AQA

General Certificate of Secondary Education
Higher Tier
June 2014

Applications of Mathematics (Linked Pair Pilot)   93702H

H

Unit 2 Geometry and Measures

Friday 13 June 2014   9.00 am to 10.30 am

For this paper you must have:
- a calculator
- mathematical instruments.

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 5, 9 and 18
  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 = $\frac{1}{2}(a+b)h$
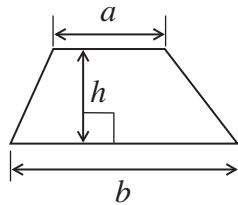
Volume of prism = area of cross section × length
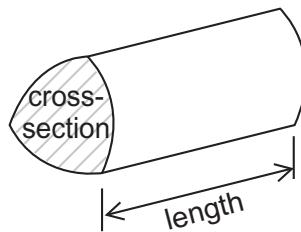
Volume of sphere = $\frac{4}{3}\pi r^3$

Surface area of sphere = $4\pi r^2$
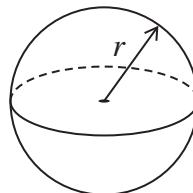
Volume of cone = $\frac{1}{3}\pi r^2 h$

Curved surface area of cone = $\pi r l$
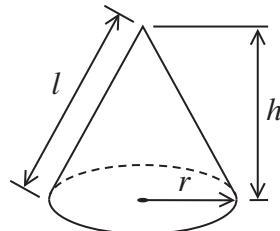
In any triangle ABC

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

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

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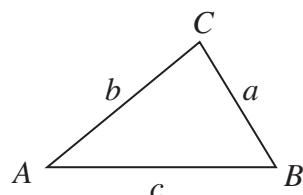
The Quadratic Equation

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

Pancakes for 6 people
50 g flour
25 g butter
1 egg
150 ml milk

How much milk is needed to make pancakes for 15 people?

[3 marks]

....

....

....

....

Answer .... ml

2 The centre circle on a football pitch has radius 9.15 metres.

Work out the circumference of the circle.

[2 marks]

....

....

Answer .... metres

5

Turn over ▶

3 Here is a metal badge in the shape of a kite.
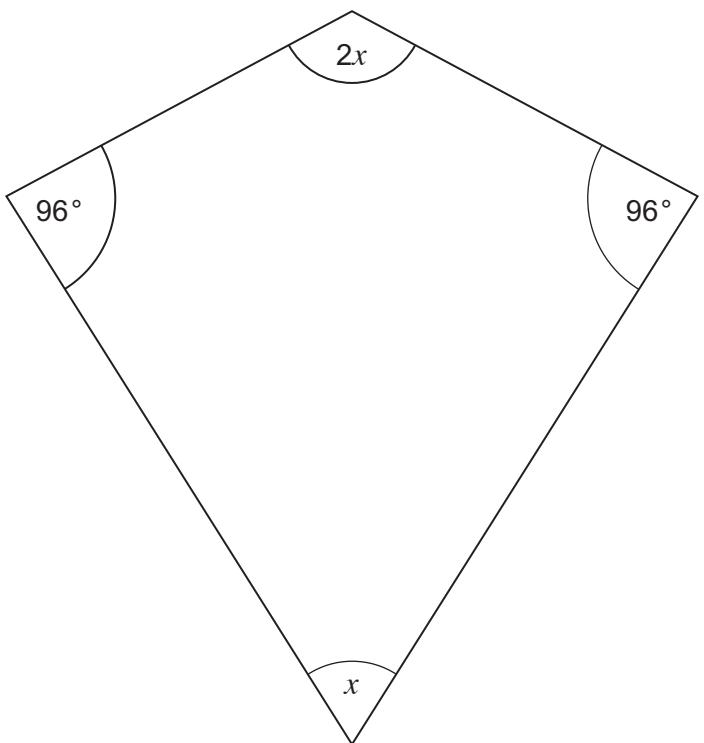
Not drawn accurately

3 (a) Set up and solve an equation to work out the value of x

[3 marks]

....

....

....

....

....

....

$x =$ ....

3 (b) The badge is cut from a rectangular sheet of metal as shown.
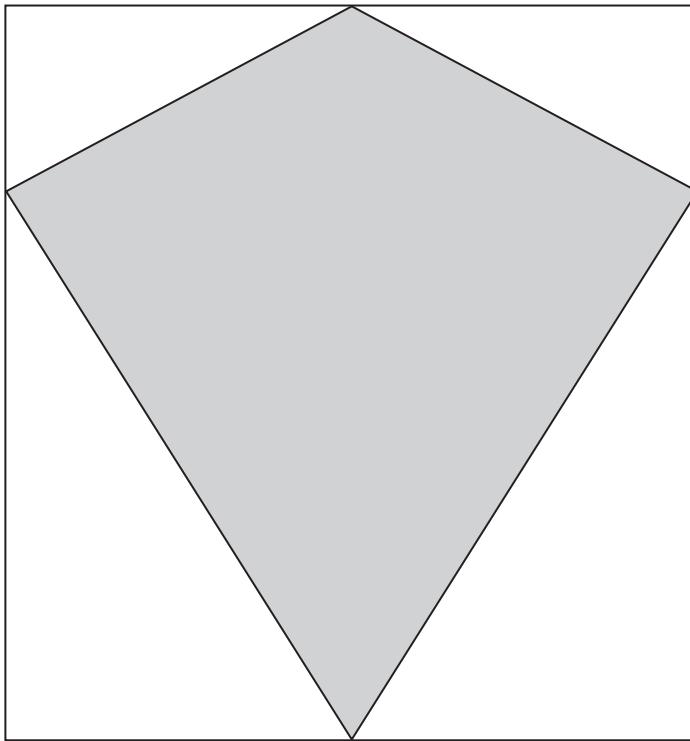
Not drawn accurately

Cathy says,

"The area of the badge is **exactly** half the area of the rectangle."

Give reasons why she is correct.
You may use the diagram to help you.

[2 marks]

....

....

....

....

....

Turn over ▶

4   A conversion graph for speeds is shown.

Kilometres per hour (vertical axis), Miles per hour (horizontal axis)
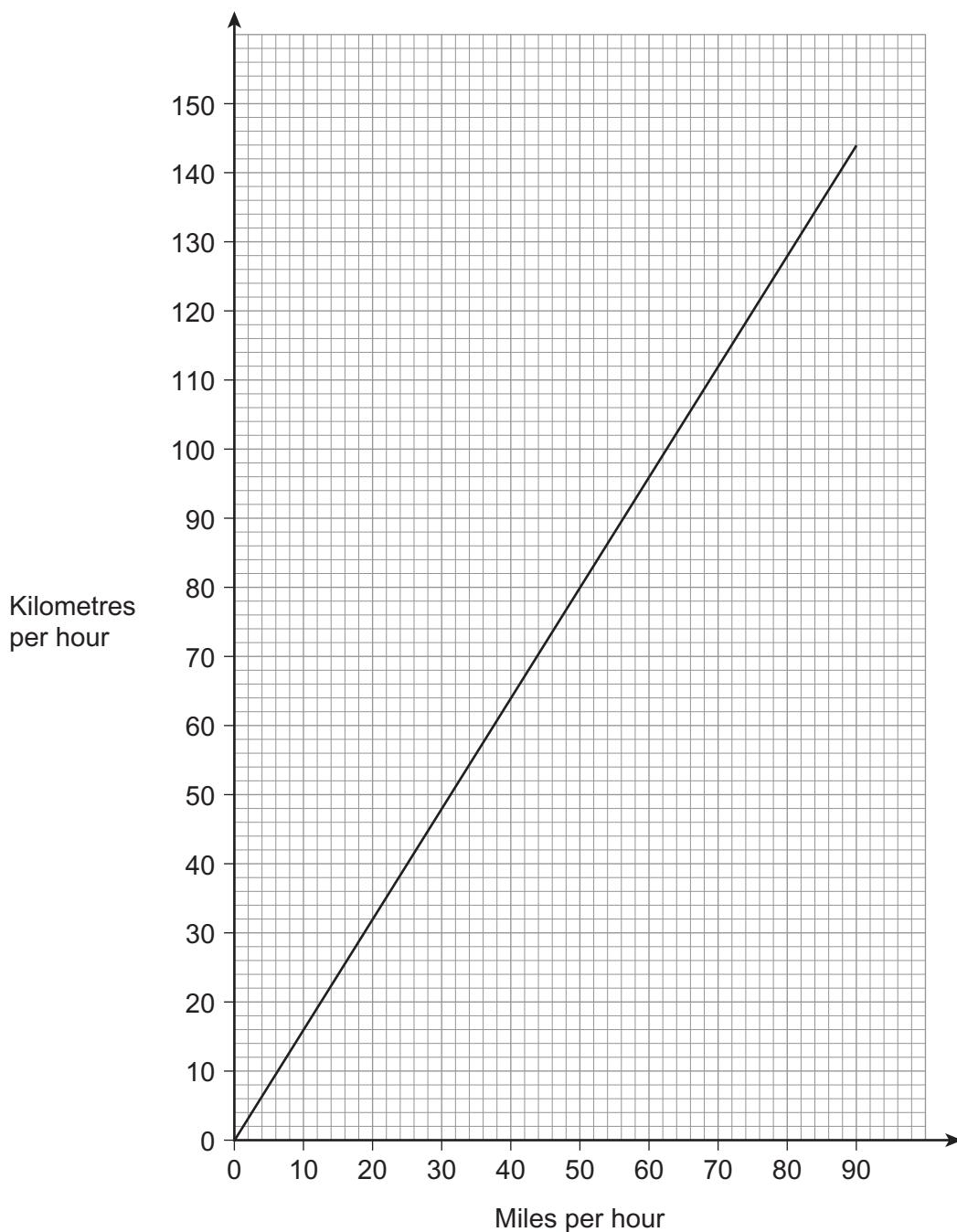
Tom is on holiday in France.

He leaves Calais at 10.45 am
The distance from Calais to Paris is 288 kilometres.

He says,

"If I drive at an average speed of 60 **miles per hour** I will be in Paris before 2 pm"

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

[4 marks]

....

....

....

....

....

....

....

....

Turn over for the next question

4

Turn over ▶

5 The diagram shows the positions of towns *A* and *B*

North

Not drawn accurately

116°

B

North

x

A
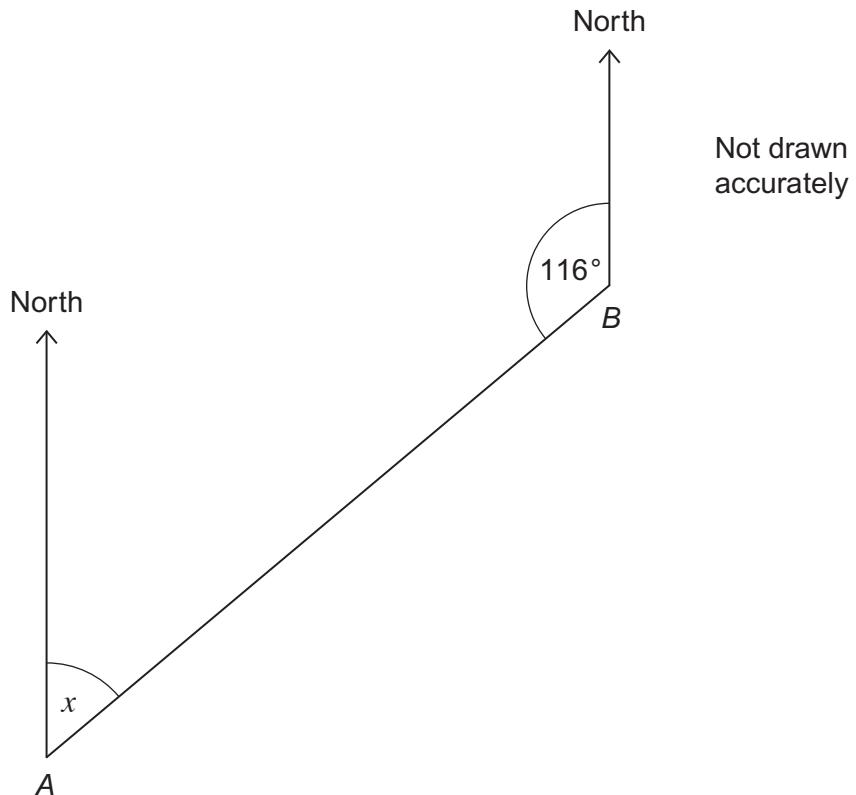
5 (a) Circle the value, in degrees, of angle *x*.

[1 mark]

44   46   54   56   64   66

*5 (b) Write down the 3-figure bearing of *B* from *A*.

[1 mark]

Answer .... degrees

5 (c)   Town *C* is due North of *A*.
Angle *ACB* = x

North   North

C

x

Not drawn
accurately

B

x

A
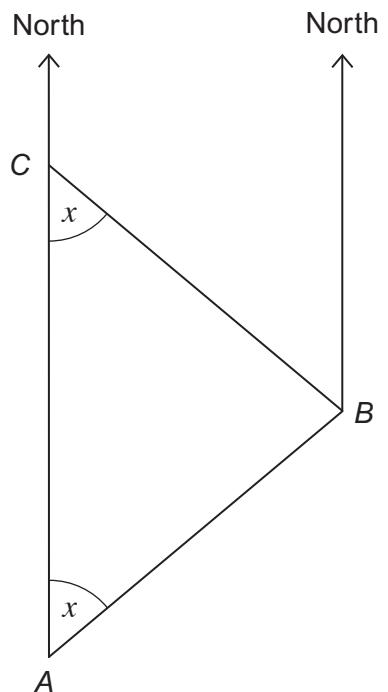
Work out the 3-figure bearing of *C* from *B*.

[3 marks]

....

....

....

Answer .... °

Turn over for the next question

5

6 This box is in the shape of a prism.
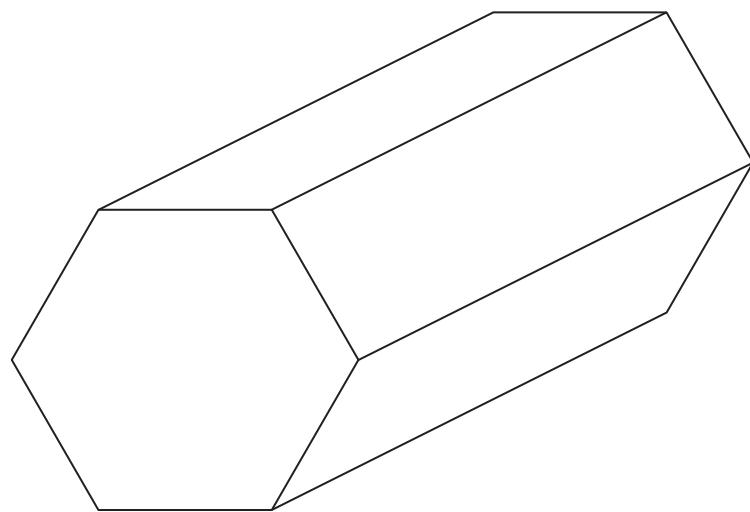
6 (a) The cross section is two identical trapeziums joined together as shown.

3.4 cm

Not drawn accurately

5 cm

6 cm

3.4 cm
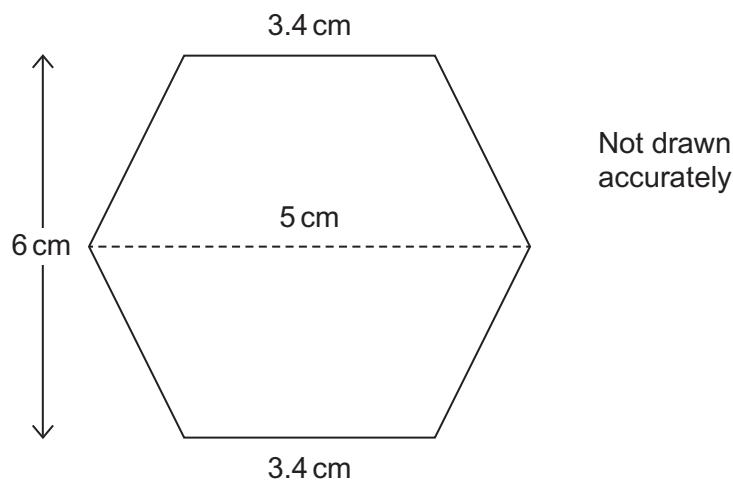
Work out the area of the cross section.

[3 marks]

....

....

....

....

Answer .... cm^2

6 (b)   The volume of the box is 360 cm^3

Work out the length of the box.

[2 marks]

....

....

....

Answer .... cm

Turn over for the next question

5

Turn over ▶

7   A sculpture consists of a cuboid on top of a cube.
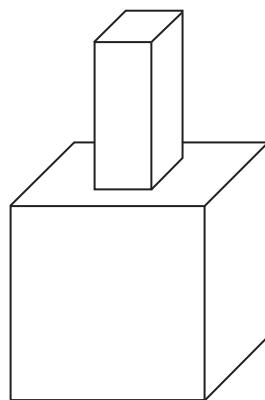
The length of the cube is x metres.
The cuboid measures 2 metres by 2 metres by x metres.

The total volume, V, in cubic metres is given by $V = x^3 + 4x$

Here is the graph of $V = x^3 + 4x$ for values of x from   0 to 4
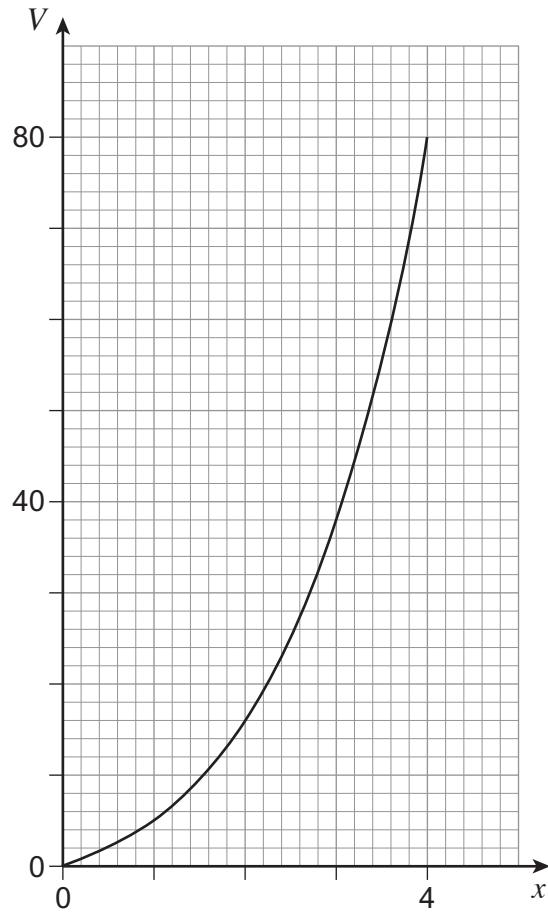
12

7 (a) The sculpture has a total volume of 50 cubic metres.

Show **on the graph** that the length of the cube is between 3 metres and 4 metres.

[2 marks]

7 (b) $x^3 + 4x = 50$

Use trial and improvement to work out the value of x to 1 decimal place.
You **must** show your working in the table.

[3 marks]

x	$x^3 + 4x$	V	Comment
4	$4^3 + 4 \times 4$ $= 64 + 16$	80	Too big

$x =$ ....

5

8 Mr Brown makes a rectangular chicken run, *PQRS*
One side is an existing wall.
The other three sides are made from 70 metres of fencing.

Existing wall

P   Q

Chicken run

S   R
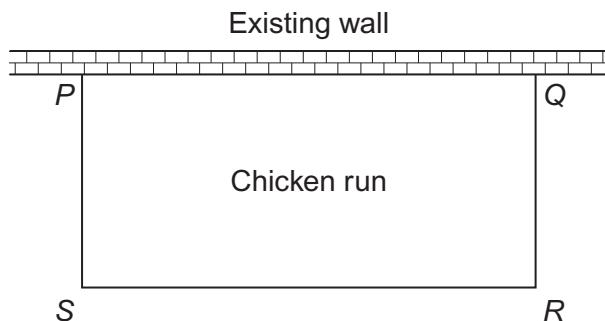
Not drawn accurately

8 (a) When *PS* = 22 metres, work out the area of the chicken run.

[2 marks]

....

....

....

Answer .... m^2

8 (b) When *PS* = *x* metres, the area of the chicken run, *A* square metres, is given by
$A = 70x - 2x^2$

Here is a table of values for $A = 70x - 2x^2$

x	0	5	10	15	17.5	20	25	30	35
A	0	300	500	600	612.5	600	500	300	0

Draw the graph of $A = 70x - 2x^2$ for values of *x* from 0 to 35

[2 marks]
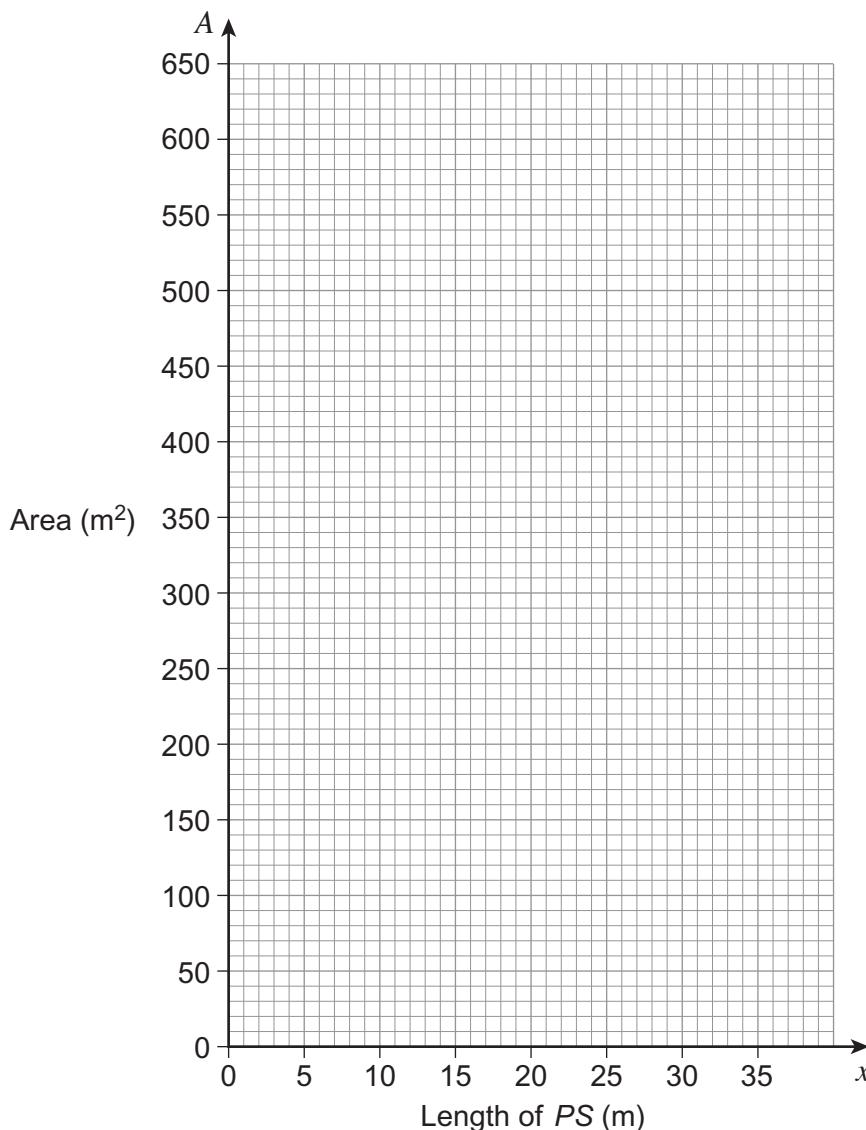
8 (c) Mr Brown makes the chicken run so that it has the **largest possible** area.
On average, each chicken needs an area of 0.75 m² to live safely.

Work out the largest number of chickens that can live safely in the chicken run.
You **must** show your working.

[3 marks]

....

....

....

....

Answer ....

Turn over ▶

*9   You need a ruler and compasses to answer this question.

A map of an island is shown on the grid.
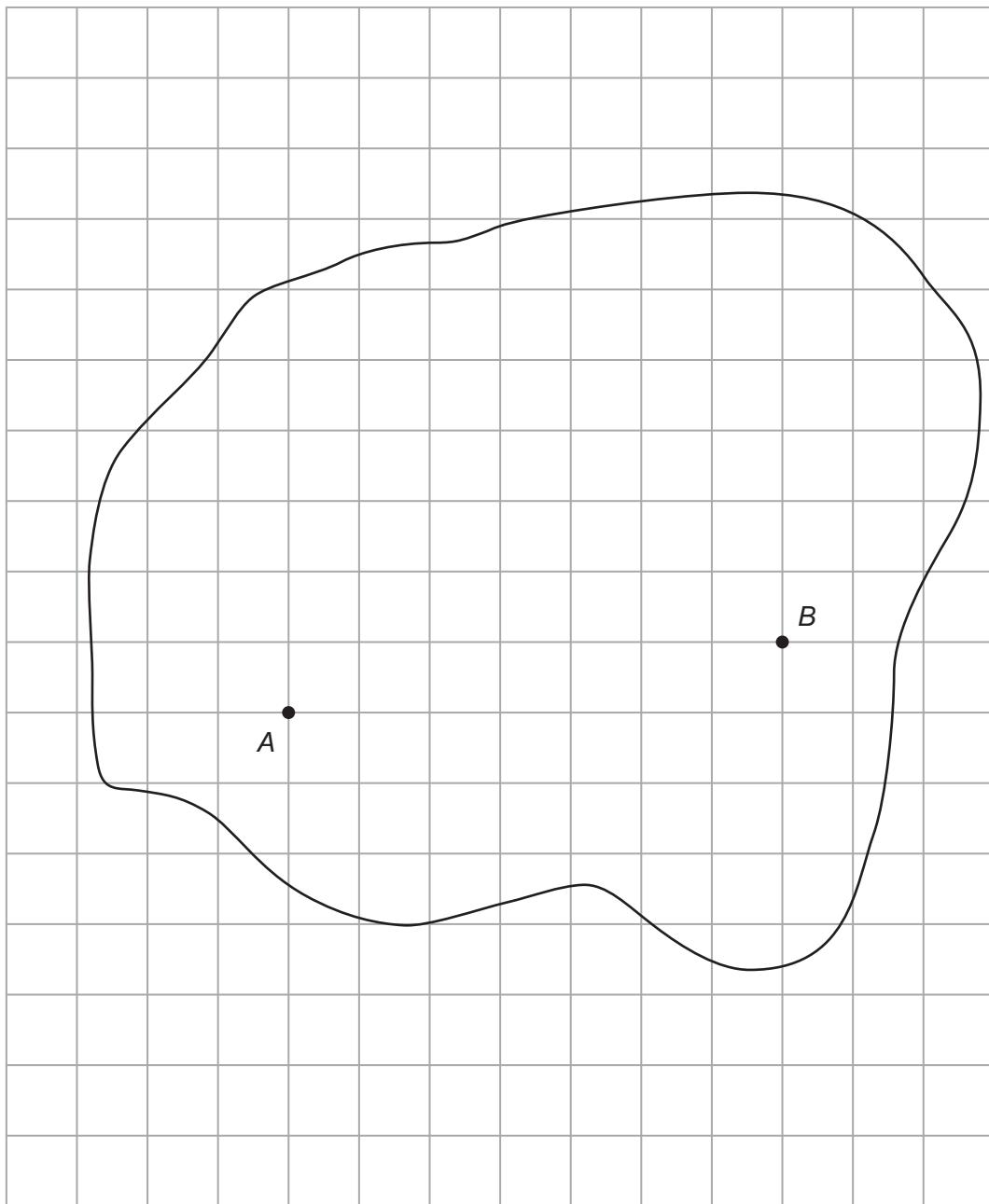
Treasure is buried on the island.
The treasure is the same distance from *A* as it is from *B*.

Construct a line on the map to show **all** the places where the treasure could be.

[3 marks]

10 Jenny buys packs of sausages and packs of bread rolls.
There are

25 bread rolls in a pack
8 sausages in a pack

She needs exactly **twice** as many sausages as bread rolls.

Work out the smallest number of each pack she could buy.

[3 marks]

....

....

....

....

....

....

....

Answer .... packs of bread rolls

.... packs of sausages

Turn over for the next question

6

Turn over ▶

11 Anika, Beth and Carmen each buy some bags of sweets.
Each bag contains x sweets.

- Anika buys 7 bags.

- Beth buys 5 bags.

- Carmen buys 2 bags.

I give Carmen
42 of my sweets.

Anika

I give Carmen
6 of my sweets.

Beth

Now we all have the
same number of sweets.
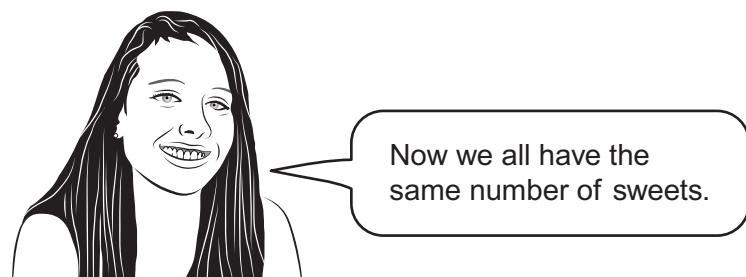
Carmen

Work out the value of x.
You **must** show your working.
Do **not** use trial and improvement.

[5 marks]

....

....

....

....

....

....

....

....

$x =$ ....

Turn over for the next question

5

Turn over ▶

12 A runner starts at *A*.
She follows this route.

$$A \rightarrow B \rightarrow C \rightarrow D \rightarrow A$$

Three of the distances are shown on the diagram.

Not drawn accurately

B

2.5 km

C

3.4 km

2 km

A

D
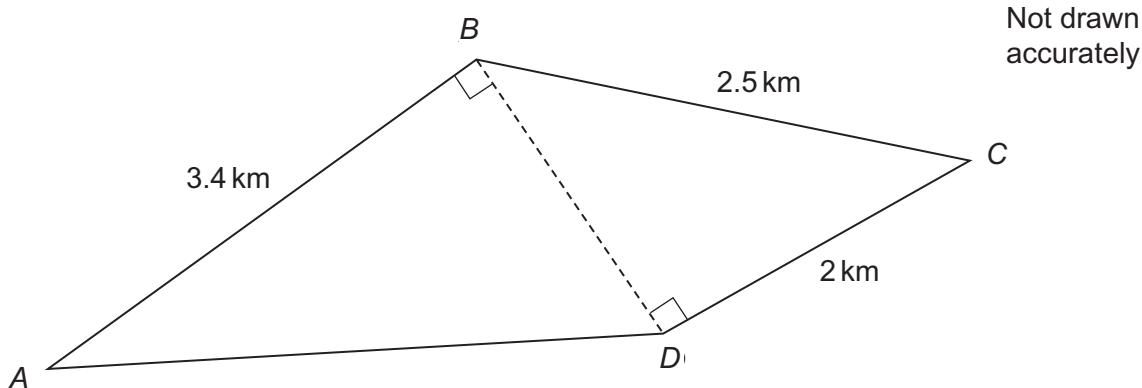
Work out the distance, in kilometres, from *D* to *A*.

[5 marks]

....

....

....

....

....

....

....

....

Answer .... km

Do not write outside the box

13 A paper filter is in the shape of a hollow cone of diameter 22 cm
The slant height of the cone is 18 cm
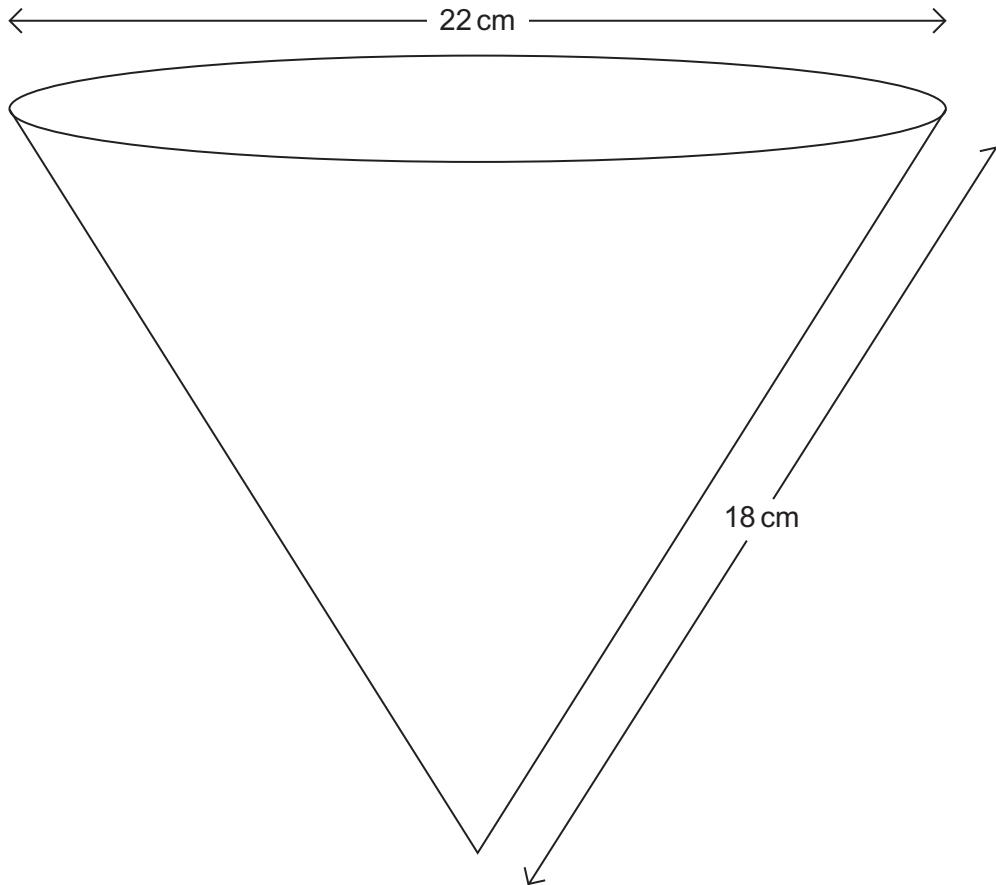
Work out the area of paper used to make the filter.
Give your answer to 2 significant figures.

[3 marks]

....

....

....

....

Answer .... cm^2

Turn over ▶

8

14 A penguin pool at a zoo consists of a rectangular prism joined to a semicircular prism.
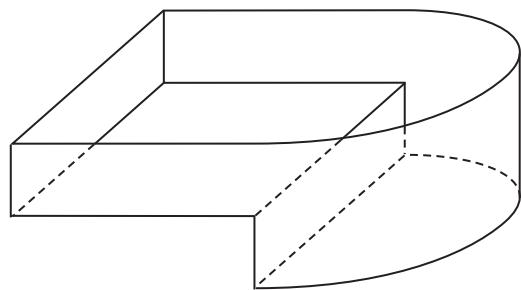
Here is a scale drawing of the plan view of the penguin pool.

Scale 1 centimetre represents 2 metres
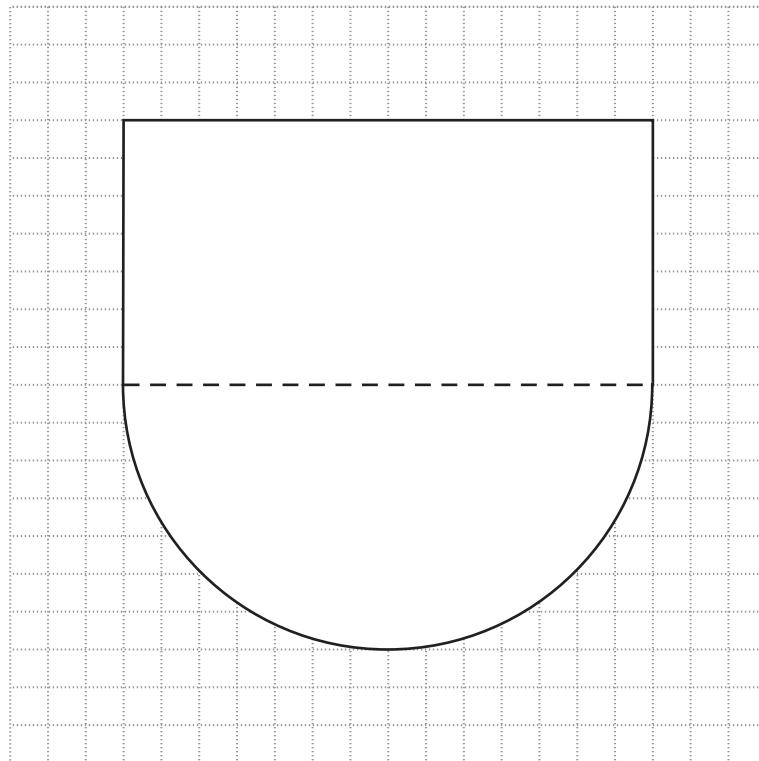
The water in the rectangular part of the pool is 1.5 metres deep.
The water in the semicircular part of the pool is 2.8 metres deep.

Work out the volume of water in the pool.

[5 marks]

....

....

....

....

....

....

....

....

....

....

....

....

Answer .... m³

5

Turn over ▶

15 The distance around a cycle track is 400 metres.

Robin cycles on the track.
Here is his speed-time graph.
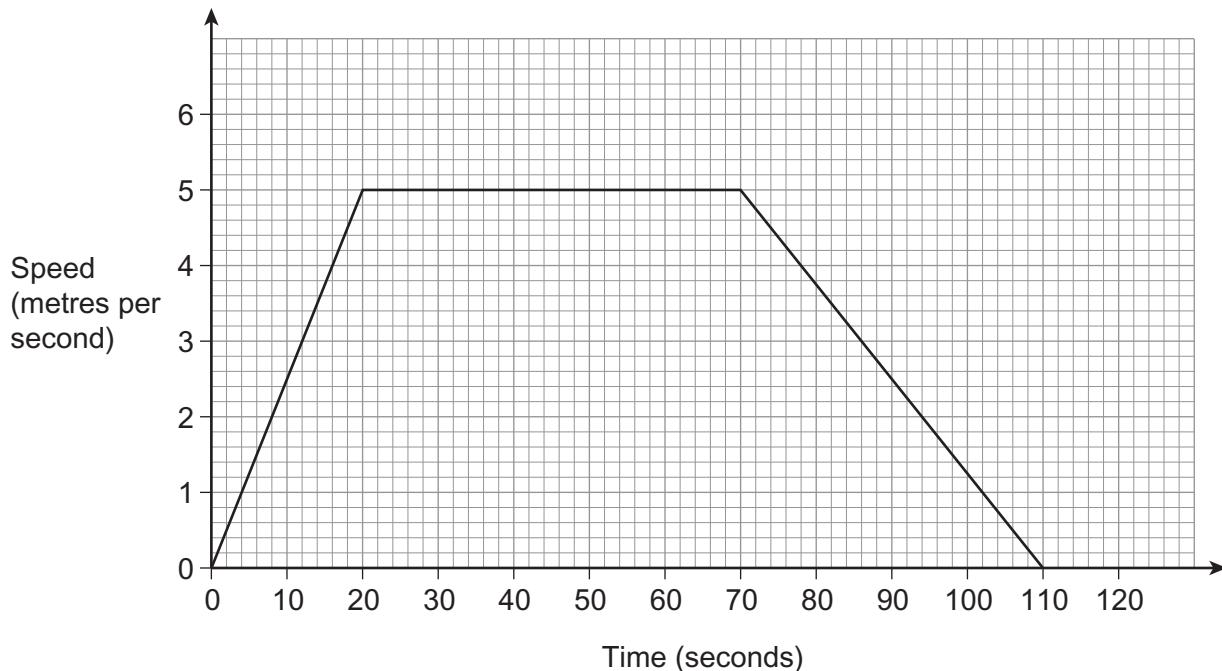
15 (a) Show that Robin cycles **exactly** once around the track in 110 seconds.

[2 marks]

....

....

....

....

....

....

15 (b) Sanjay cycles on the same track.

Here is his speed-time graph.
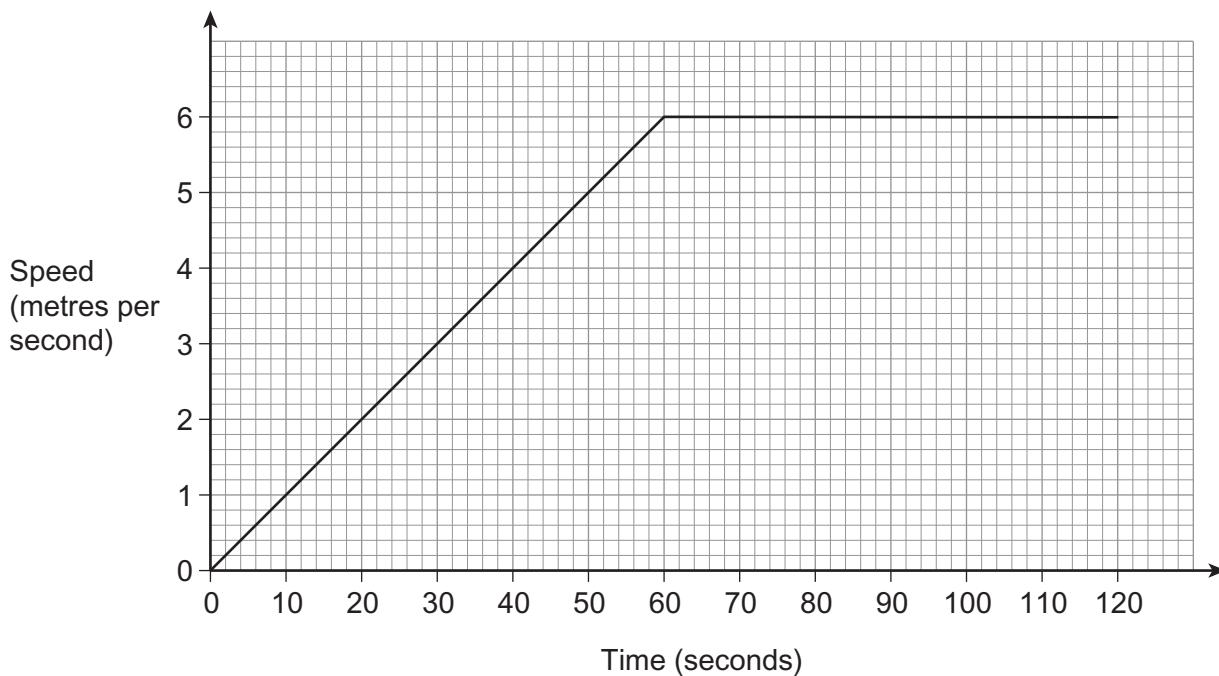
Does Sanjay cycle the first 400 metres in a quicker time than Robin?
You **must** show your working.

[3 marks]

....

....

....

....

....

....

....

....

....

Turn over ▶

5

16 The diagram shows two positions, *A* and *B*, of a boat sailing directly towards a lighthouse, *CD*.

Not drawn accurately

- The vertical height of the lighthouse is 38.3 m

- The angle of elevation of *C* from *A* is 12°

- The angle of elevation of *C* from *B* is 20°

This information can be modelled by the diagram below.

Not drawn accurately

38.3 m
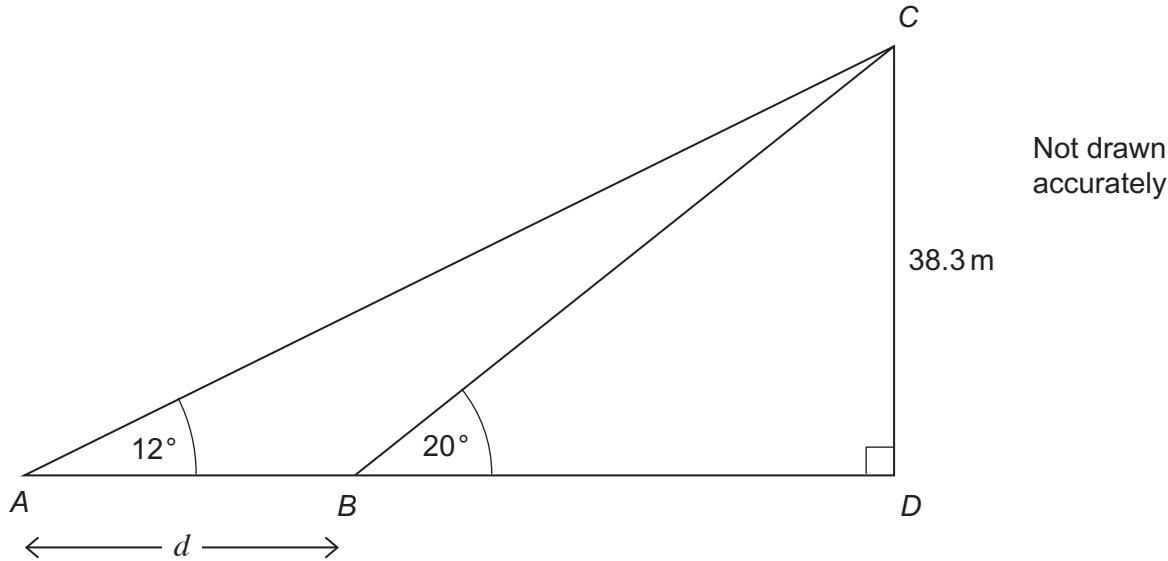
Work out d, the distance the boat sails between A and B.

[5 marks]

....

....

....

....

....

....

....

....

....

....

....

Answer .... m

Turn over for the next question

17 The graph shows the temperature, T (°C) of bread, m (minutes) after it is placed in a freezer.
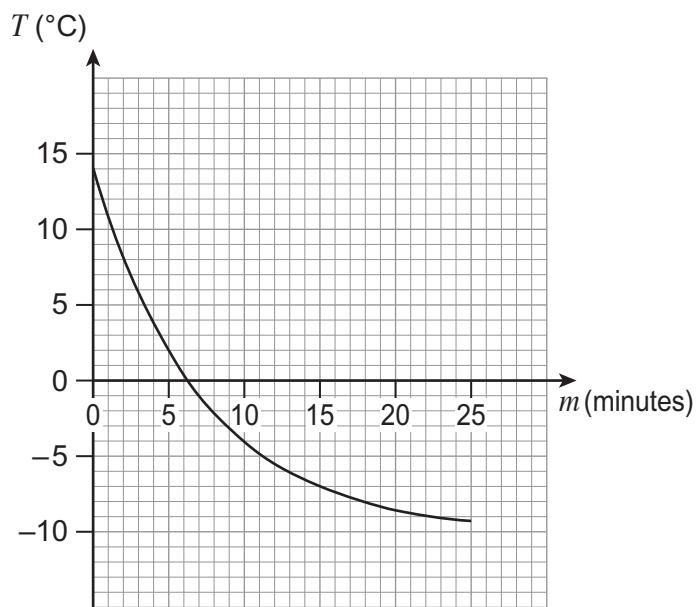
17 (a) How many minutes does it take for the temperature to reach 0 °C?

[1 mark]

Answer .... min

17 (b)   Estimate the rate at which the temperature is decreasing when $m = 3$
You **must** show your working.

[3 marks]

....

....

....

....

Answer .... °C per minute

Turn over for the next question

Turn over ▶

18 Two boxes of cereal are shown.
The boxes are similar cuboids of heights 32 cm and 20 cm

Medium   **Small**

Cracklies   Cracklies

32 cm   20 cm
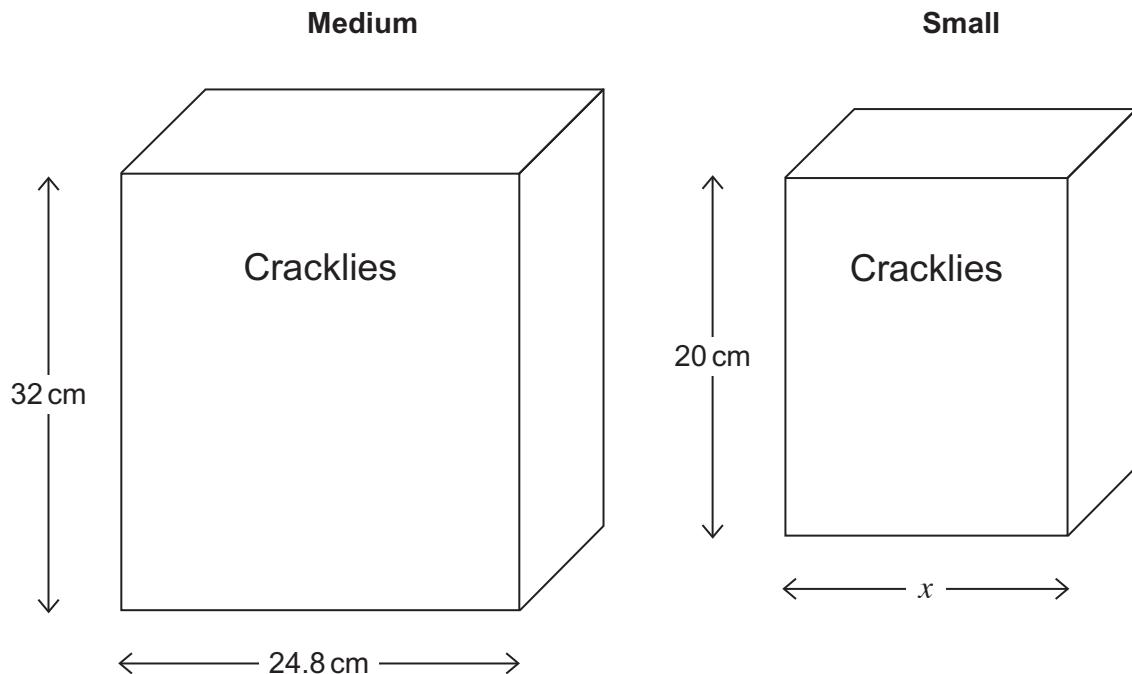
←——— 24.8 cm ———→   ←——— x ———→

18 (a) The width of the medium box is 24.8 cm

Work out the width, x, of the small box.

[3 marks]

....

....

....

....

Answer .... cm

*18 (b)   A large box of cereal is a similar cuboid to the medium box.
The large box has height 37 cm

It is claimed that the large box has a volume 50% larger than the medium box.

Is this claim true?
You **must** show your working.

[3 marks]

....

....

....

....

....

END OF QUESTIONS

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED