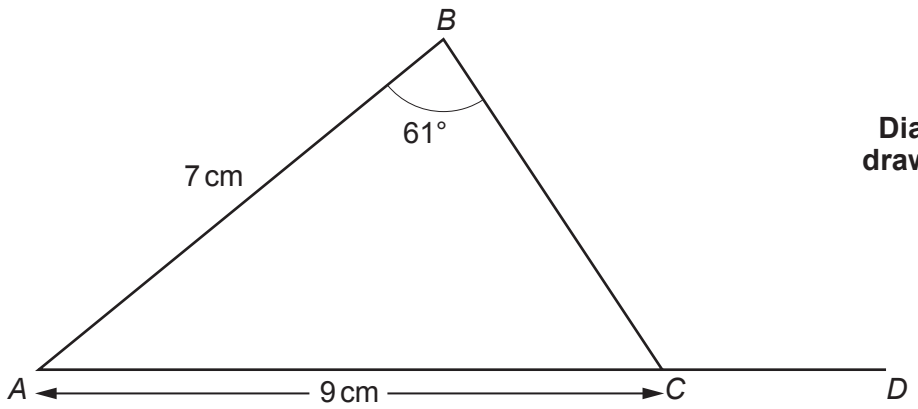

Diagram not drawn to scale

In triangle ABC, $AB = 7$ cm, $AC = 9$ cm and $A\hat{B}C = 61°$.
ACD is a straight line.

Find $B\hat{C}D$. [4]

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20.

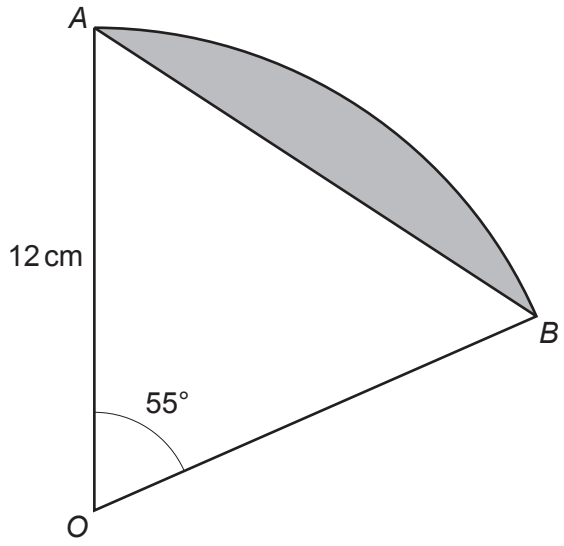

Diagram not drawn to scale

The diagram shows a sector of a circle, centre O, radius 12 cm.
$A\hat{O}B$ is 55°.

(a) Find the area of the shaded region. [4]

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(b) Find the perimeter of the shaded region. [6]

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21.

$$g(x) = 2x^2$$

$$h(x) = \frac{x+1}{4}$$

(a) Show algebraically that the x-coordinates of the points of intersection of

- the curve with equation $y = g(x)$, and
- the line with equation $y = h^{-1}(x)$,

are solutions of the equation [3]

$$2x^2 - 4x + 1 = 0.$$

Examiner only

(b) Use an algebraic method to find the x-coordinates of the points of intersection of

- the curve $y = g(x)$, and
- the line $y = h^{-1}(x)$.

Give your answers correct to 2 decimal places.
You must show all your working. [3]

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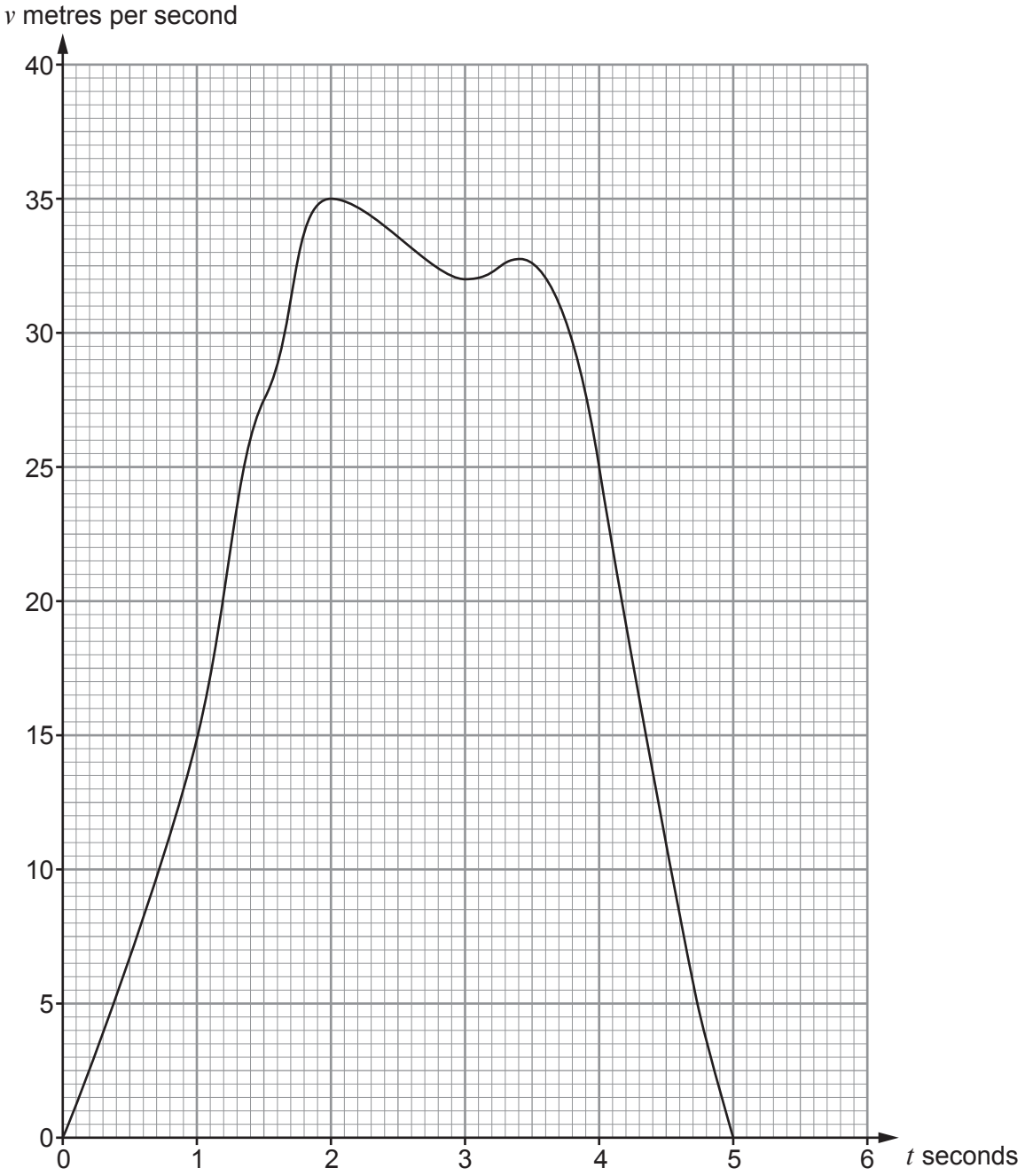
22. The diagram shows the velocity, v metres per second, of a particle t seconds after it passes a fixed point.



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(a) Calculate an estimate of the acceleration of the particle when $t = 3{\cdot}5$ seconds. [3]

(b) Use five vertical strips of equal width to estimate the distance travelled by the particle in the first 5 seconds after it passes the fixed point. [4]

END OF PAPER

Question number	Additional page, if required. Write the question number(s) in the left-hand margin.

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