Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____
I declare this is my own work.

GCSE
MATHEMATICS

H

Higher Tier Paper 3 Calculator

Monday 13 November 2023 Morning Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:
- a calculator
- mathematical instruments
- the Formulae Sheet (enclosed).

Instructions

- Use black ink or black ball-point pen. Draw diagrams in pencil.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 80.
- You may ask for more answer paper, graph paper and tracing paper. These must be tagged securely to this answer book.

Advice

In all calculations, show clearly how you work out your answer.

For Examiner's Use	
Pages	Mark
2–3	
4–5	
6–7	
8–9	
10–11	
12–13	
14–15	
16–17	
18–19	
20–21	
22–23	
24–25	
26	
TOTAL	

Do not write outside the box

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

1 The first four terms of a linear sequence are

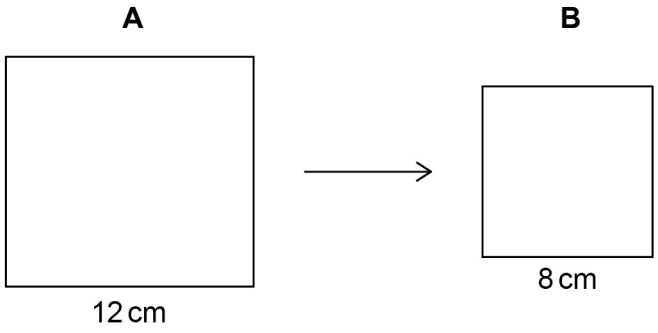
6 13 20 27

Write down the expression for the nth term.

[1 mark]

Answer _____

2 Square A is enlarged to square B.



Not drawn accurately

Write down the scale factor of the enlargement as a fraction.

[1 mark]

Answer _____

Do not write outside the box

3 The length of a line is 8 cm to the nearest centimetre.

Complete the error interval.

[2 marks]

Answer _____ cm $\leqslant$ length $<$ _____ cm

4 At what point does the graph $y = x^3 - 1$ cross the y axis?

[1 mark]

Answer (_____ , _____)

Turn over for the next question

5

Do not write outside the box

5 Carly's total annual pay = salary + bonus

	Salary	**Bonus**
Last year	£26 000	£4000
This year	6% increase	9% decrease

Work out the percentage change in her total annual pay.

State whether it is an increase or a decrease.

[4 marks]

Answer _____

Do not write outside the box

6 An exhibition

was open for 240 hours

and

had 29 760 visitors.

For $\frac{2}{5}$ of the time the exhibition was open, there were 172 visitors per hour.

For the remaining time, how many visitors per hour were there?

[4 marks]

Answer _____

7 The first two cube numbers are 1 and 8

Show that

the 3rd cube number can be written as the sum of three different prime numbers.

[3 marks]

$$\square = \square + \square + \square$$

11

Do not write outside the box

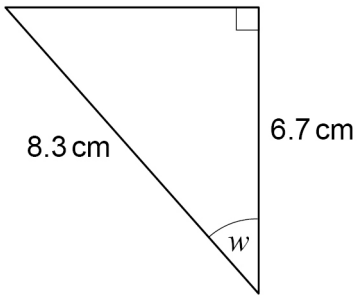
8 Circle the largest number.

[1 mark]

$5.30\dot{4}$ 5.344 5.34 $5.3\dot{4}$

9 Use trigonometry to work out the size of angle w.

[3 marks]



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$w =$ _____ °

Do not write outside the box

10 Two bags contain only green discs and yellow discs.

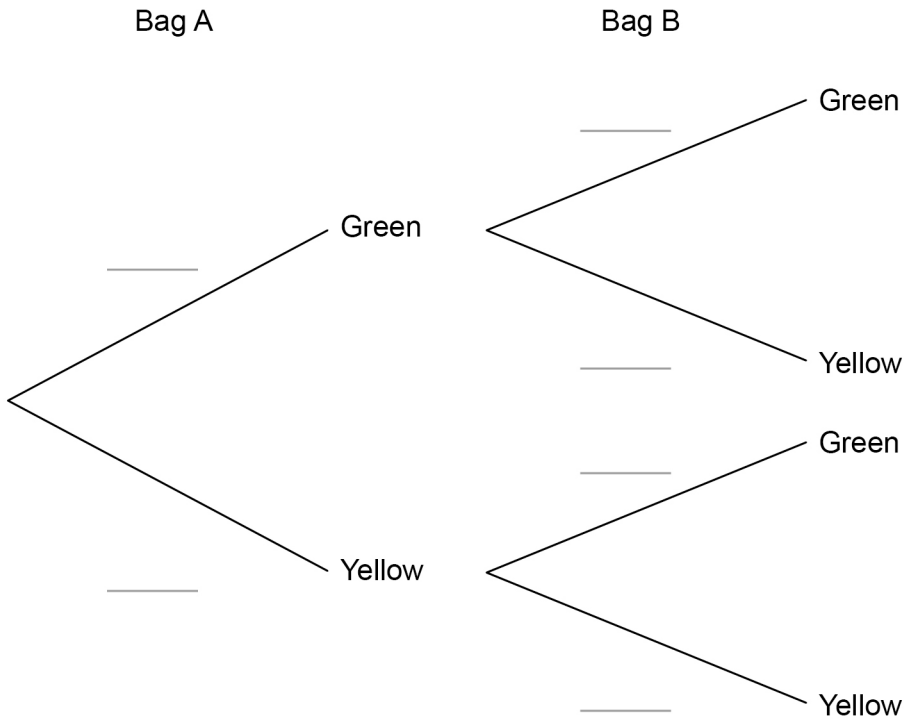
Bag A contains 1 green disc and 4 yellow discs.

Bag B contains 3 green discs and 7 yellow discs.

One disc is picked at random from each bag.

10 (a) Complete the tree diagram with the correct probabilities.

[2 marks]



10 (b) Work out the probability that **both** discs are green.

[2 marks]

Answer _____

8

Turn over ►

Do not write outside the box

11 Solve these simultaneous equations.

$$7x + 2y = 100$$
$$3x + 2y = 48$$

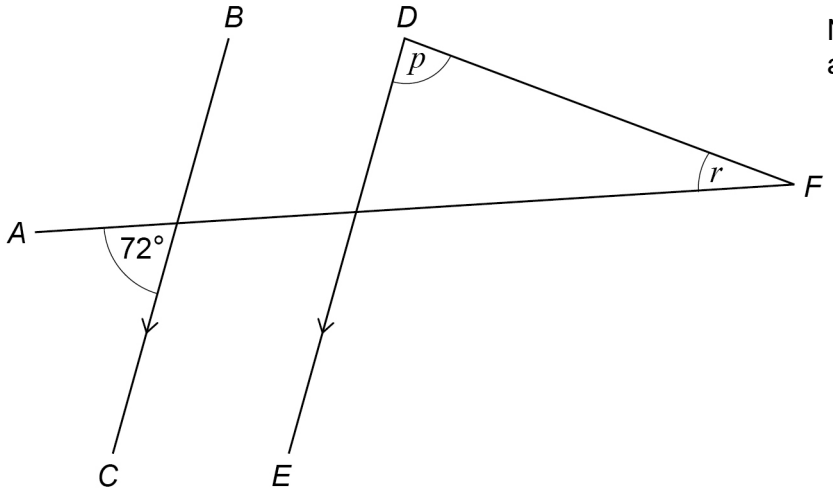
[3 marks]

$x =$ _____ $y =$ _____

Do not write outside the box

12 *AF*, *BC*, *DE* and *DF* are straight lines.

BC and *DE* are parallel.



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p is three times r.

Work out the size of angle p.

[3 marks]

$p =$ _____ °

6

Turn over ►

Do not write outside the box

13 100 people were asked about the distance they travel from home to work.

The table shows information about the results.

Distance, d (miles)	**Frequency**
$0 \leqslant d < 5$	21
$5 \leqslant d < 10$	24
$10 \leqslant d < 20$	37
$20 \leqslant d < 40$	18

13 (a) Write down the **greatest** possible number of people who work from home.

[1 mark]

Answer _____

13 (b) One person is chosen at random.

Work out the probability that the person travels **at least** 10 miles.

[1 mark]

_____

Answer _____

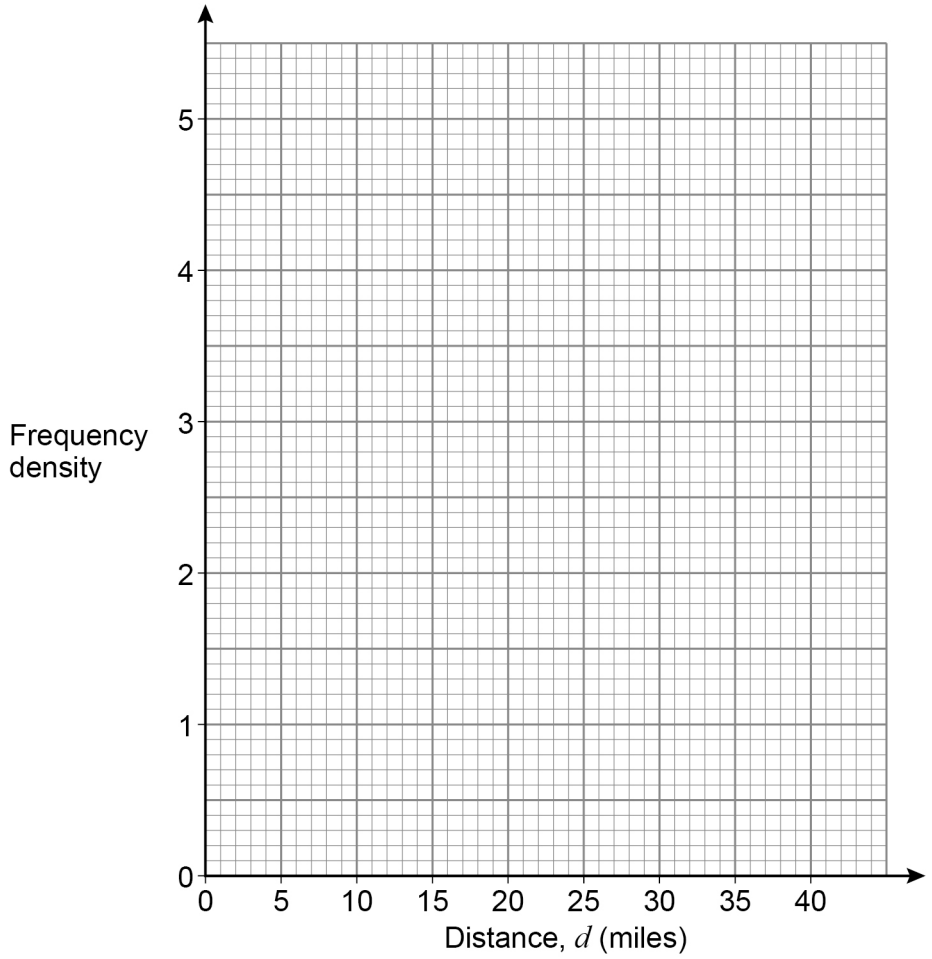
Do not write outside the box

13 (c) The table is repeated.

Distance, d (miles)	**Frequency**
$0 \leqslant d < 5$	21
$5 \leqslant d < 10$	24
$10 \leqslant d < 20$	37
$20 \leqslant d < 40$	18

Draw a histogram to represent the results.

[3 marks]



5

Turn over ►

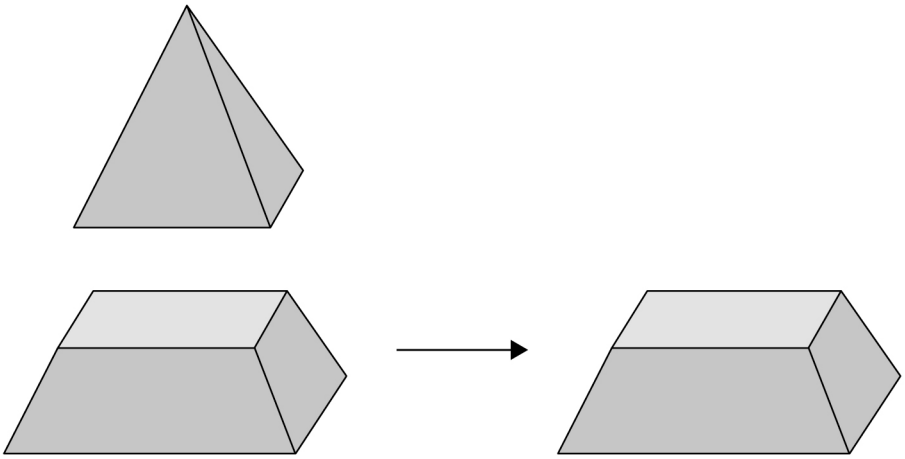
Do not write outside the box

14 A solid trophy consists of a stand and a player.

Trophy

The stand is made by removing a small pyramid from a large pyramid.

Large pyramid	Square base, edge 8 cm	Perpendicular height 16 cm
Small pyramid	Square base, edge 5 cm	Perpendicular height 10 cm



Stand

Volume of a pyramid $= \frac{1}{3} \times$ area of base $\times$ perpendicular height

Do not write outside the box

14 (a) Show that the volume of the **stand** is 258 cm^3

[2 marks]

14 (b) The trophy is made from a metal of density 7.5 grams per cm^3

The **total** mass of the trophy is 2340 grams.

Work out the volume of the **player**.

[2 marks]

Answer _____ cm^3

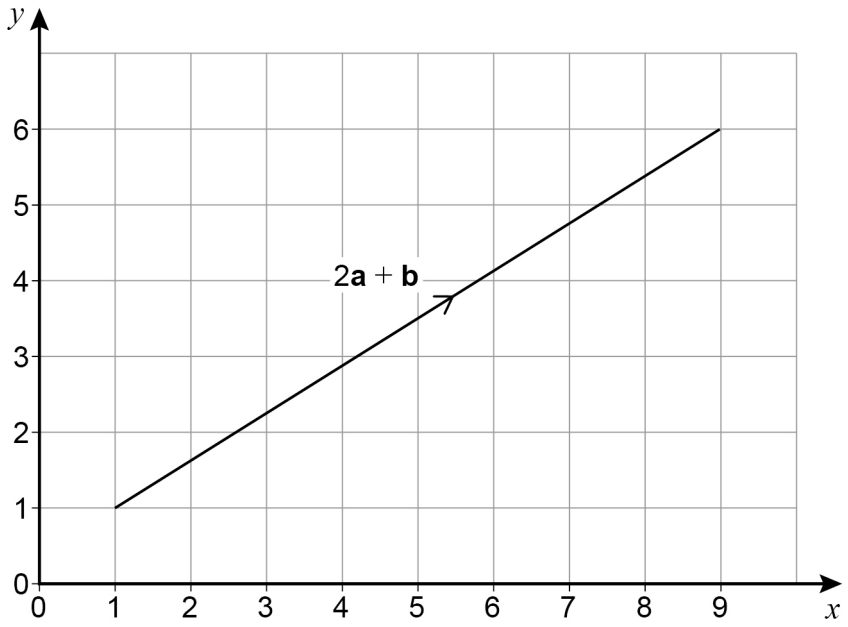
4

Turn over ►

Do not write outside the box

15 $\mathbf{a} = \begin{pmatrix} m \\ 3 \end{pmatrix}$ $\mathbf{b} = \begin{pmatrix} -4 \\ p \end{pmatrix}$

The diagram shows the vector $2\mathbf{a} + \mathbf{b}$



Work out the values of m and p.

[4 marks]

$m =$ _____ $p =$ _____

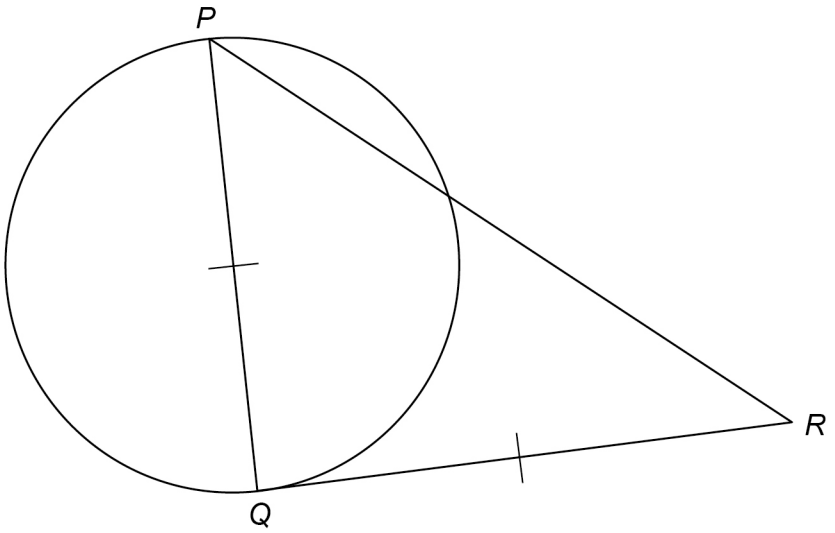
Do not write outside the box

16 PQ is a diameter of a circle.

QR is a tangent to the circle.

$PQ = QR$

$PR = 10\,\text{cm}$



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Work out the **radius** of the circle.

Give your answer as a decimal.

[3 marks]

Answer _____ cm

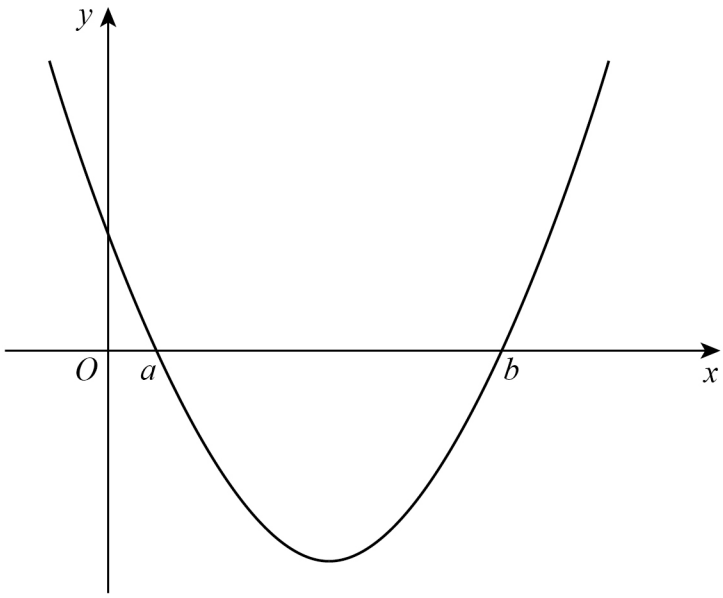
7

Turn over ►

Do not write outside the box

17 Here is a sketch of the quadratic graph $y = \mathrm{f}(x)$

The graph crosses the x-axis at $x = a$ and $x = b$



Write an expression for the x-coordinate of the turning point.

[1 mark]

Answer _____

Do not write outside the box

18 Simplify $\dfrac{2(x+4)^5}{(x+4)^3}$

Give your answer in the form $ax^2 + bx + c$ where a, b and c are integers.

[3 marks]

Answer _____

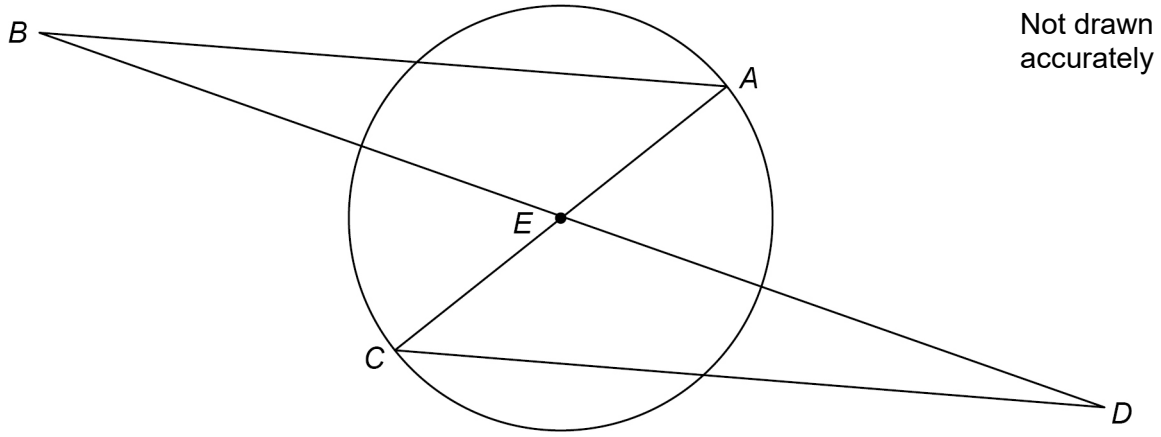
Turn over for the next question

4

Do not write outside the box

19 *AC* is a diameter of a circle, centre *E*.

E is the midpoint of *BD*.



Prove that triangle *ABE* is congruent to triangle *CDE*.

[4 marks]

Do not write outside the box

20 Solve $2x(x + 10) = 5x - 18$

[4 marks]

Answer _____

Turn over for the next question

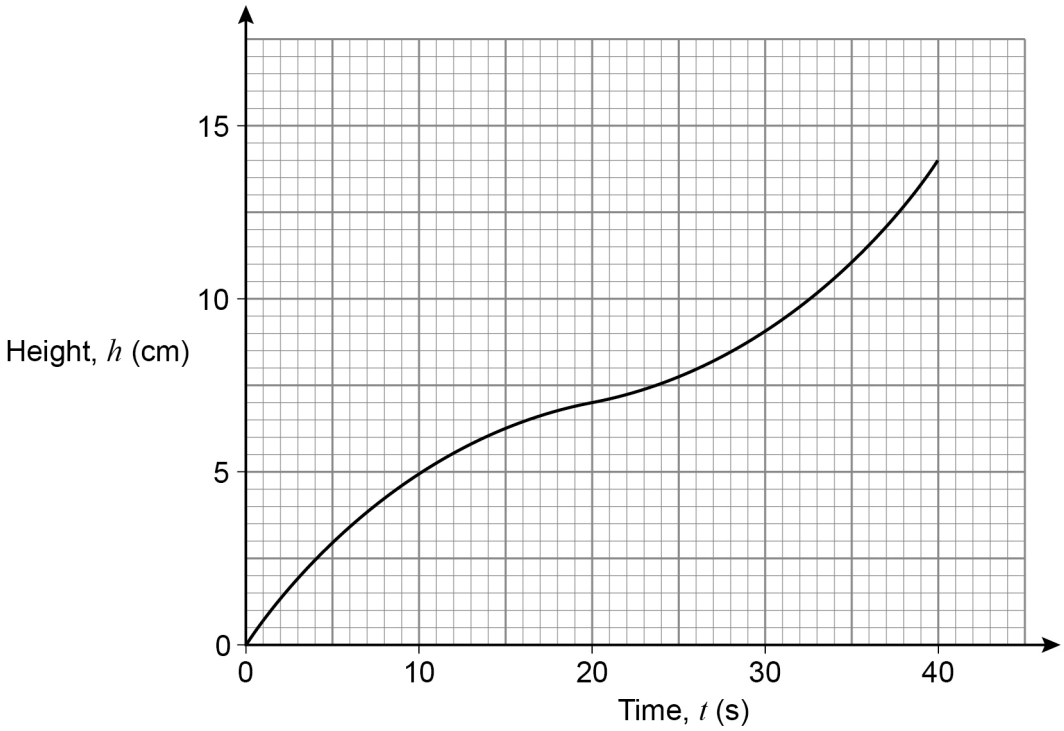
8

Do not write outside the box

21 Water flows from a tap at a constant rate.

A container is filled with water from the tap in 40 seconds.

The graph shows the height, h centimetres, of the water after time, t seconds.

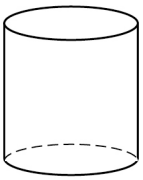


21 (a) The container is one of these shapes.

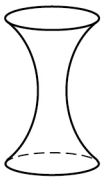
Circle the letter of the correct shape.

[1 mark]

A



B



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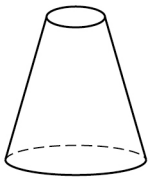
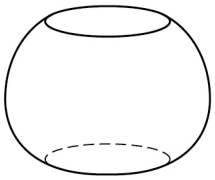


D



Do not write outside the box

21 (b) By drawing a tangent on the graph,

estimate the rate at which the height is increasing when $t = 10$

[2 marks]

Answer _____ cm/s

22 Write $\frac{7}{2a^2} - \frac{3}{5a}$ as a single fraction in its simplest form.

[2 marks]

Answer _____

5

Turn over ►

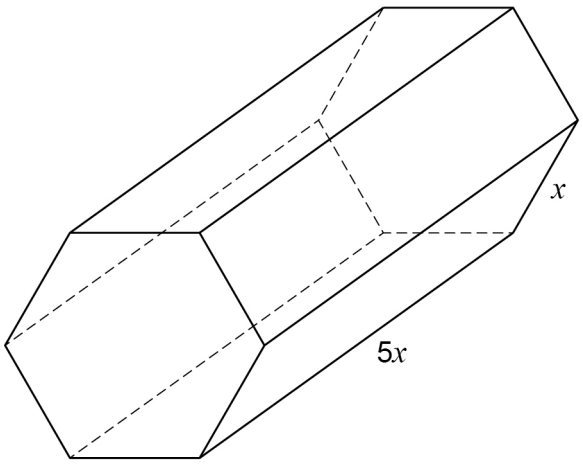
Do not write outside the box

23 A chocolate box in the shape of a prism is being designed.

All lengths are in centimetres.

The cross section is a regular hexagon with side x

The length is $5x$



An expression for the area of the cross section, in cm^2, is $\frac{3\sqrt{3}}{2}x^2$

The **total** surface area of the box must be less than 650 cm^2

Work out the largest possible **integer** value of x.

You **must** show your working.

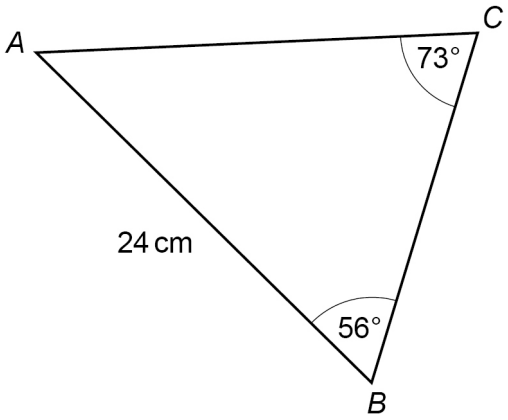
[4 marks]

Answer _____

Do not write outside the box

24 Work out the area of triangle *ABC*.

[4 marks]



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Answer _____ cm^2

8

Turn over ►

Do not write outside the box

25 a is three quarters of c

$6b = 5c$

Work out the ratio $a : b : c$

Give your answer in its simplest form, where a, b and c are integers.

[3 marks]

Answer _____ : _____ : _____

Do not write outside the box

26 In a game, these numbered tiles are in a bag.

5	5	5	5
3	3	2	1

To play the game

Choose tiles at random one at a time and do not replace the tiles.

You win if at any stage the total of the numbers on your tiles is 10

Amber plays the game once.

Work out the probability that she wins.

[4 marks]

Answer _____

7

Turn over ►

Do not write outside the box

27 (a) The graph of $y = x^3$ is translated to the graph of $y = (x - 2)^3$

Write down the translation vector.

[1 mark]

Answer $\begin{pmatrix} \quad \\ \quad \end{pmatrix}$

27 (b) The graph of $y = 5x + 4$ is reflected in the y-axis.

Write down the equation of the reflected graph.

[1 mark]

Answer _____

END OF QUESTIONS

2

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