

Centre Number						Candidate Number				
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Other Names										
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For Examiner's Use	
Examiner's Initials	
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TOTAL	



General Certificate of Secondary Education
Higher Tier
January 2013

Applications of Mathematics (Linked Pair Pilot)

93702H

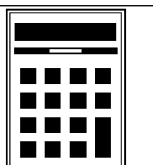
Unit 2 **Geometry and Measures**

H

Tuesday 22 January 2013 1.30 pm to 3.00 pm

For this paper you must have:

- mathematical instruments.
- You may use a calculator.



Time allowed

- 1 hour 30 minutes

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.
- Do all rough work in this book. Cross through any work that you do not want to be marked.
- If your calculator does not have a π button, take the value of π to be 3.14 unless another value is given in the question.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 80.
- The quality of your written communication is specifically assessed in Questions 1, 5 and 11.
These questions are indicated with an asterisk (*).
- You may ask for more answer paper, graph paper and tracing paper.
These must be tagged securely to this answer booklet.
- You are expected to use a calculator where appropriate.

Advice

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



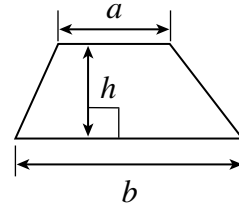
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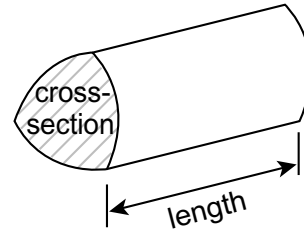
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Formulae Sheet: Higher Tier

Area of trapezium = $\frac{1}{2}(a+b)h$

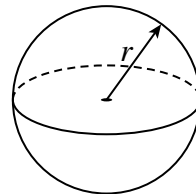


Volume of prism = area of cross-section \times length



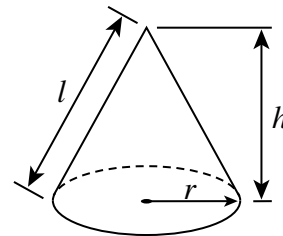
Volume of sphere = $\frac{4}{3}\pi r^3$

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



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

Curved surface area of cone = $\pi r l$

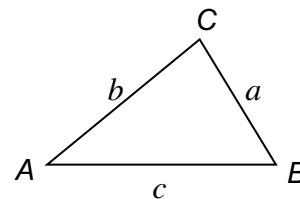


In any triangle ABC

Area of triangle = $\frac{1}{2}ab \sin C$

Sine rule $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

Cosine rule $a^2 = b^2 + c^2 - 2bc \cos A$



The Quadratic Equation

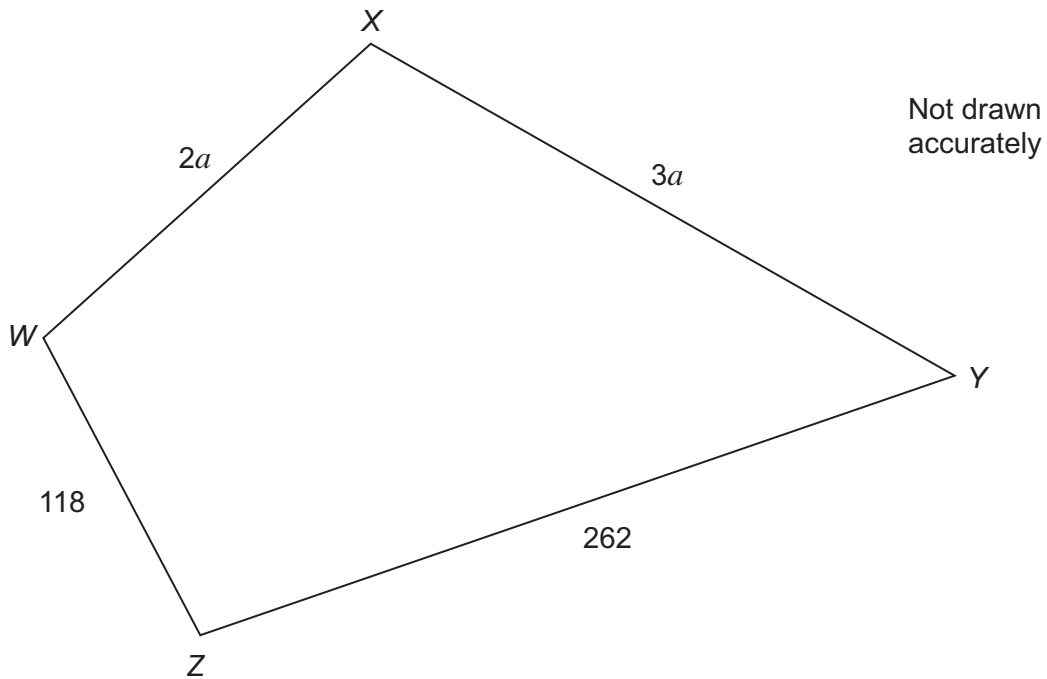
The solutions of $ax^2 + bx + c = 0$, where $a \neq 0$, are given by

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$



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

***1** Four straight paths with distances, in metres, are shown.



Amir walks along paths WX and XY .
Cath walks along paths WZ and ZY .
They both walk the same distance.

Set up and solve an equation to find the value of a .

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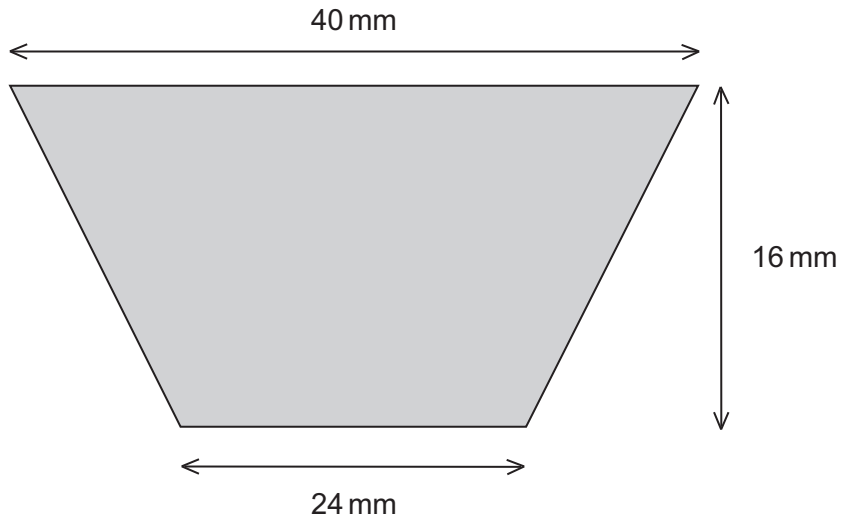
$a =$ (4 marks)

4

Turn over ►



2 (a) A jeweller has a piece of silver in the shape of a trapezium.



Not drawn
accurately

Work out the area of the trapezium.

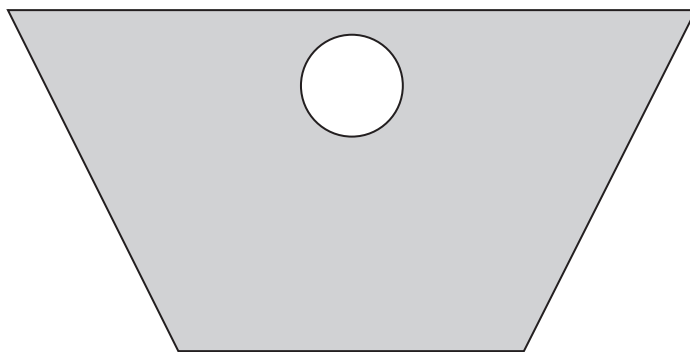
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Answer mm² (2 marks)

2 (b) She cuts out a circle of radius 4 mm from the trapezium to make a pendant.



Not drawn
accurately

Work out the area of the circle.

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Answer mm² (2 marks)



2 (c) The silver from the circle is waste material.

What percentage of silver does the jeweller waste making the pendant?

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Answer% (2 marks)

3 Vans are used to deliver 3000 sheets of wood to a factory.

Each sheet of wood weighs 800 grams.
Each van can carry a load of 750 kilograms.

Work out the least possible number of vans needed.

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Answer (4 marks)

Turn over for the next question

10

Turn over ►



4 Green paint is made by mixing yellow paint and blue paint in the ratio 5 : 1

Yellow paint costs £ 5.60 per litre.
Blue paint costs £ 6.20 per litre.

Work out the cost of 24 litres of green paint.

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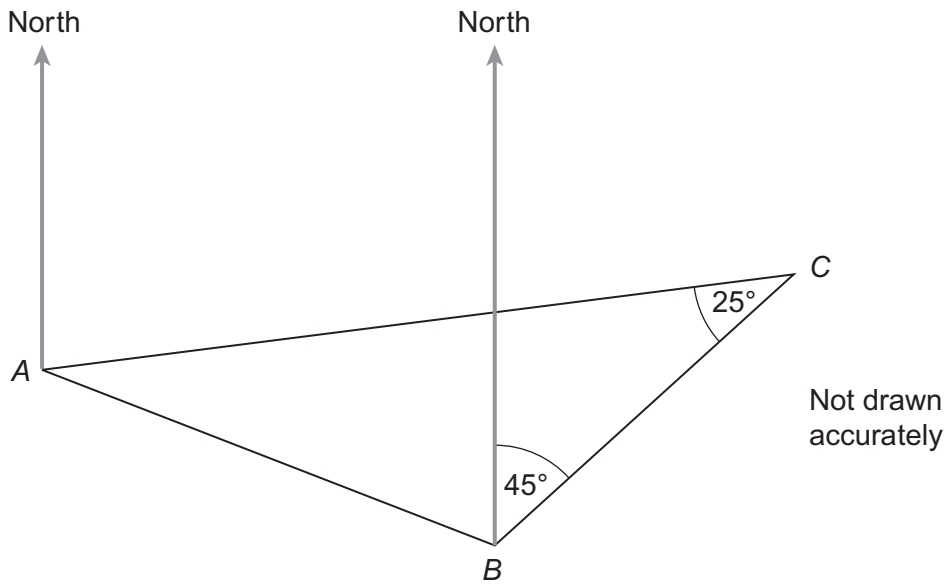
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£ (5 marks)



***5 (a)** The diagram represents a cross-country course.



Work out the three-figure bearing of C from A.
You **must** show your working.

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Answer° (3 marks)

5 (b) Steve completes the course in 15 minutes.
He runs at an average speed of 8 miles per hour.

How many miles does he run?

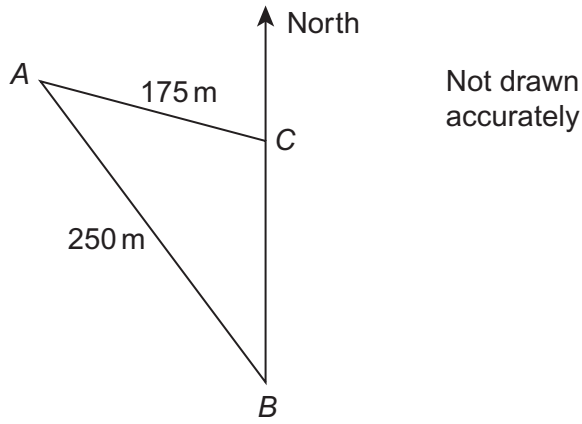
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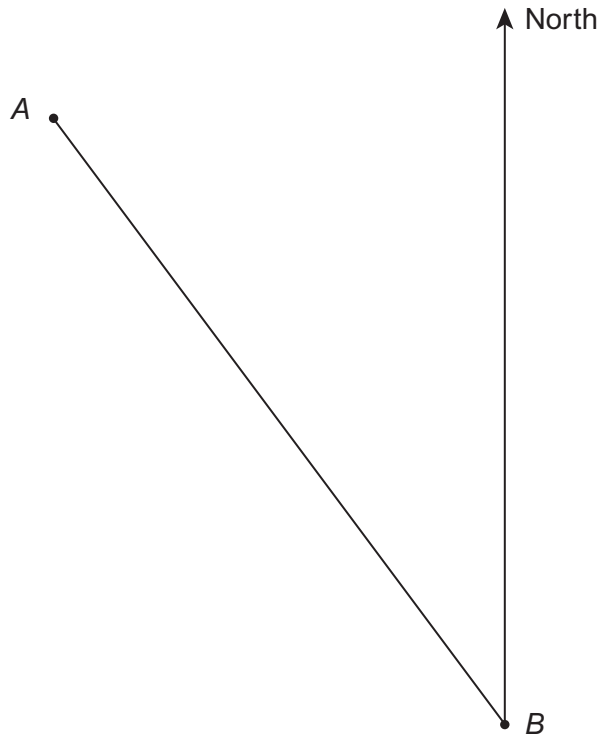
Answer miles (2 marks)



6 (a) Here is a sketch of a triangular field ABC .



Complete this scale drawing of the field.



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(3 marks)



6 (b) $PQRS$ represents a garden.



A straight path across the garden is the same distance from PQ and PS .

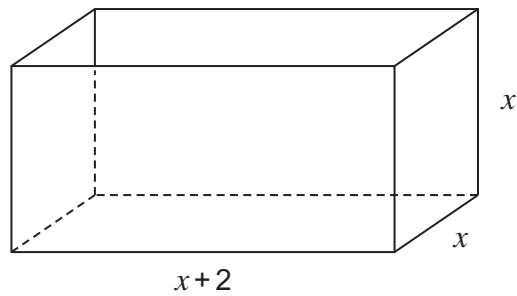
Use ruler and compasses to construct the position of the path.

(2 marks)

Turn over for the next question



- 7 A storage box is a cuboid.



The formula for the volume, $V\text{m}^3$, is

$$V = x^3 + 2x^2$$

The volume is 5m^3 .

Use trial and improvement to work out the value of x .
Give your answer to **two** decimal places.

Use the table opposite for your trials.



x	$x^3 + 2x^2$	V	Comment
1.3	$1.3^3 + 2 \times 1.3^2$ $= 2.197 + 3.38$	5.577	Too big

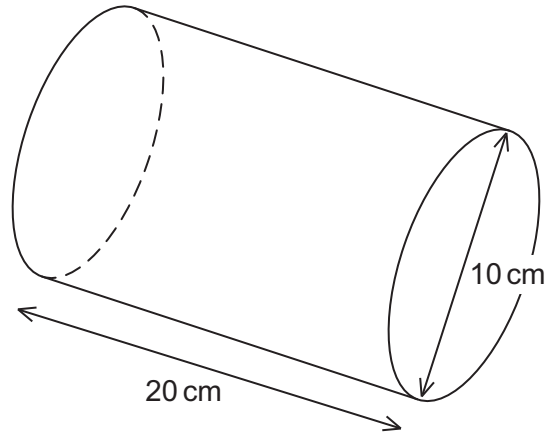
$x = \dots\dots\dots$ m (4 marks)

4

Turn over ►



8 A cylindrical bag has diameter 10 cm and length 20 cm.



The bag is made from three pieces of material.

Two pieces are circles.
One piece is a rectangle.

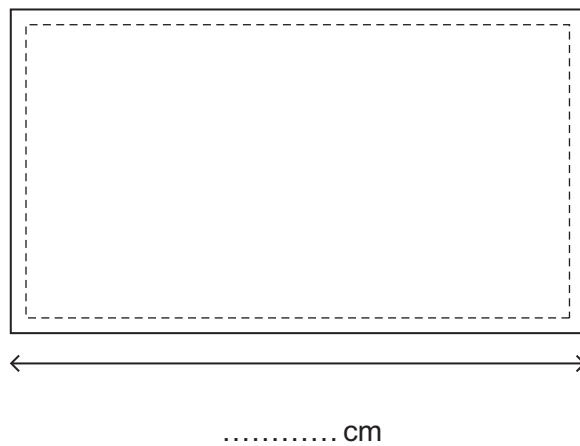
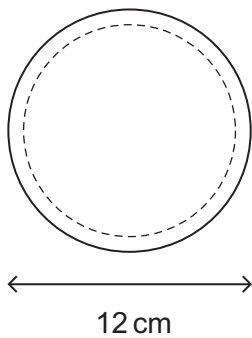
Each piece has a border of width 1 cm, added on to each edge, to allow the pieces to be joined.

8 (a) Write the dimensions of the rectangle on the diagram below.

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Not drawn
accurately

(3 marks)



8 (b) The three pieces are cut from a roll of material that is 50 cm wide.

On the diagram, show how the three pieces can be cut from the roll so that the minimum length of material is used.

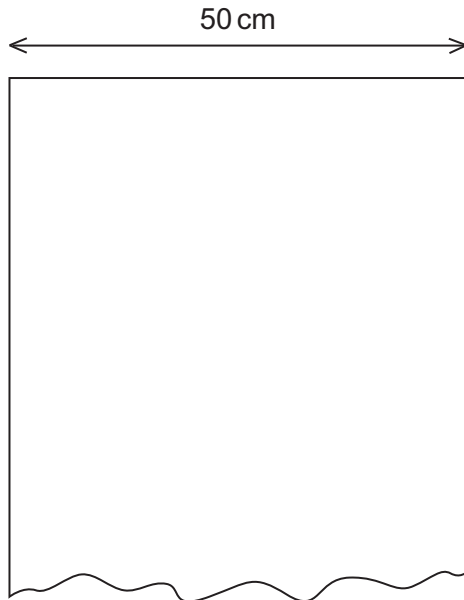
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(2 marks)

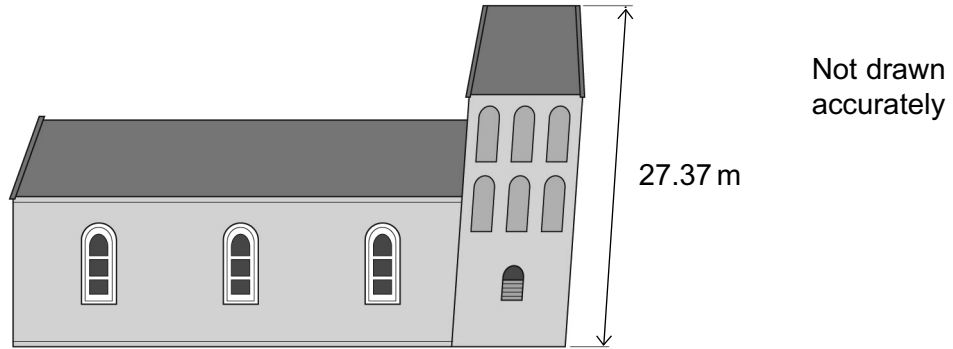


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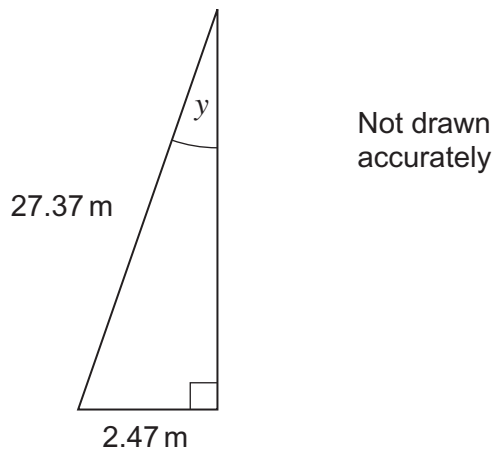
Turn over for the next question



9 A church tower leans at an angle.



The diagram below shows the angle, y , at which the tower leans.



Work out angle y .

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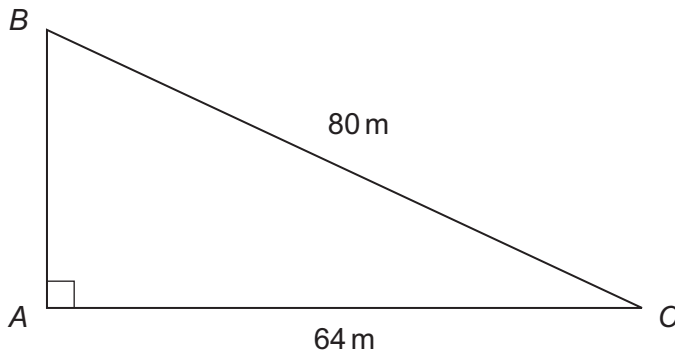
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Answer degrees (3 marks)



10 This triangular plot of land is for sale.



Not drawn
accurately

The land is sold for £ 6400 per acre.
1 acre = 4047 m²

Work out the cost of the land.
Give your answer to 2 significant figures.

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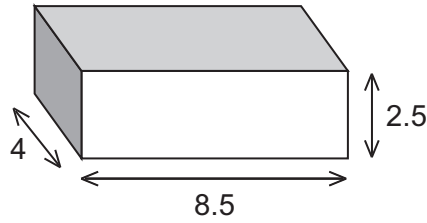
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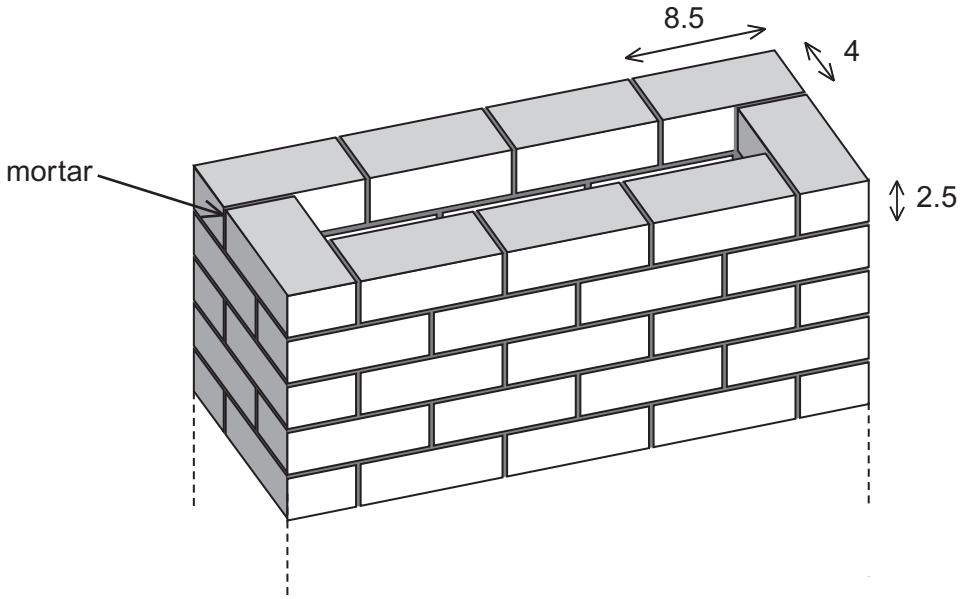
£ (6 marks)



11 Bricks are cuboids with dimensions, in inches, as shown.

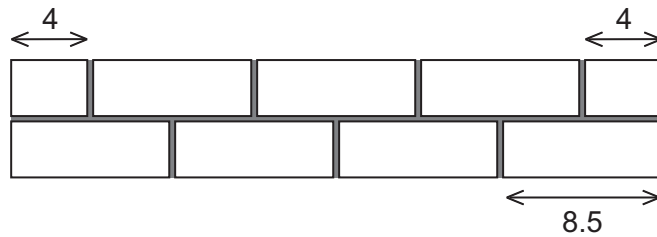


The diagram shows a wall.



The bricks are joined together using mortar. Each layer of mortar is the same thickness vertically and horizontally.

*11(a) A front elevation of part of the wall is shown.



Not drawn accurately

Show that the thickness of the mortar is 0.5 inches.

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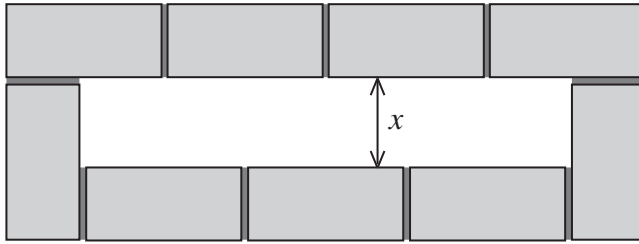
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(3 marks)



11 (b) A plan view of the wall is shown.



Not drawn accurately

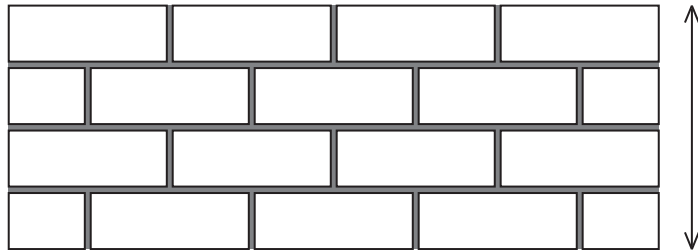
Work out the distance between the bricks, marked x on the diagram.

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Answer inches (3 marks)

11 (c) The front elevation of part of the wall has 4 rows of bricks.



Not drawn accurately

11 (c) (i) Work out the value of the height, h .

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Answer inches (2 marks)

11 (c) (ii) A front elevation of part of the wall has n rows of bricks.

Work out an expression for the height, in inches.
Give your answer in terms of n .

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Answer (2 marks)



12 The depth of water, d metres, in a harbour at a time, t hours after 12 noon, is given by

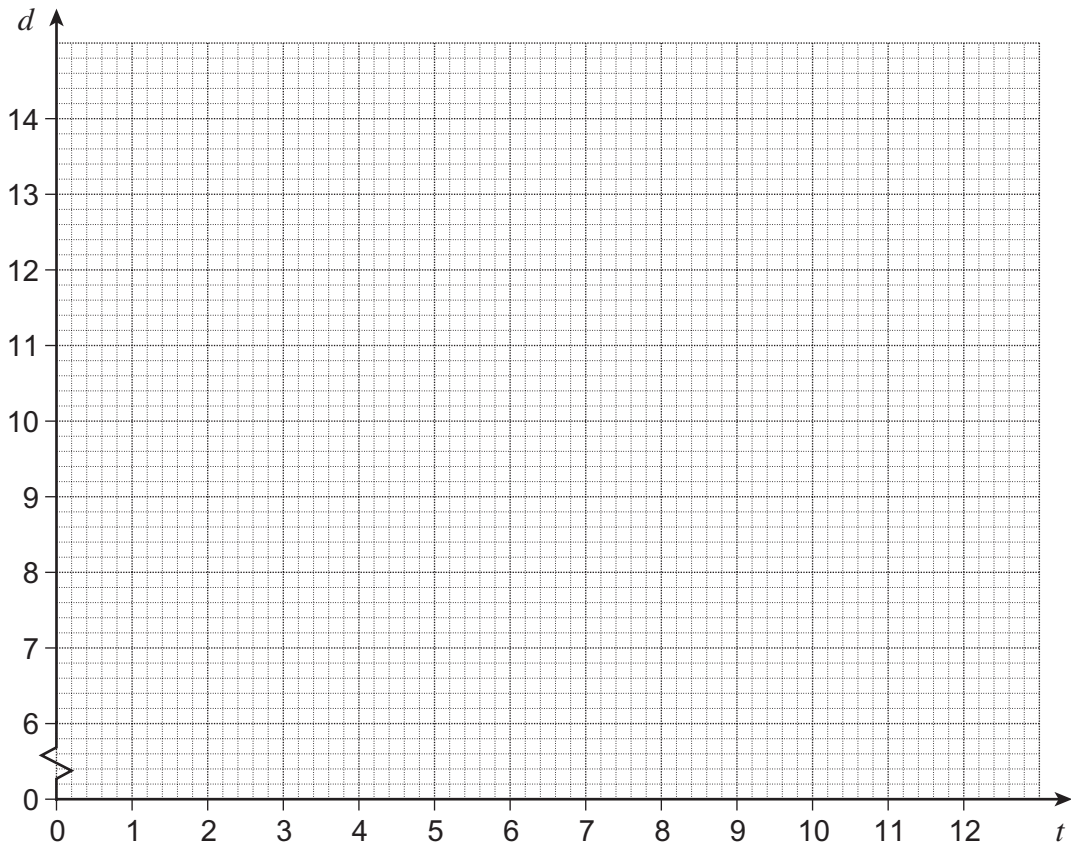
$$d = 10 - 4 \cos(30t)^\circ$$

12 (a) Complete the table of values.

t	0	1	2	3	4	5	6	7	8	9	10	11	12
d	6	6.5	8	10	12	13.5	14	13.5	12	10	8	6.5	

.....
(1 mark)

12 (b) On the grid, draw the graph of $d = 10 - 4 \cos(30t)^\circ$ for values of t from 0 to 12.



(2 marks)



12 (c) The depth of water must be at least 9 metres for a ship to enter the harbour.
At 12 noon a ship is waiting to enter the harbour.

Use the graph to estimate the **earliest** time the ship can enter.

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Answer (2 marks)

12 (d) A different ship enters the harbour at 4.15 pm.
The ship must leave the harbour before the depth of water falls below 9 metres.

Use the graph to estimate the maximum time the ship can stay in the harbour.
Give your answer in hours and minutes.

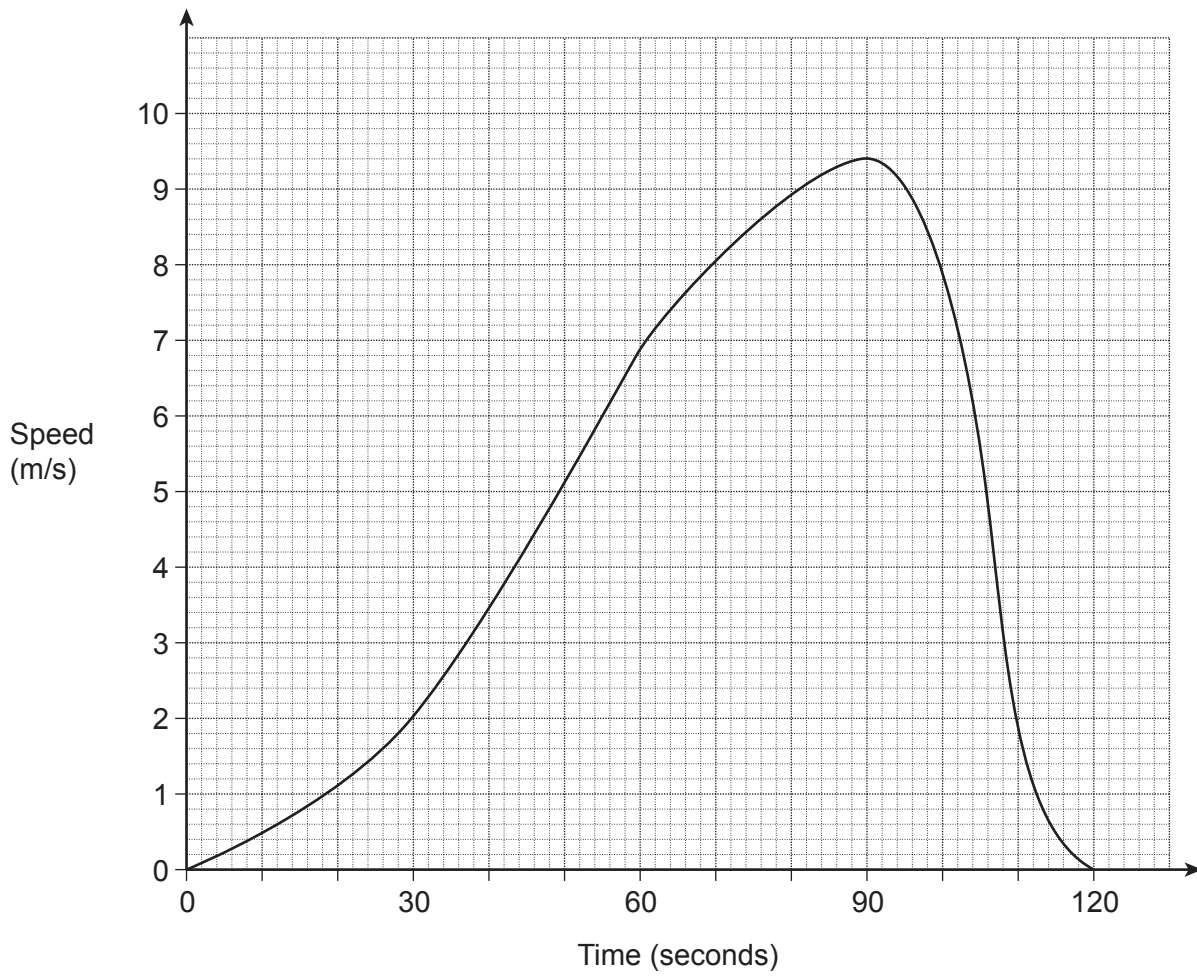
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Answerhoursminutes (3 marks)

Turn over for the next question



- 13 The graph shows the speed of a snowboarder for 2 minutes.



13 (a) Estimate the distance travelled by the snowboarder.
State the units of your answer.

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Answer (4 marks)

13 (b) Work out the gradient of the graph at 70 seconds.

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Answer m/s² (3 marks)

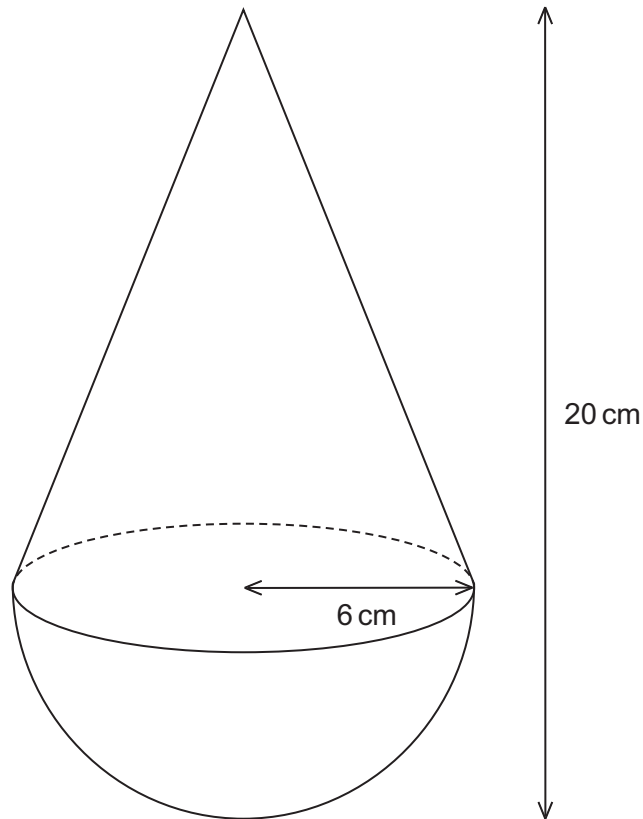
7

Turn over ►



14

A small toy is made by joining a solid cone and a solid hemisphere together. The cone and hemisphere each have radius 6 cm.



14 (a) Show that the volume of the toy is $312\pi \text{ cm}^3$.

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(4 marks)



14 (b) A larger version of the toy is made that has

- dimensions twice the size of the small toy
- mass 1.5 kilograms.

The toy is made from foam.

Work out the density of the foam.

Give your answer in grams per cubic centimetre.

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Answer g per cm³ (4 marks)

END OF QUESTIONS

8



There are no questions printed on this page

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**

