Surname

Other Names

Candidate Signature

AQA

General Certificate of Secondary Education
Higher Tier
June 2012

Applications of Mathematics **93702H** (Linked Pair Pilot)
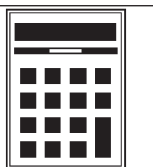
H

Unit 2   Geometry and Measures

Thursday 21 June 2012   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 and 13. 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.

Formulae Sheet: Higher Tier

Area of trapezium $= \frac{1}{2}(a+b)h$
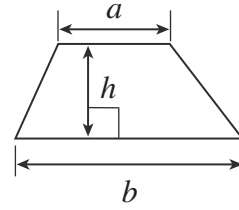
Volume of prism = area of cross-section × length
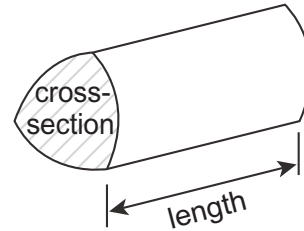
Volume of sphere $= \frac{4}{3}\pi r^3$

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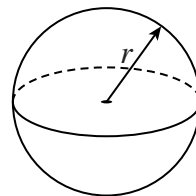
Volume of cone $= \frac{1}{3}\pi r^2 h$

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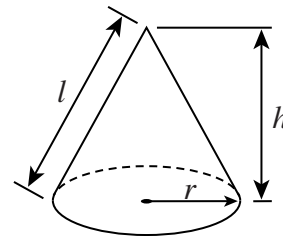
In any triangle ABC

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

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

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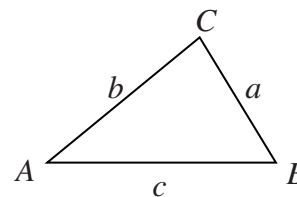
The Quadratic Equation

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 Rosie makes lemonade.
She mixes soda water and lemon juice in the ratio 4 : 1
She has 480 ml of soda water and 150 ml of lemon juice.
She wants to use all the lemon juice to make lemonade.

Work out how much **more** soda water she needs.

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....

....

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

Turn over for the next question

2 This paving slab has two equal sides.
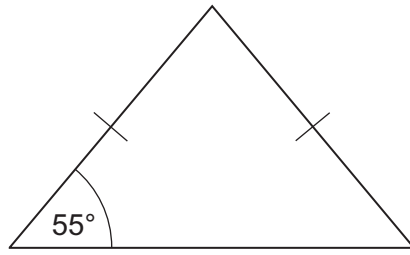
Not drawn accurately

The slab and three different slabs are put together to make a square as shown.
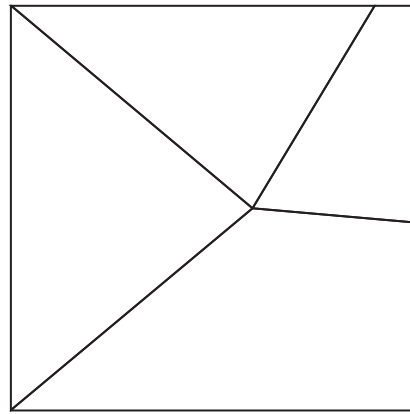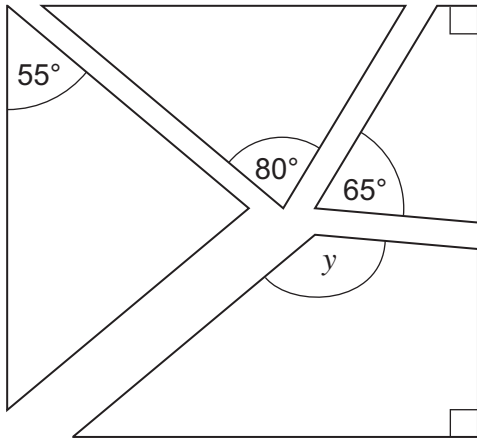
Not drawn accurately

2 (a) Work out the value of the angle marked y.

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

2 (b) Two of the squares make this rectangle.
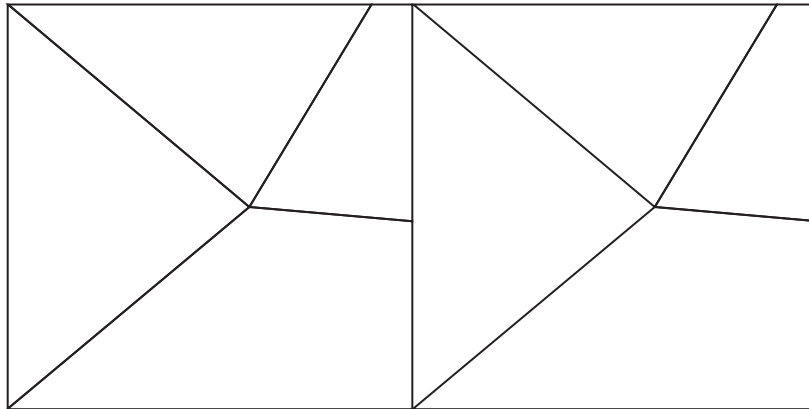
Not drawn accurately

The perimeter of the rectangle is 420 cm.

Work out the area of the rectangle.

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Answer .... cm^2 *(4 marks)*

Turn over for the next question

Turn over ▶

7

3 (a)   Ship *A* and Ship *B* are both travelling to port *C*.
The positions of the ships are shown.

Ship *A* travels on a bearing of 142º.
Ship *B* travels on a bearing of 255º.

Show the position of *C* on the diagram.

North

A ×

× *B*
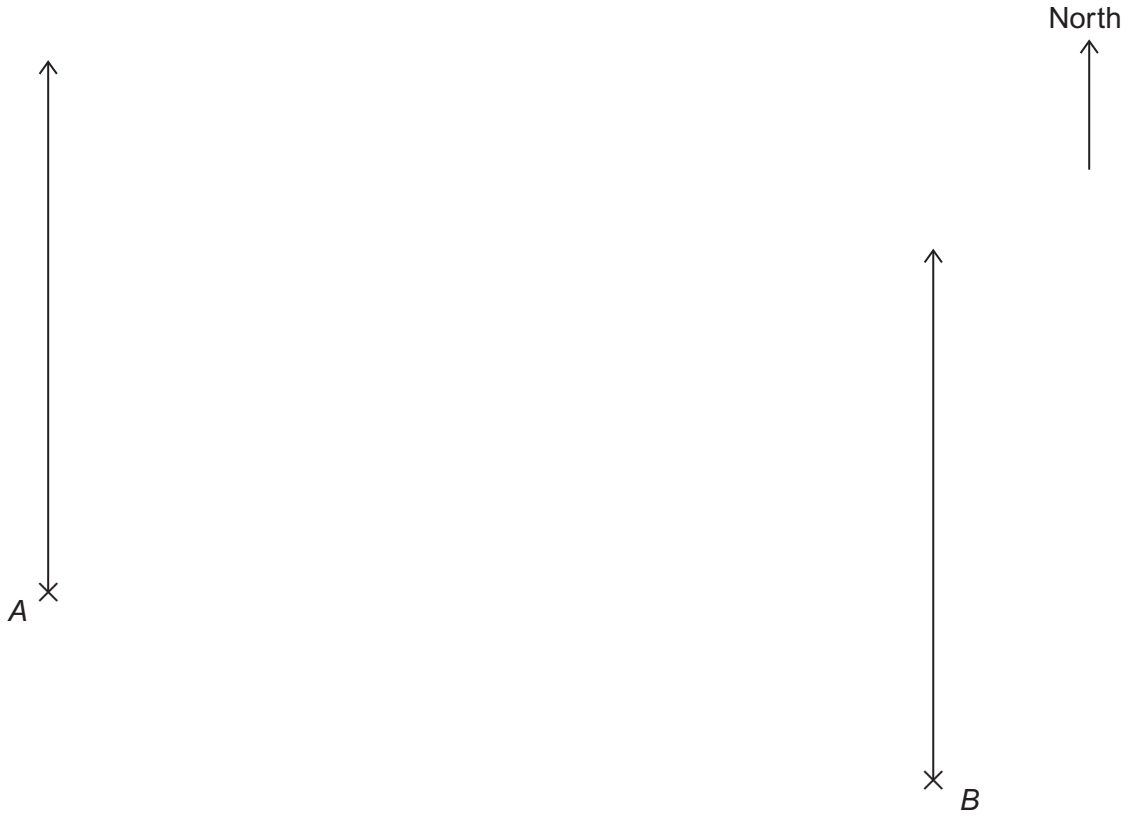
(3 marks)

3 (b) The distance-time graphs show the journeys of two ships, *P* and *Q*.
Both ships start their journeys at 1.00 pm.
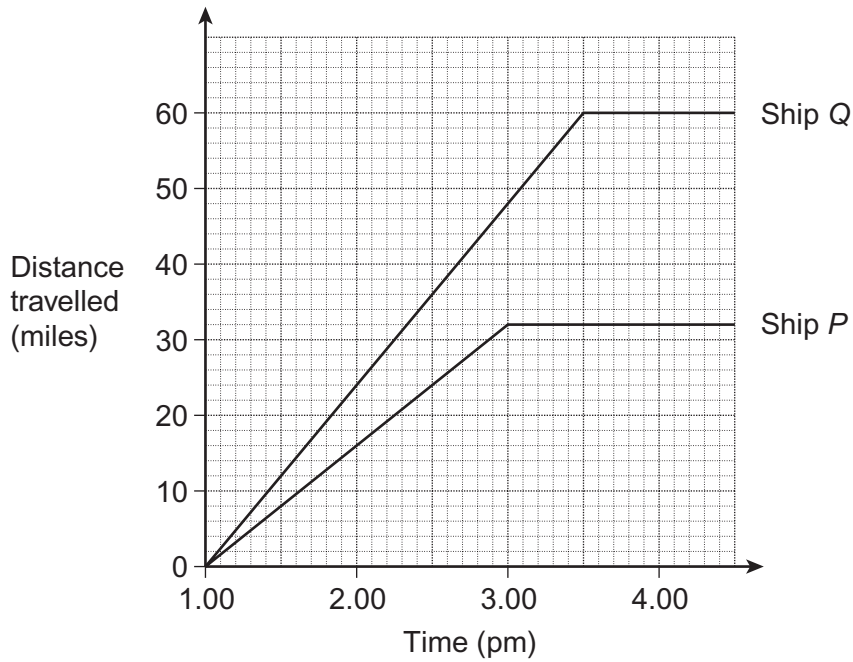
Which ship travels faster?
Work out how many miles per hour faster.

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Ship .... travels .... miles per hour faster
(2 marks)

Turn over for the next question

Turn over ▶

5

4 A wooden shed is in the shape of a prism.
Both rectangular walls have identical glass windows.
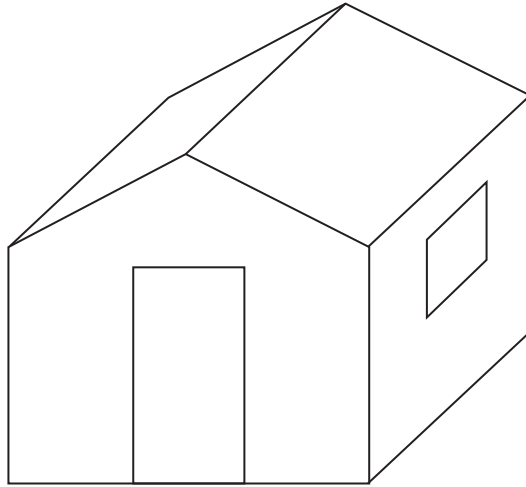
4 (a) One rectangular wall is shown.

0.6 m   window

1.9 m

1.2 m

Not drawn accurately

2.8 m
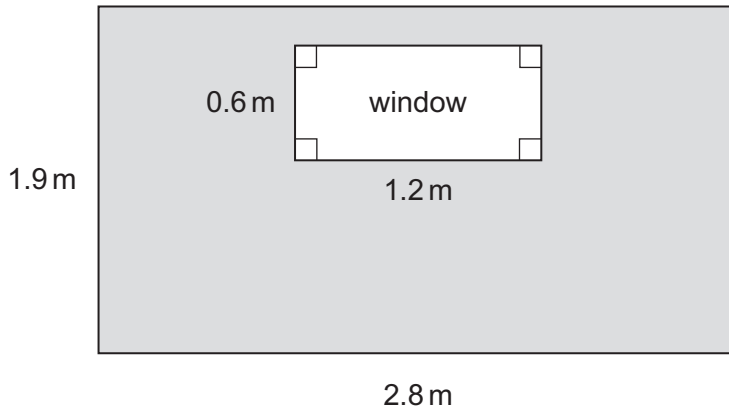
4 (a) (i) Work out the area of the window.

....

Answer .... m² *(1 mark)*

4 (a) (ii) Work out the area of wood in the wall.
This area is shaded on the diagram.

....

....

Answer .... m² *(2 marks)*

4 (b) Here is a diagram of the front wall and door.
The diagram is symmetrical.

2.2 m

1.9 m

door

2.4 m
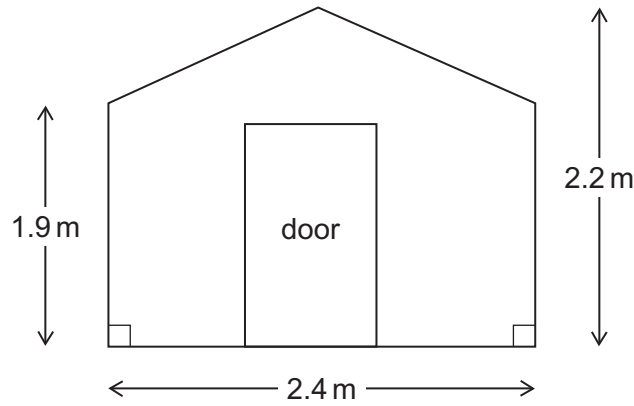
Not drawn accurately

Show that the total area of the front wall and door is 4.92 m².

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(2 marks)

4 (c) The wood on the outside surfaces of the four walls and the door is painted.

Each surface needs **two** coats of paint.
One litre of paint covers 5 m².

How many litres of paint are needed?
You **must** show your working.

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

Turn over ▶

*5   Here are two cylindrical tubes.

Tube _A_
diameter 5 cm
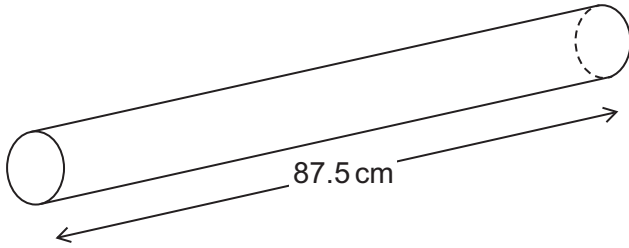
Tube _B_
diameter 7.6 cm

87.5 cm

48 cm
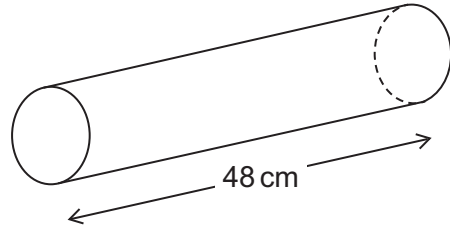
5 (a)   Which tube has the smaller volume?
You **must** show your working.

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Answer ....   *(5 marks)*

5 (b) Three of **Tube B** are packed in a box of height 50 cm.

Front view of box

Plan view of box

50 cm
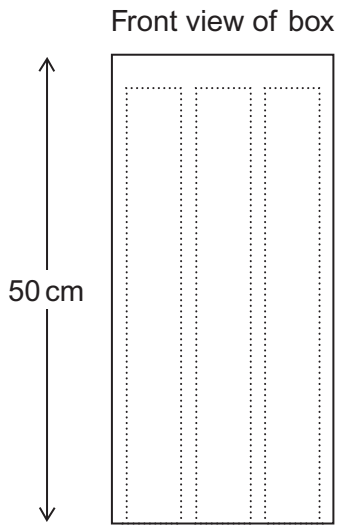
Not drawn accurately

There is a 0.5 cm gap between the tubes.
There is a 0.5 cm gap between the tubes and the sides of the box.

Work out the volume of the box.

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Answer .... cm³   *(4 marks)*

6 The number of fish in a lake is expected to decrease by $\frac{1}{4}$ each year.

There are 8000 fish in the lake.

How many fish are expected to be in the lake after 3 years?

....

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Answer ....   *(3 marks)*

12

Turn over ▶

7 A scale diagram of a rectangular field is shown.

Scale : 1 centimetre represents 2 metres
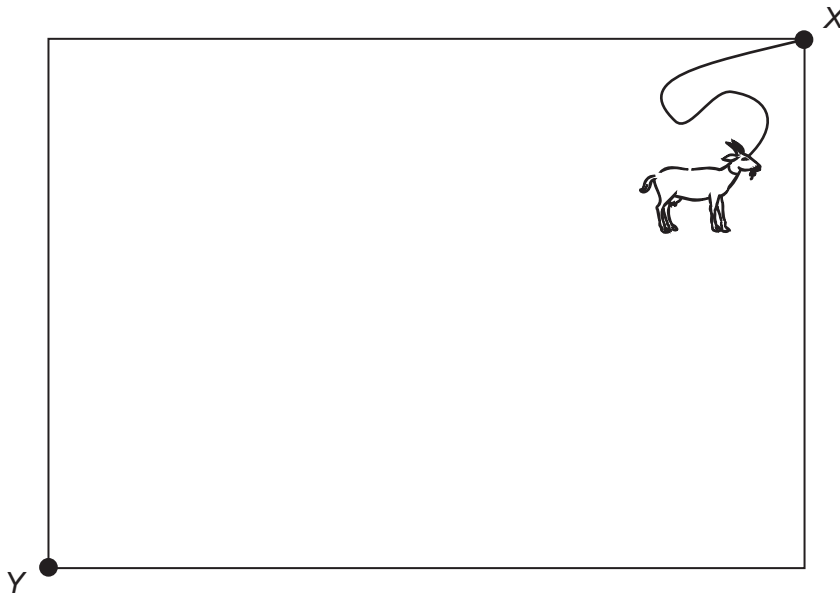
7 (a) A goat is tied to a post at *X* by a rope.
The goat can reach 8 metres from *X*.

Draw accurately on the scale diagram to show the area of the field the goat can reach.

(2 marks)

7 (b) A horse is tied to a post at *Y* by a different rope.
The areas of the field the horse and goat can reach do **not** overlap.

What is the longest possible length of this rope?

....

....

Answer .... metres   *(2 marks)*

8 Here is a side view of a ladder and slide.
All dimensions are in feet (ft).

Not drawn accurately

ladder 7 ft

h

slide 15 ft

x

←——— 4.2 ft ———→←——————— 13.9 ft ———————→
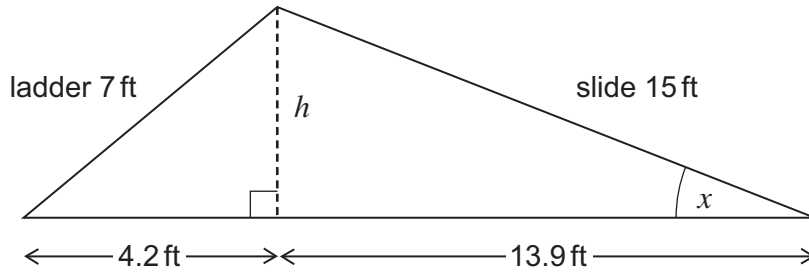
8 (a) The ladder is safe if

the top of the ladder is less than 6 feet above the ground.

Show that the ladder is safe.

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(3 marks)

8 (b) The slide is safe if

the maximum value of angle x is 24°.

Show that the slide is safe.

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(3 marks)

10

Turn over ▶

9   A circular lawn has radius 5 metres.
A lawnmower is used to cut the grass on the lawn.
Circular sections of width 0.5 metres are cut as shown.
The shaded area has been cut.

5 m
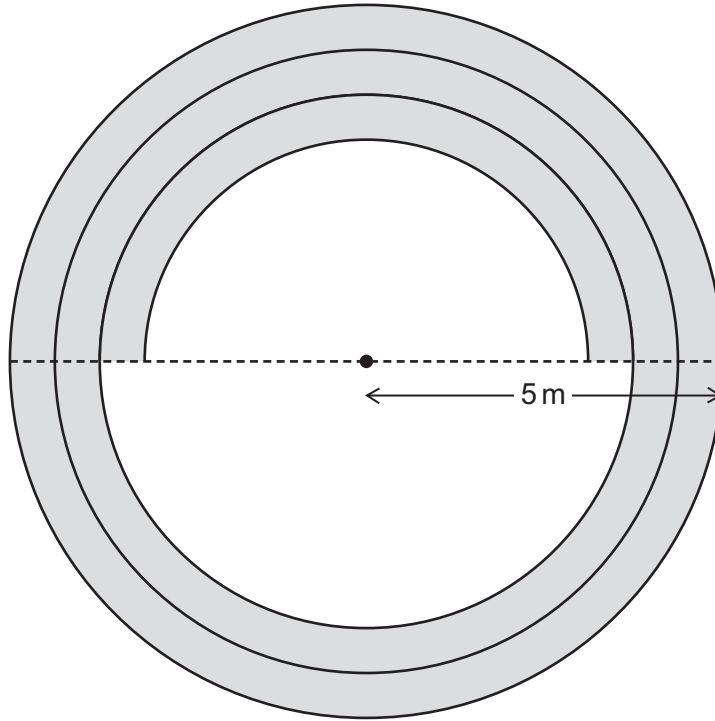
Not drawn
accurately

Show that more than half of the lawn has **not** been cut.

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(5 marks)

10   The diagram shows an empty container.
Each part is a cylinder.

16 cm

12 cm

Water is added to the container at a steady rate.
The container is full after T seconds.

The sketch graph shows the height, in cm, of the water as the container fills.

Height (cm)

B

A

0

0   10 T

Time (seconds)
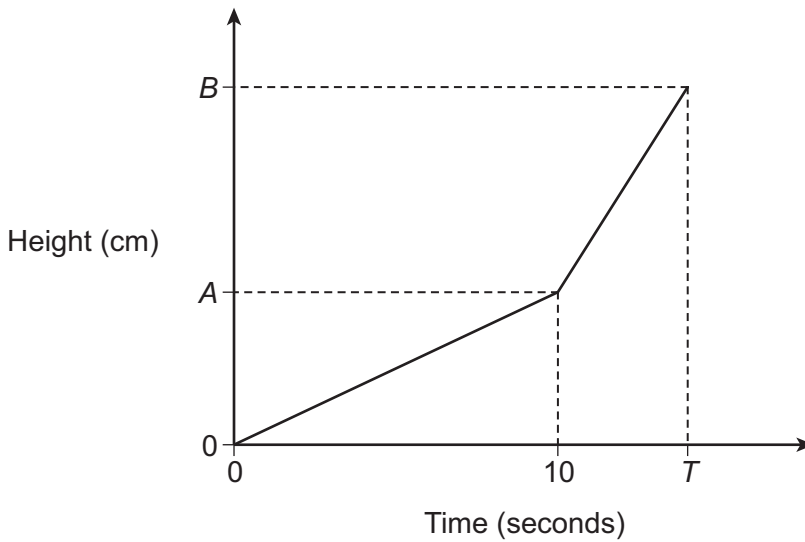
10 (a)   State the values of A and B.
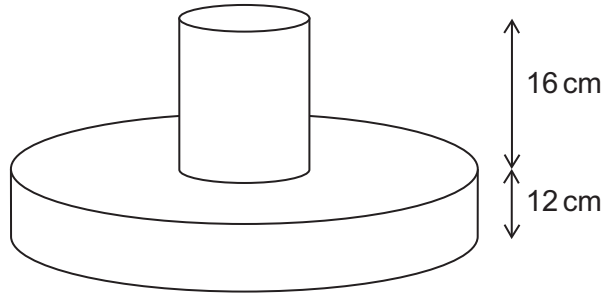
Answer A = ... , B = ... *(2 marks)*

10 (b)   The water is added at 250 millilitres per second.
When full, the container holds 3.25 litres.

After how many seconds is the height of the water 20 cm?
You **must** show your working.

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

10

Turn over ▶

11 Point *P* is at the lowest point of a vertical wheel, centre *C*.
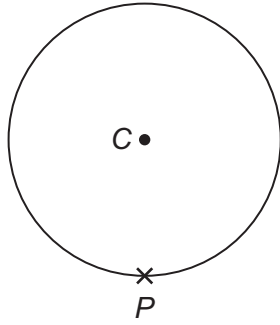
The wheel turns at a constant speed, about *C*.
After *t* minutes, the height of *P* above the lowest point on the wheel is *h* metres.
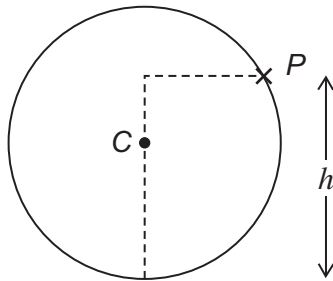
11 (a) The wheel turns through 360º in 20 minutes.

The table shows some values for *t* and *h*.

t (minutes)	0	5	10	15	20
h (metres)	0	15	30	15	0

What is the diameter of the wheel?
Give a reason for your answer.

Diameter .... metres

Reason ....

....

....

(2 marks)

11 (b) (i)   The graph shows the height of *P* above the lowest point of the wheel for the first 20 minutes.

Complete the graph for the first 60 minutes.

....

....

....

h

Height (metres)

30
25
20
15
10
5
0

0   5   10   15   20   25   30   35   40   45   50   55   60   *t*

Time (minutes)
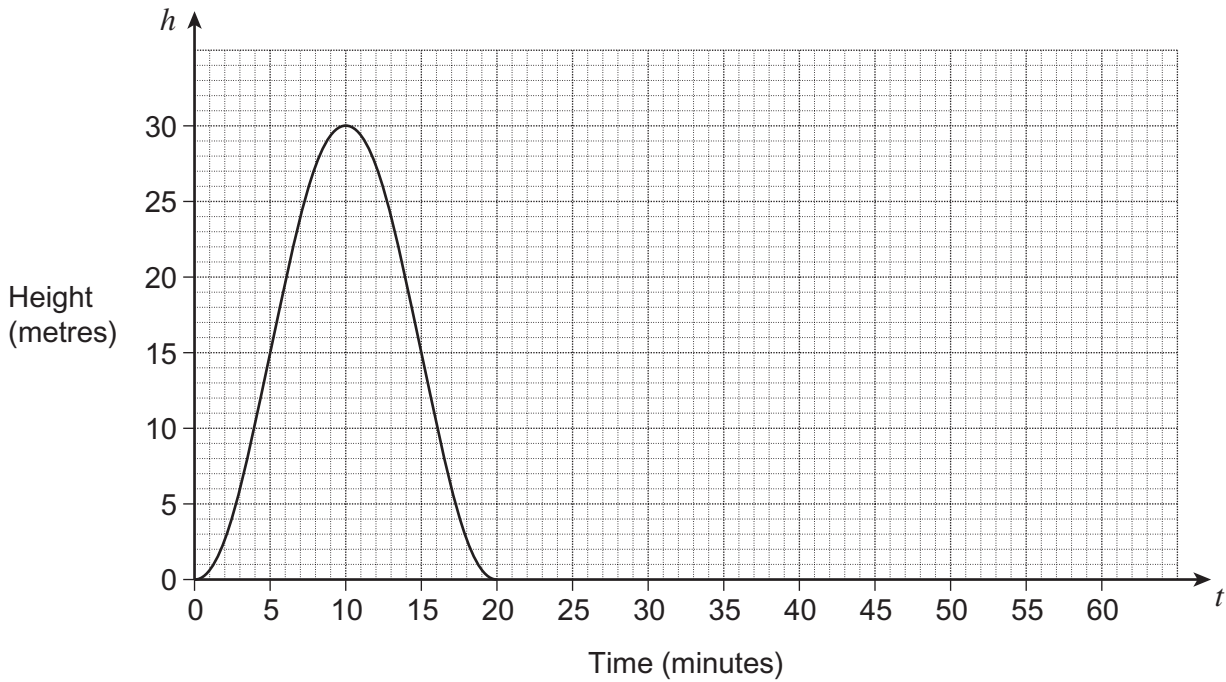
(3 marks)

11 (b) (ii)   Use the graph to estimate how long *P* is at a height of more than 25 metres during the first 20 minutes.

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Answer... minutes   *(2 marks)*

7

Turn over ▶

12   Two boxes of Ozo washing powder are shown.
The boxes are similar cuboids of heights 25 cm and 35 cm.
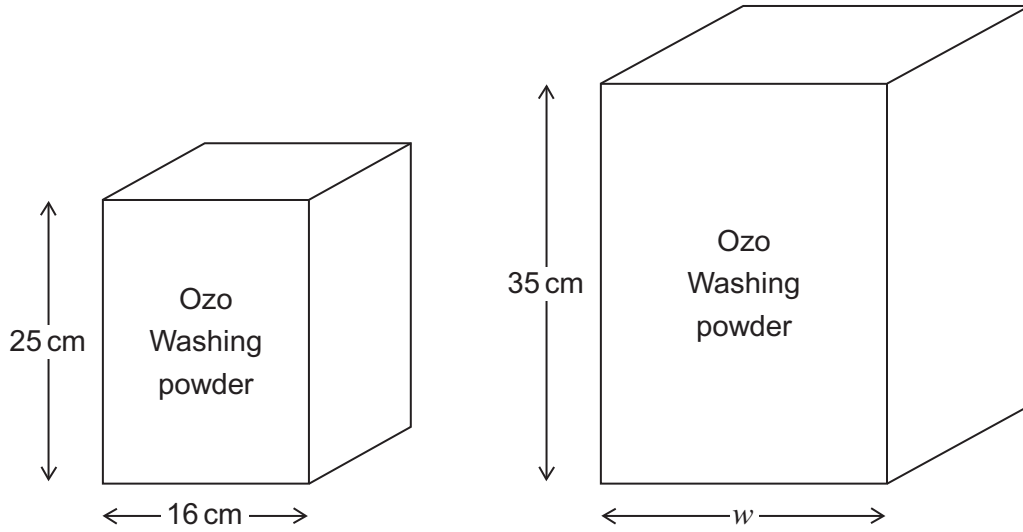
12 (a)   The width of the smaller box is 16 cm.

Work out the width, w, of the larger box.

....

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....

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

12 (b) The powder in the smaller box is enough for exactly 15 washes.

Here is an advert.

The larger box of Ozo contains enough powder for 42 washes
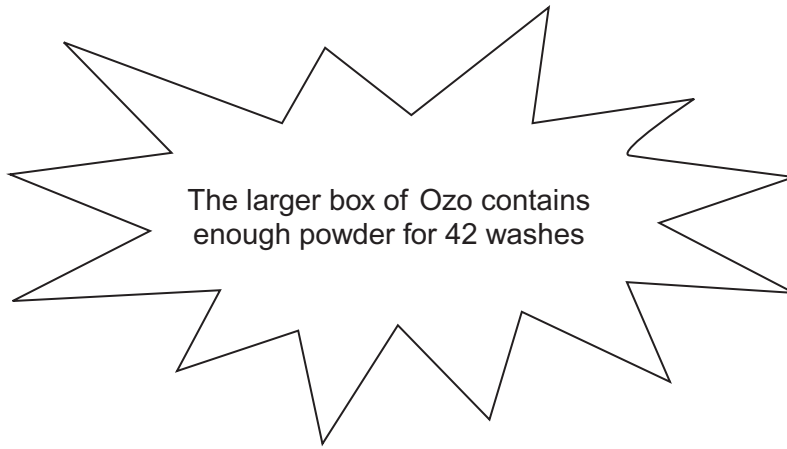
Is the advert correct?
Assume that each wash uses the same amount of powder.
You **must** show your working.

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(3 marks)

Turn over for the next question

6

Turn over ▶

*13 The graph shows the speed of a train for 16 seconds.

13 (a) For how many seconds is the train travelling at a speed of less than 8 m/s?

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

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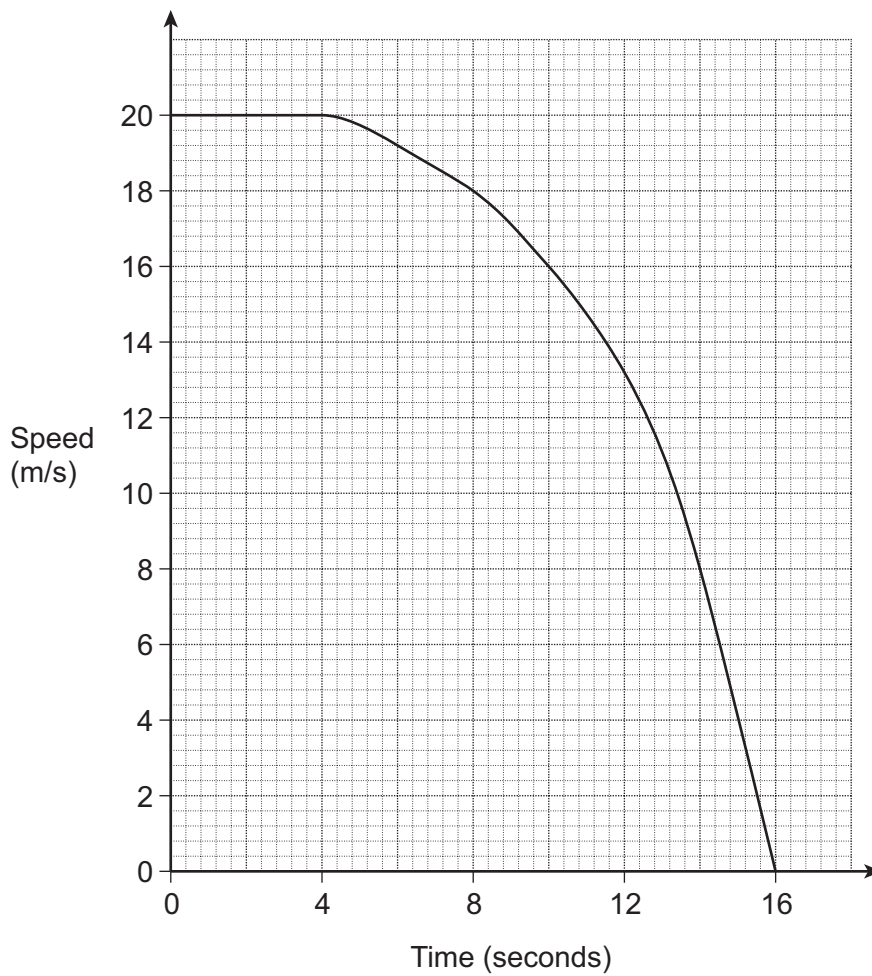**13 (b)** Work out an estimate of the average speed of the train during the 16 seconds.

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Answer .... m/s   *(6 marks)*

13 (c) (i) Work out an estimate for the gradient of the graph after 8 seconds.

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Answer ....   *(3 marks)*

13 (c) (ii) What does this gradient represent?

Answer ....   *(1 mark)*

END OF QUESTIONS

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