Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Pages	Mark
3	
4 – 5	
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24 – 25	
26 – 27	
TOTAL	

AQA

General Certificate of Secondary Education
Higher Tier
November 2013

Applications of Mathematics (Linked Pair Pilot) 93702H

Unit 2 Geometry and Measures

H

Wednesday 13 November 2013 9.00 am to 10.30 am

For this paper you must have:
- mathematical instruments.

You may use a calculator.

Time allowed
- 1 hour 30 minutes

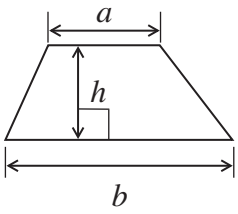
Instructions
- Use black ink or black ball-point pen. Draw diagrams in pencil.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this 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 4, 8 and 16.
  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 book.
- You are expected to use a calculator where appropriate.

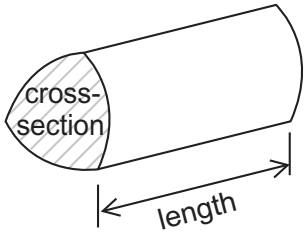
Advice
- In all calculations, show clearly how you work out your answer.

Formulae Sheet: Higher Tier

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

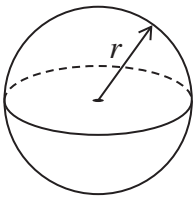


Volume of prism = area of cross-section × length



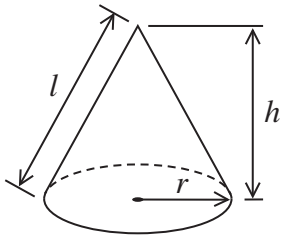
Volume of sphere = $\frac{4}{3}\pi r^3$

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



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

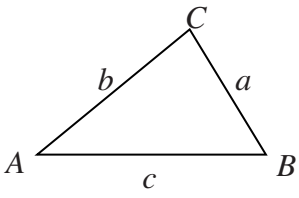
Curved surface area of cone = $\pi r l$



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 Circle the correct value in each part.

1 (a) 8 kilometres is about

5 miles 10 miles 15 miles 20 miles

(1 mark)

1 (b) 1 inch is about

0.5 cm 2.5 cm 4.5 cm 6.5 cm

(1 mark)

1 (c) 1 gallon is about

0.5 litres 2.5 litres 4.5 litres 6.5 litres

(1 mark)

2 Here is a formula for the distance, d metres, travelled by a cyclist in time, t seconds.

$$d = \frac{1}{2}t^2 + 3t \quad \text{for} \quad 0 \leqslant t \leqslant 15$$

The cyclist travels 100 metres.

Show by substitution, that the time taken is between 11 and 12 seconds.

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(2 marks)

5

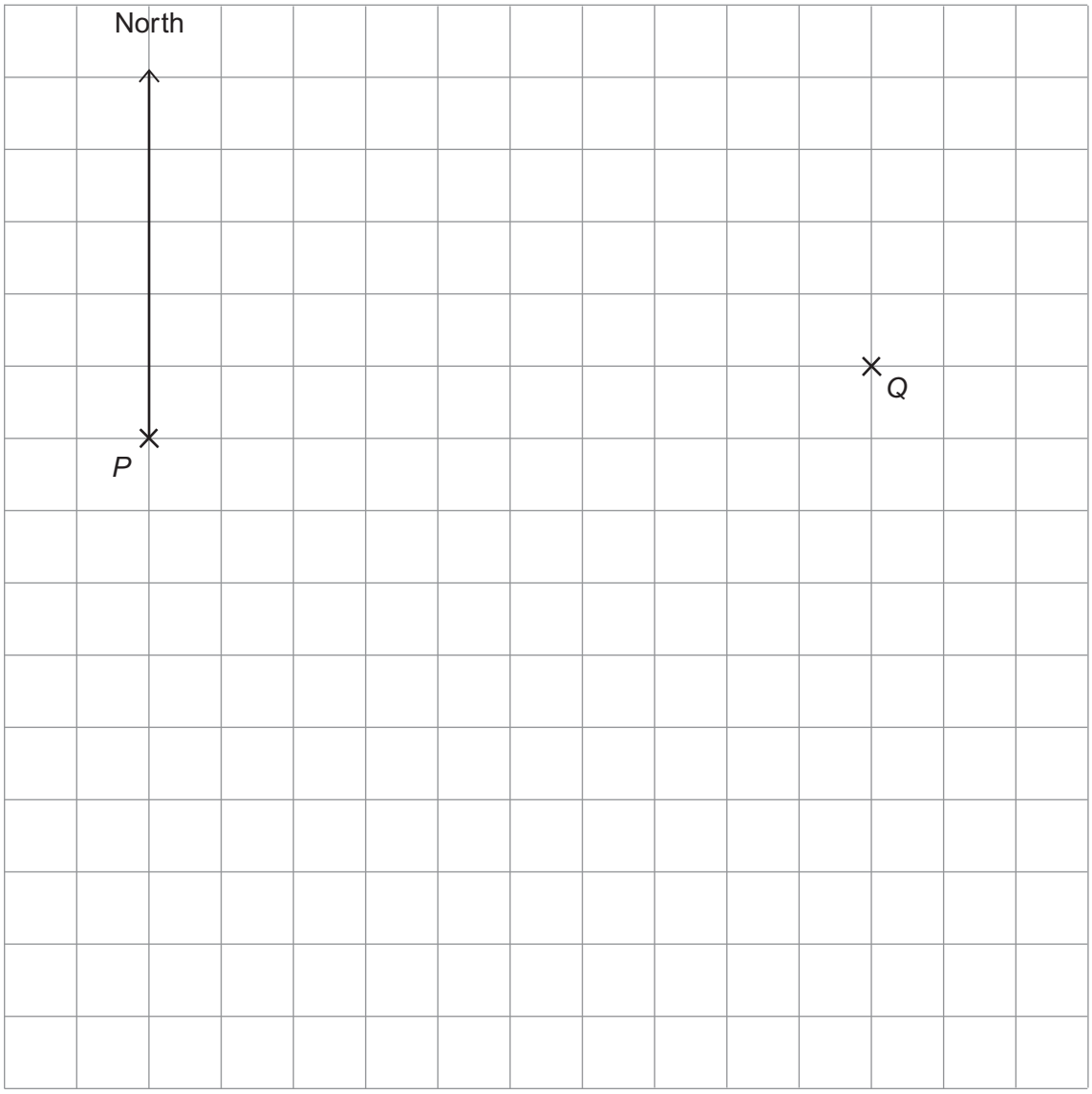
Turn over ▶

3 Use a protractor, a ruler and compasses in this question.

A ship starts at *P* and sails directly to an island on a bearing of 115º
The island is 30 kilometres from *Q*.

On the scale drawing, show the **two** possible positions of the island.

Scale 1 cm represents 5 km



(3 marks)

4 48 rugby players need to stay at a hotel for one night.

Comfy Hotel	
Rooms for 2 people	Rooms for 3 people
£ 95 per room per night	£ 120 per room per night

4 (a) There are only 11 rooms for 3 people available.

Work out the **cheapest** total cost for 48 people to stay at the hotel for one night.

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£ ..... *(3 marks)*

***4 (b)**

Breakfast at Comfy Hotel
£ 8 per person
Groups of between 20 and 30 pay 10% less
Groups of more than 30 pay 15% less

All of the rugby players have breakfast.

Work out the total cost of breakfast.

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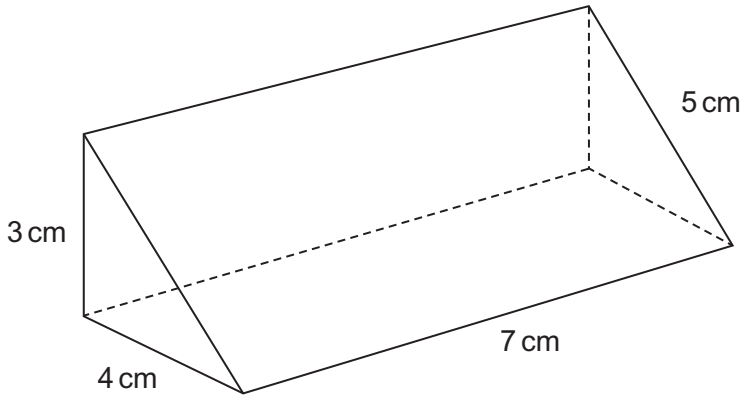
£ ..... *(4 marks)*

10

5 Ann makes boxes for confetti.

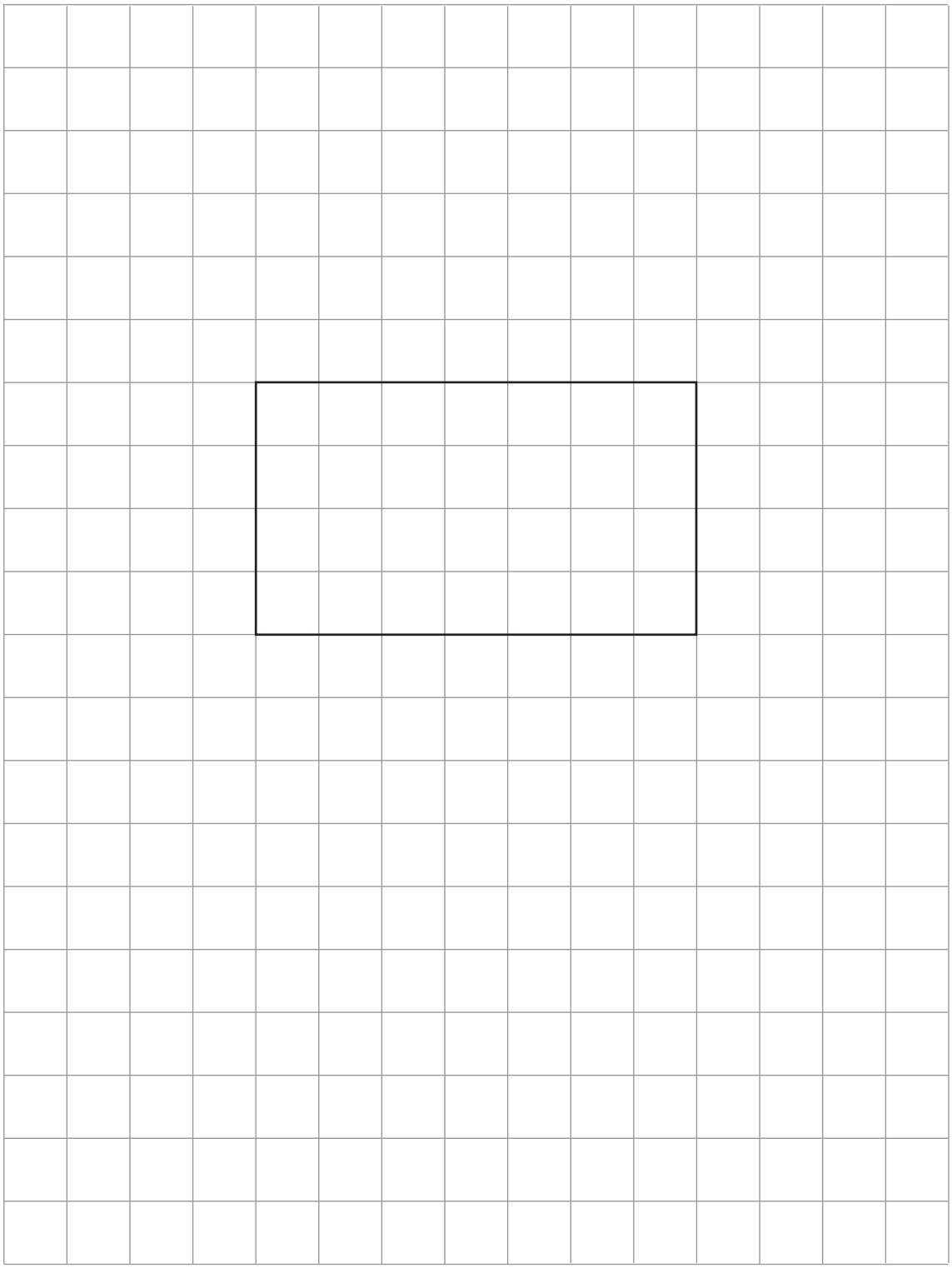
Each box is a triangular prism.

The cross-section is a right-angled triangle.



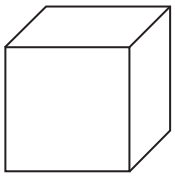
Complete an accurate net of the box on the grid.

(3 marks)



3

6 Building blocks are cubes of side 1 centimetre.



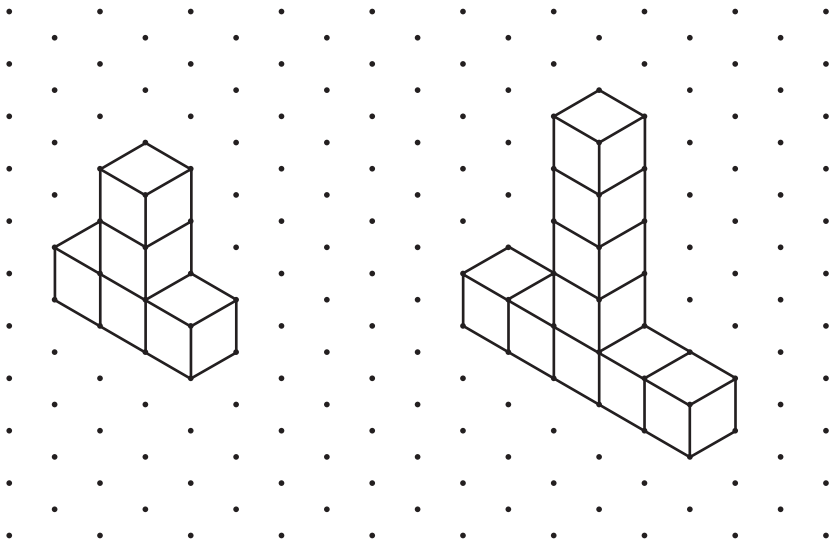
1 cm

Eli uses blocks to make T-shapes.

I will make T-shapes that have equal length and height.

Eli

The first two T-shapes are shown.



length 3 cm
height 3 cm

length 5 cm
height 5 cm

6 (a) Is it possible to make a T-shape using **exactly** 29 blocks?
Tick the correct box.

Yes ☐ No ☐

Give a reason for your answer.

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(2 marks)

6 (b) Work out an expression for the number of blocks in a T-shape that has length $(2n + 1)$ cm and height $(2n + 1)$ cm

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Answer ..... *(1 mark)*

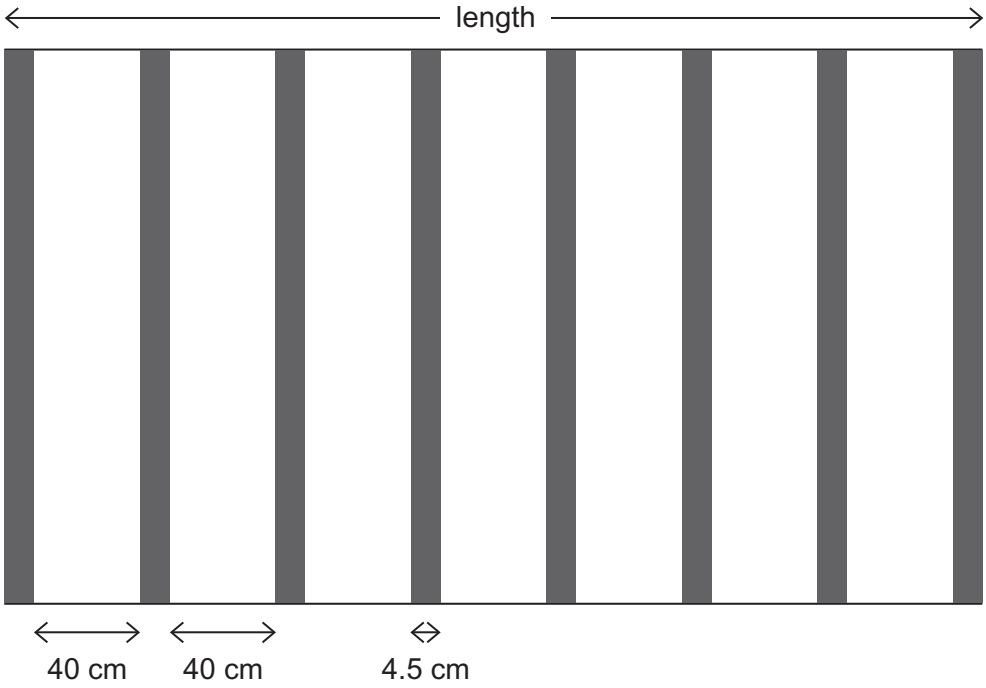
Turn over for the next question

3

7 Floor joists are wooden boards that support a floor in an upstairs room of a house.

The diagram shows 8 joists laid parallel to the shorter side of a rectangular room.

- Gaps between joists are 40 cm
- Each joist is 4.5 cm wide.



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7 (a) Show that the length of the room is 316 cm

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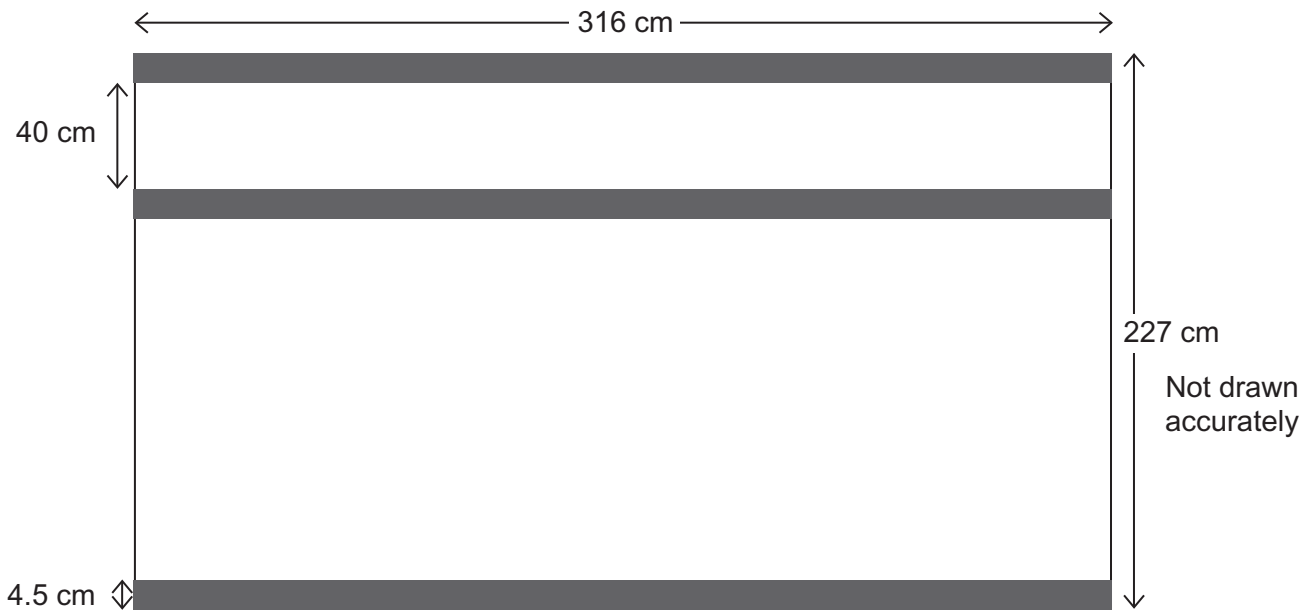
(2 marks)

Joists can also be laid parallel to the longer side of the room.
Three of the joists are shown on the diagram.



7 (b) Which way should the joists be laid so that the least amount of wood is used?
You **must** show your working.

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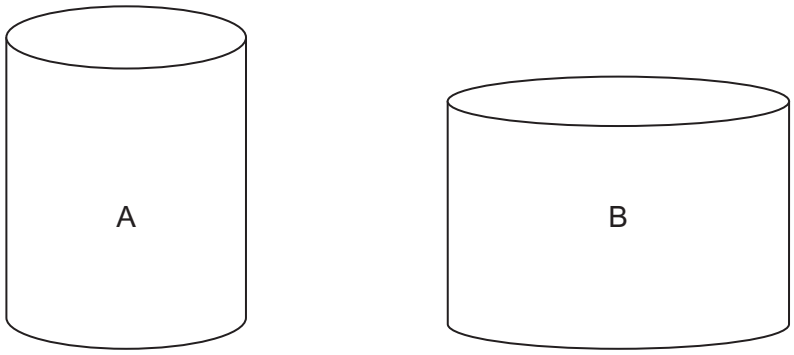
(5 marks)

7

Turn over ▶

8 Can A and Can B are hollow cylinders.



Radius 3.7 cm
Height 10.9 cm

Radius 6.1 cm
Height 4 cm

***8 (a)** Show that, to 2 significant figures, the cans have the same volume.

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(3 marks)

8 (b) Each can consists of a top, a base and a curved surface.
The cans are made of metal of the same thickness.

Which can is made from the least amount of metal?
You **must** show your working.

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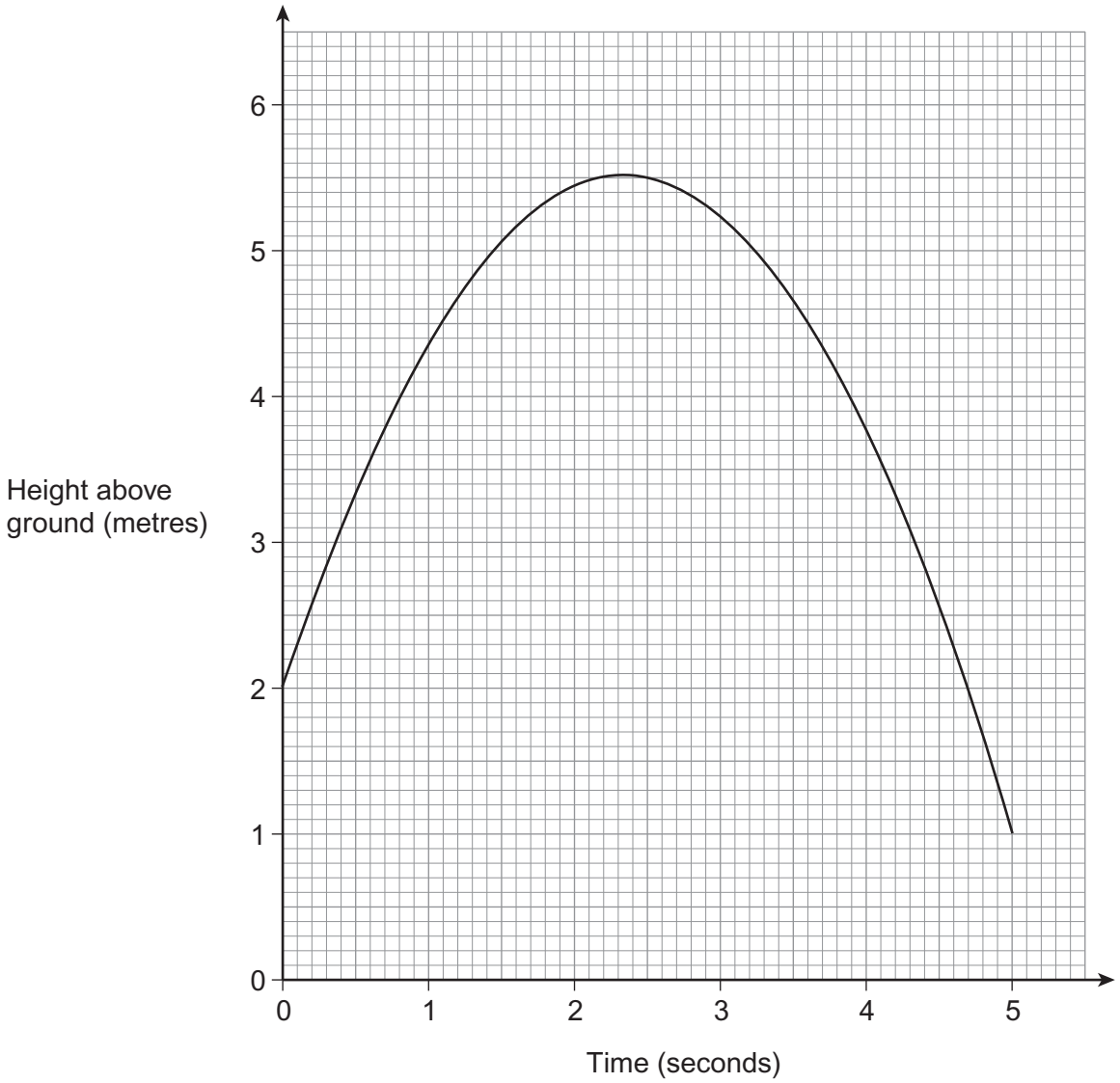
Answer ..... *(4 marks)*

Turn over for the next question

7

9 Asif throws a cricket ball to Ben.
The ball is in the air for 5 seconds.
The graph shows the height of the ball above the ground.



9 (a) Give a reason why the graph shows that Ben catches the ball.

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(1 mark)

9 (b) After how many seconds is the ball at its greatest height?

Answer ..... seconds *(1 mark)*

9 (c) What is the greatest height of the ball?

Answer ..... metres *(1 mark)*

Turn over for the next question

3

10 A subject has two examination papers.
There is a non-calculator paper and a calculator paper.

The ratio of the number of marks on the papers is

non-calculator : calculator = 9 : 11

The total number of marks for the two papers is 120

Work out the number of marks on the calculator paper.

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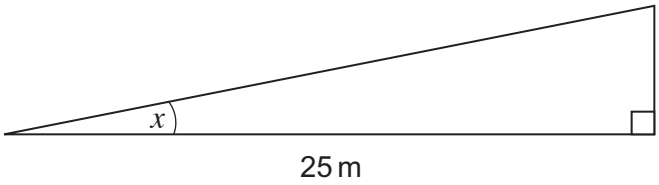
Answer ..... *(3 marks)*

11 (a) A ramp for hand-propelled wheelchairs is shown.



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Work out the size of angle x to 1 decimal place.

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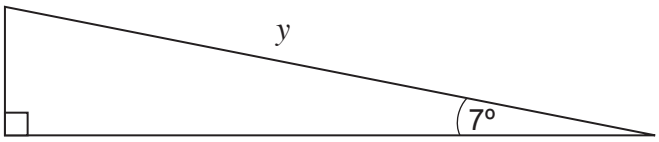
Answer ..... degrees *(4 marks)*

11 (b) A ramp for powered wheelchairs is shown.



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Work out length y.

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Answer ..... m *(3 marks)*

10

12 A painting has a value of £2000

The value increases at a rate of 8% per year.

The value, V pounds, of the painting after x years is

$$V = 2000 \times 1.08^{x}$$

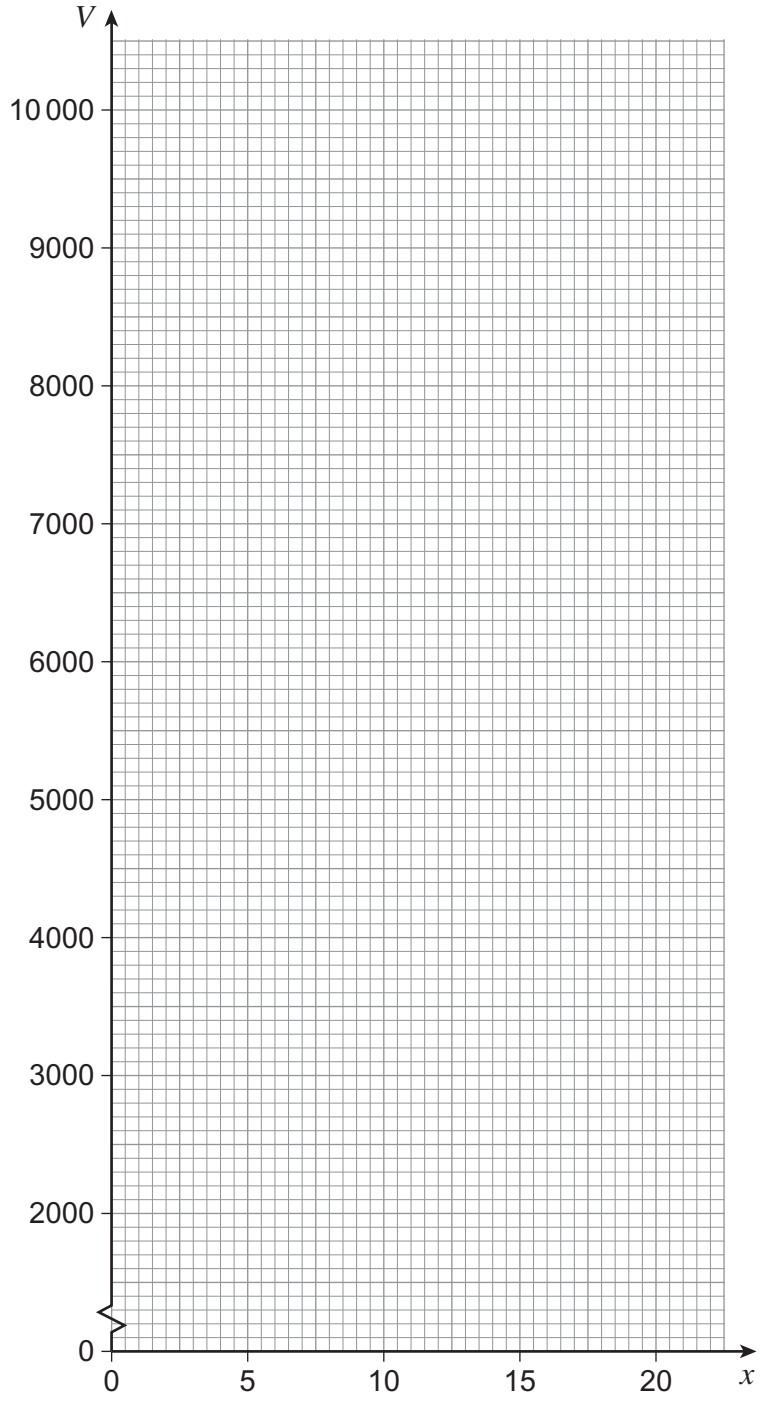
12 (a) Complete the table of values.

Values of V are given to the nearest £100

x	0	5	10	15	20
V	2000	2900	4300	6300	

(1 mark)

12 (b) Draw the graph of $V = 2000 \times 1.08^x$ for x values from 0 to 20



(2 marks)

12 (c) Use the graph to estimate the number of years it takes for the painting to have a value of £ 5000
You **must** show your working.

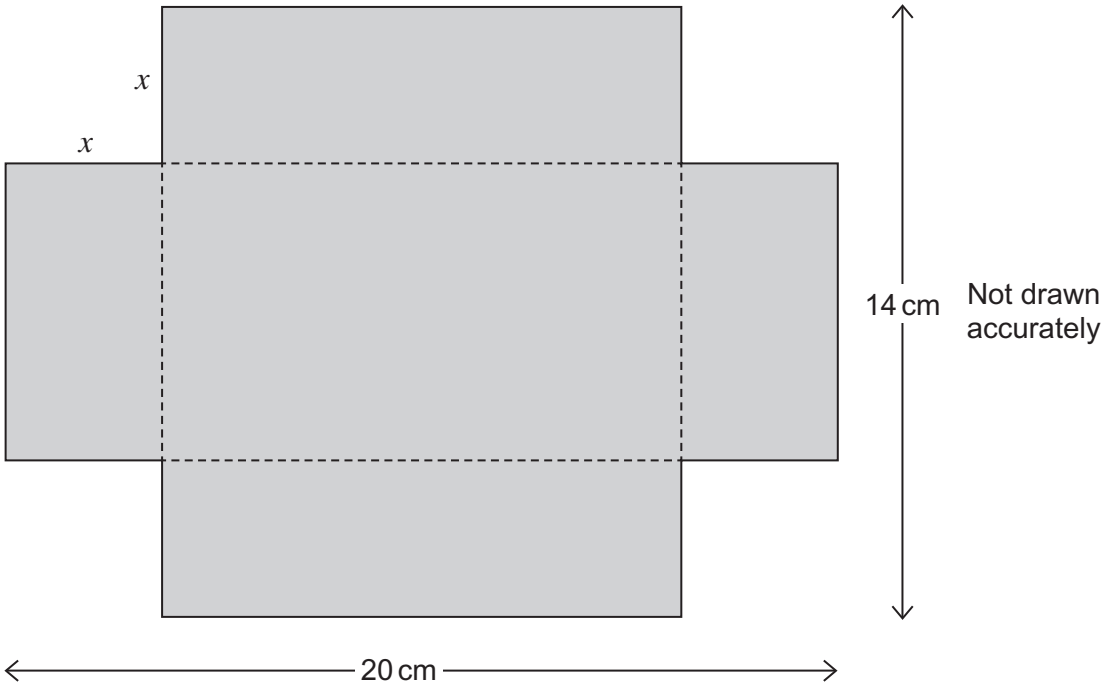
Answer ..... years *(2 marks)*

5

Turn over ▶

13 A rectangular piece of card measures 20 cm by 14 cm

Squares of side length x cm are cut from the four corners of the card.



The remaining card is folded along the dotted lines to make a box without a lid.

13 (a) The length of the box is $(20 - 2x)$ cm

Write down an expression for the width of the box.

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Answer ..... cm *(1 mark)*

13 (b) The length of the box is **double** its width.

Work out the volume of the box.

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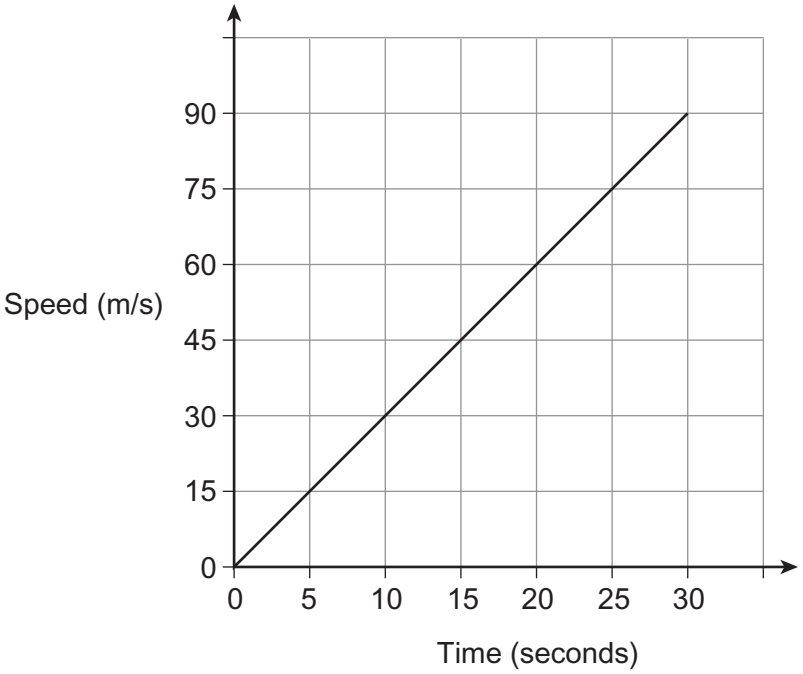
Answer ..... cm^3 *(6 marks)*

7

14 A plane accelerates along a runway for 30 seconds.

The graph shows the speed-time graph for the plane.



14 (a) The plane takes off after 30 seconds.

What is the speed of the plane when it takes off?

Answer ..... m/s *(1 mark)*

14 (b) Work out the distance the plane travels on the runway.

Give your answer in kilometres.

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Answer ..... km *(3 marks)*

14 (c) Work out the acceleration of the plane.

State the units of your answer.

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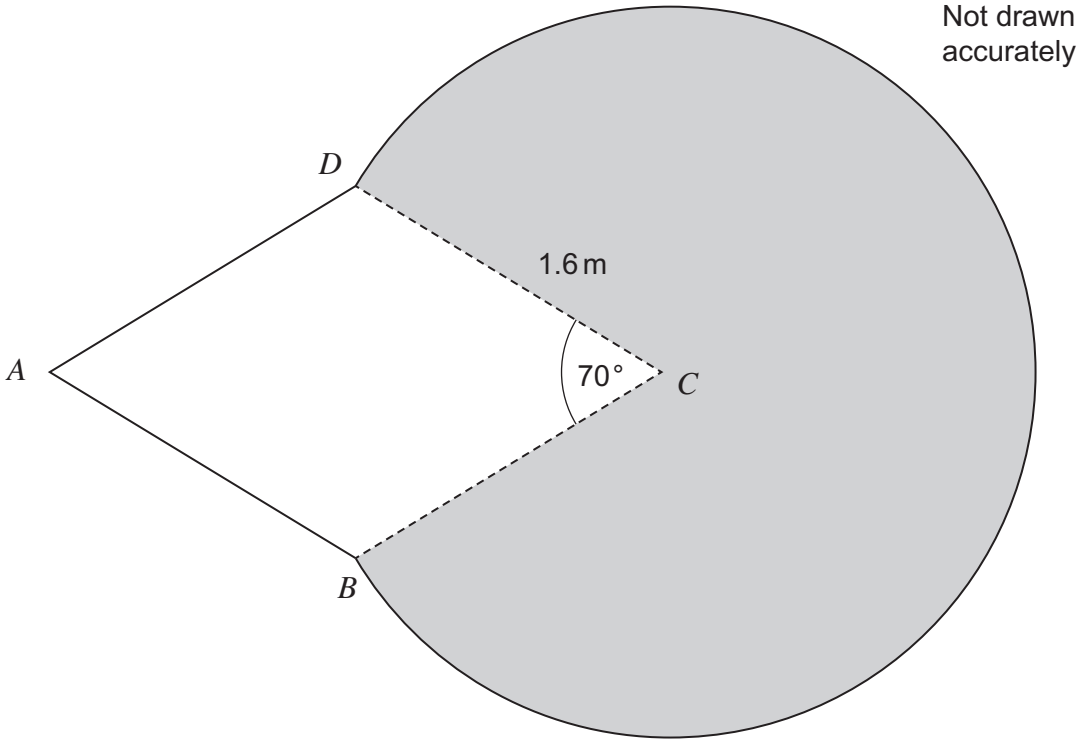
Answer ..... *(3 marks)*

Turn over for the next question

7

15 A logo for a bird sanctuary is shown.

BD is a major arc of a circle, radius 1.6 metres, centre C.
$ABCD$ is a rhombus.



15 (a) The shaded area is painted.

Work out the area that is painted.

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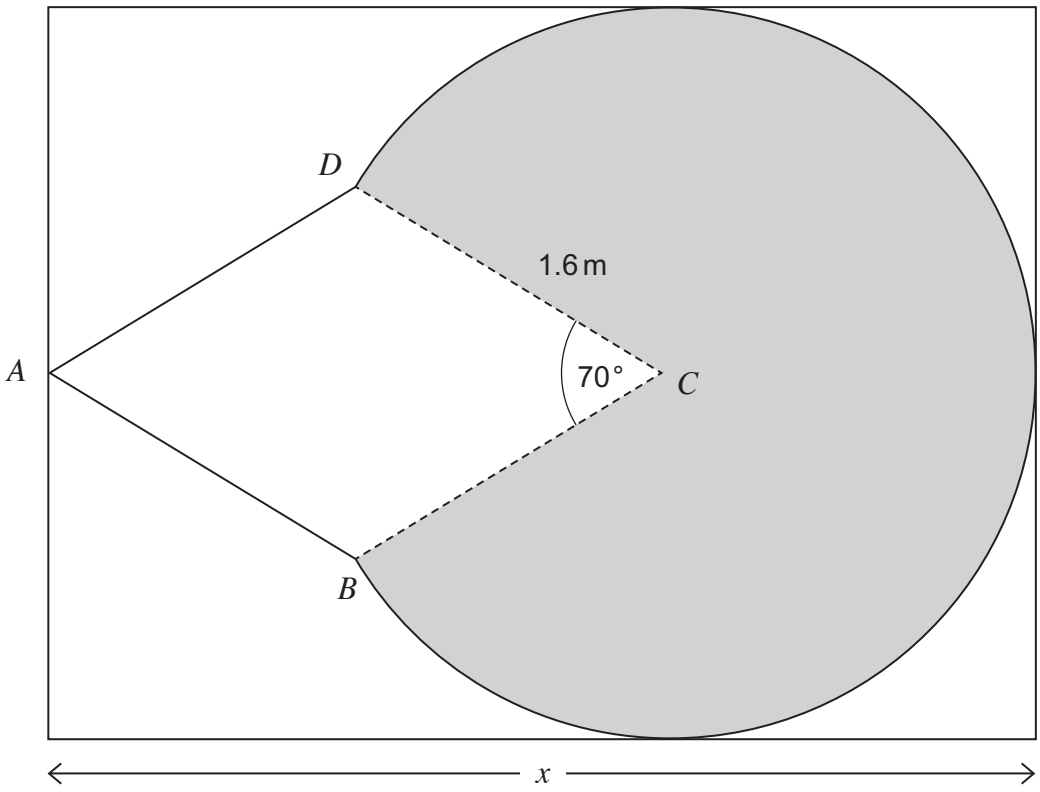
Answer ..... m^2 *(3 marks)*

15 (b) The logo just fits on a rectangular board.



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Work out the length, x, of the rectangular board.

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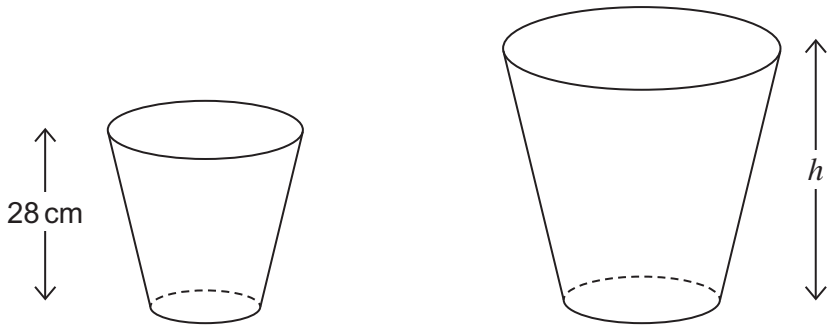
Answer ..... m *(4 marks)*

7

16 Jim makes two sizes of bin.

They are similar shapes.



Small Large

The ratio of the **areas** of the bases of the bins is 4 : 9

16 (a) Work out the height, h, of the large bin.

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Answer ..... cm *(3 marks)*

***16 (b)** Jim says,

"The volume of the large bin is more than 3 times the volume of the small bin."

Is he correct?
You **must** show your working.

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(3 marks)

END OF QUESTIONS

6

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED