Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
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28 – 29	
30	
TOTAL	

AQA

General Certificate of Secondary Education
Higher Tier
November 2014

Applications of Mathematics (Linked Pair) 93702H

Unit 2 Geometry and Measures

H

Friday 7 November 2014 9.00 am to 10.30 am

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

Time allowed
- 1 hour 30 minutes

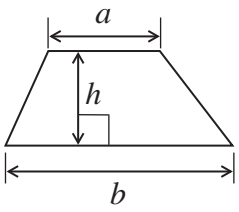
Instructions
- Use black ink or black ball-point pen. Draw diagrams in pencil.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the space provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. 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 7 and 19
  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.

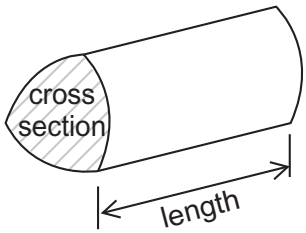
Advice
- In all calculations, show clearly how you work out your answer.

Formulae Sheet: Higher Tier

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

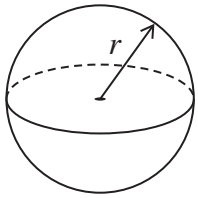


Volume of prism = area of cross section × length



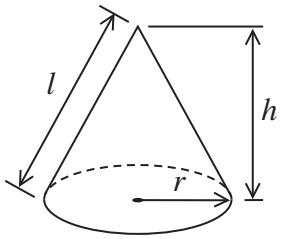
Volume of sphere = $\frac{4}{3}\pi r^3$

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



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

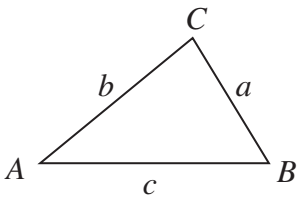
Curved surface area of cone = $\pi r l$



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

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

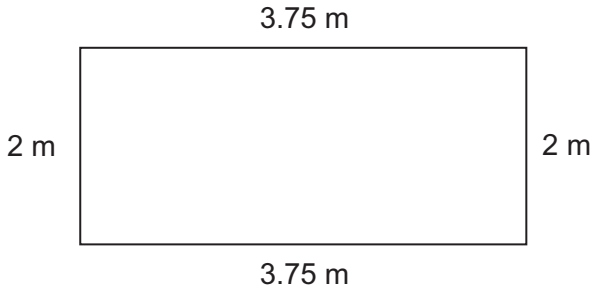
Answer **all** questions in the spaces provided.

1 Paul has four straight pieces of wood.

Two pieces are 3.75 m long.

Two pieces are 2 m long.

He arranges the pieces to make a frame in the shape of a quadrilateral.



Not drawn accurately

1 (a) One quadrilateral he could make is a rectangle.

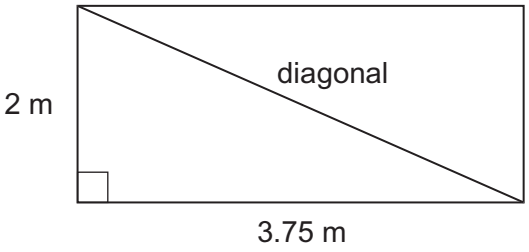
Name one different quadrilateral he could make.

[1 mark]

Answer .....

1 (b) Work out how long the diagonal should be when the quadrilateral is a rectangle.

[3 marks]



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Answer ..... m

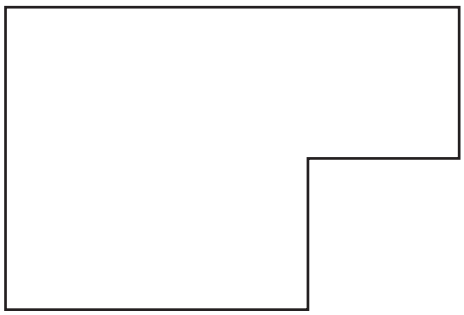
4

2 Helen and Sidrah share a flat.

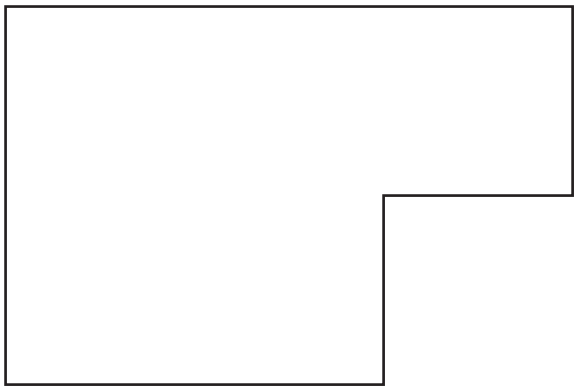
They each make a scale drawing of the kitchen floor in the flat.
They each use a different scale.

Helen

Scale 1 cm represents 50 cm



Sidrah



2 (a) Work out the scale for Sidrah's drawing.

[3 marks]

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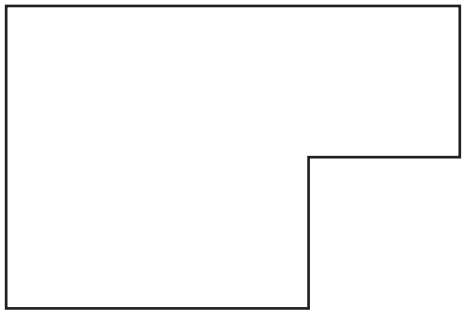
1 cm represents ..... cm

2 (b) Covering the kitchen floor with tiles costs £32.75 per square metre.

Use Helen's diagram below to work out the cost of covering the kitchen floor with tiles.

[3 marks]

Scale 1 cm represents 50 cm



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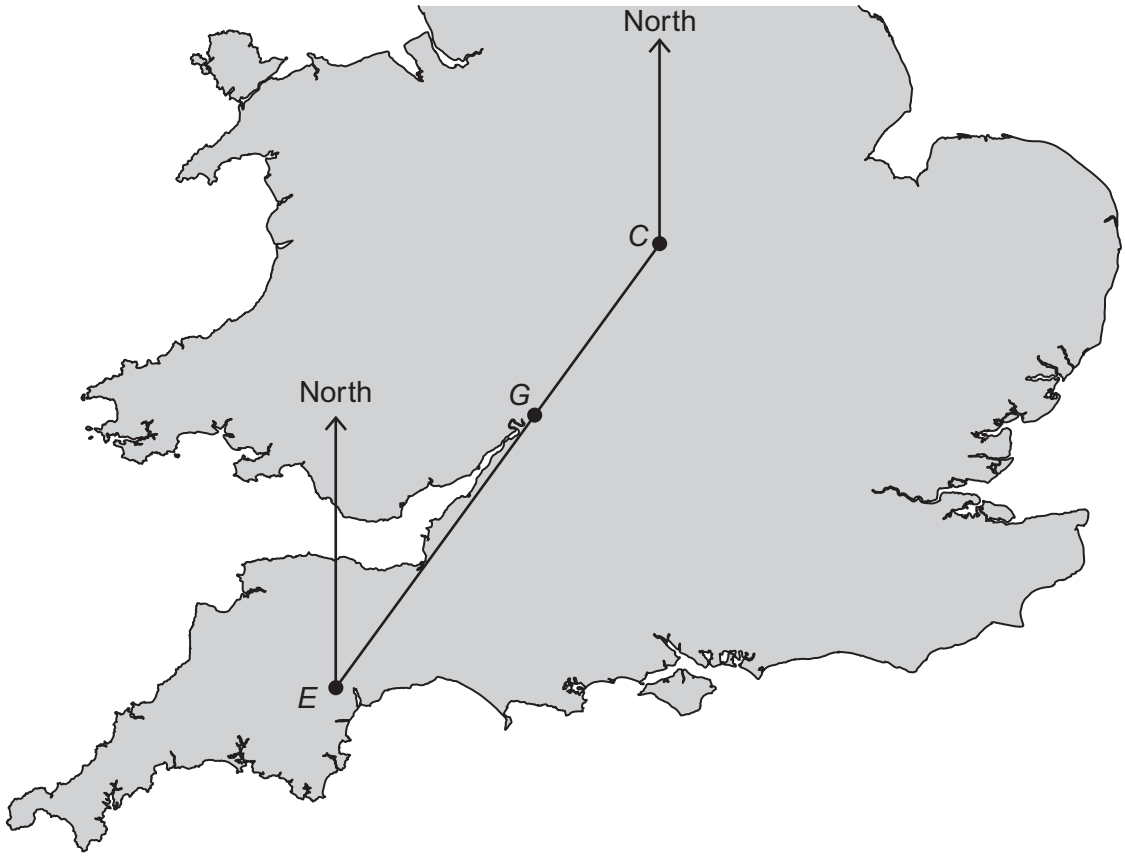
£ .....

6

3 The map shows the cities Coventry (*C*), Gloucester (*G*) and Exeter (*E*).



EGC is a straight line.
The bearing from Exeter to Coventry is 036º

3 (a) What is the bearing from Gloucester to Coventry?

[1 mark]

Answer ..... º

3 (b) Work out the bearing from Coventry to Exeter.

[2 marks]

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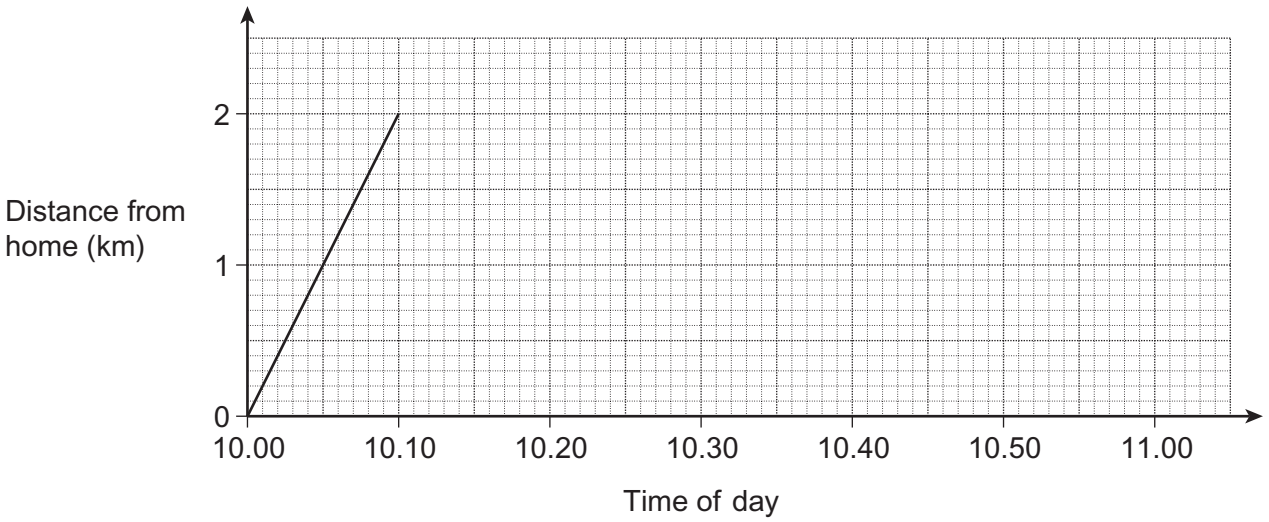
Answer ..... º

4 Amy cycles to the gym.
The graph shows her journey from her home to the gym.



4 (a) Work out the speed for her journey to the gym.
Give your answer in kilometres per hour.

[2 marks]

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Answer ..... km/h

4 (b) Amy stays at the gym for 30 minutes.
She cycles back home at a constant speed of 8 km/h

Work out the time she arrives home.
You may use the graph to help you.

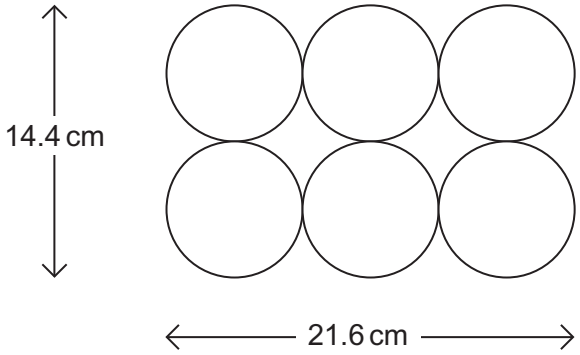
[2 marks]

Answer .....

7

5 Six tins of soup are arranged in a pack.
The tins are identical cylinders.

A plan view of the pack is shown.



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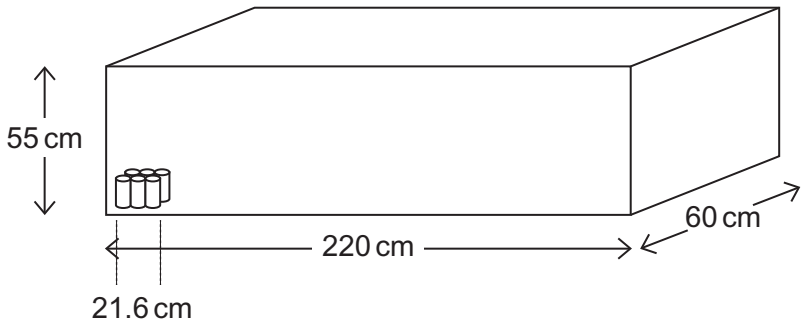
Ben works at a supermarket.
He puts some of the packs on a shelf.

- The space on the shelf is a cuboid measuring 220 cm by 60 cm by 55 cm
- Each pack has height 10.7 cm
- The packs are all arranged on the shelf in the same way.



Work out the **maximum** number of packs Ben can put on the shelf.

[5 marks]

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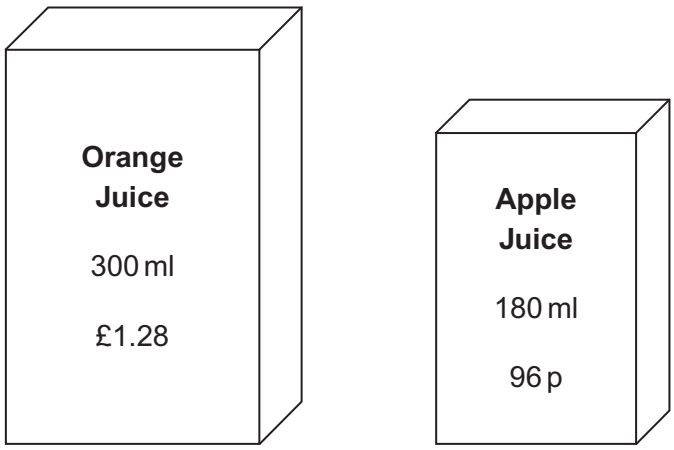
Answer .....

Turn over for the next question

5

6 Liam buys some of these cartons of orange juice and apple juice.



He buys the same number of millilitres of orange juice and apple juice.

Work out the **least** amount he could spend.

[3 marks]

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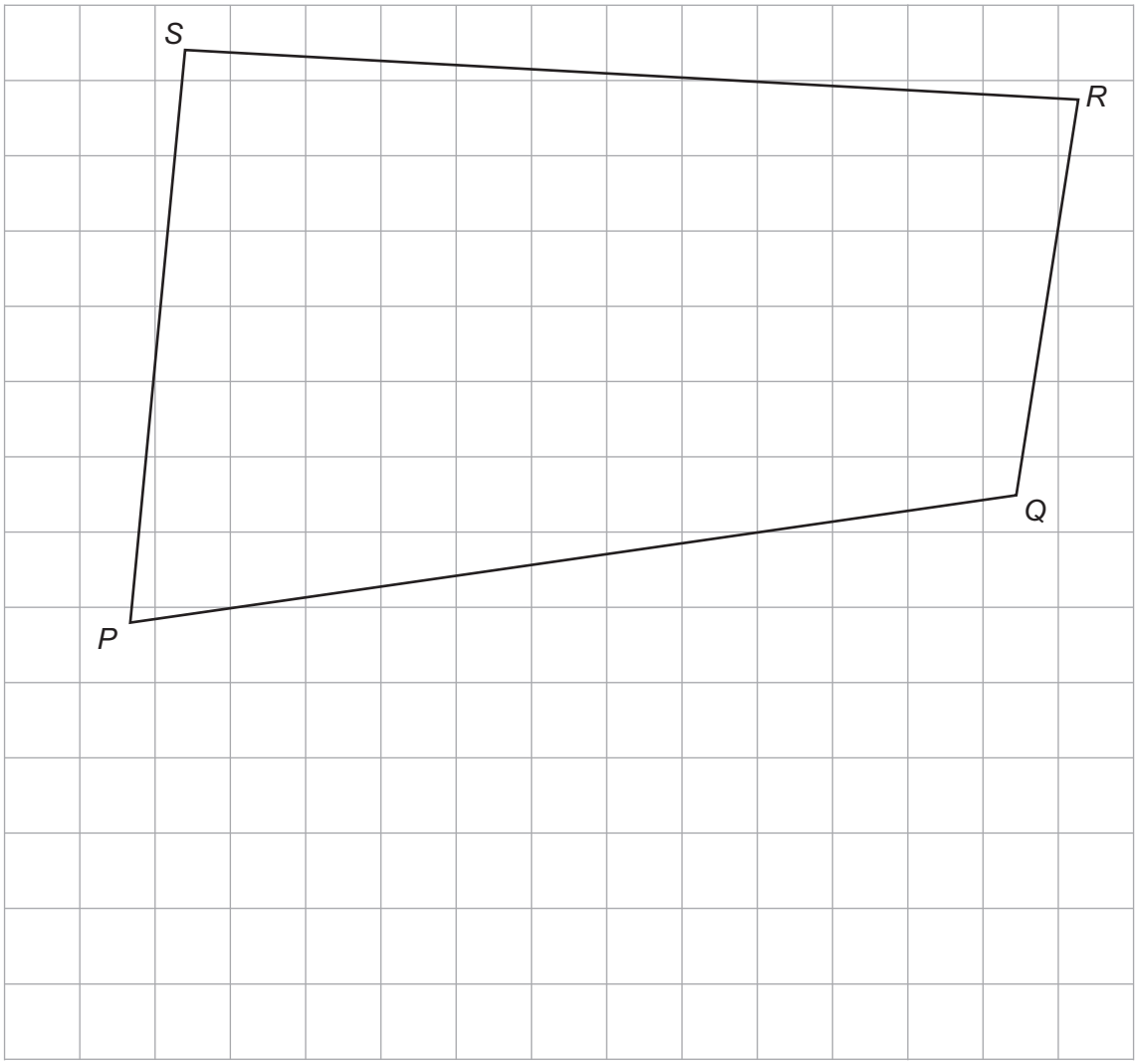
£ .....

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

PQRS is a plan of a garden.



A straight path in the garden

- joins *PQ* to *SR*
- is perpendicular to *PQ*
- is the same distance from *P* and *Q*

Construct the position of the path.

[2 marks]

5

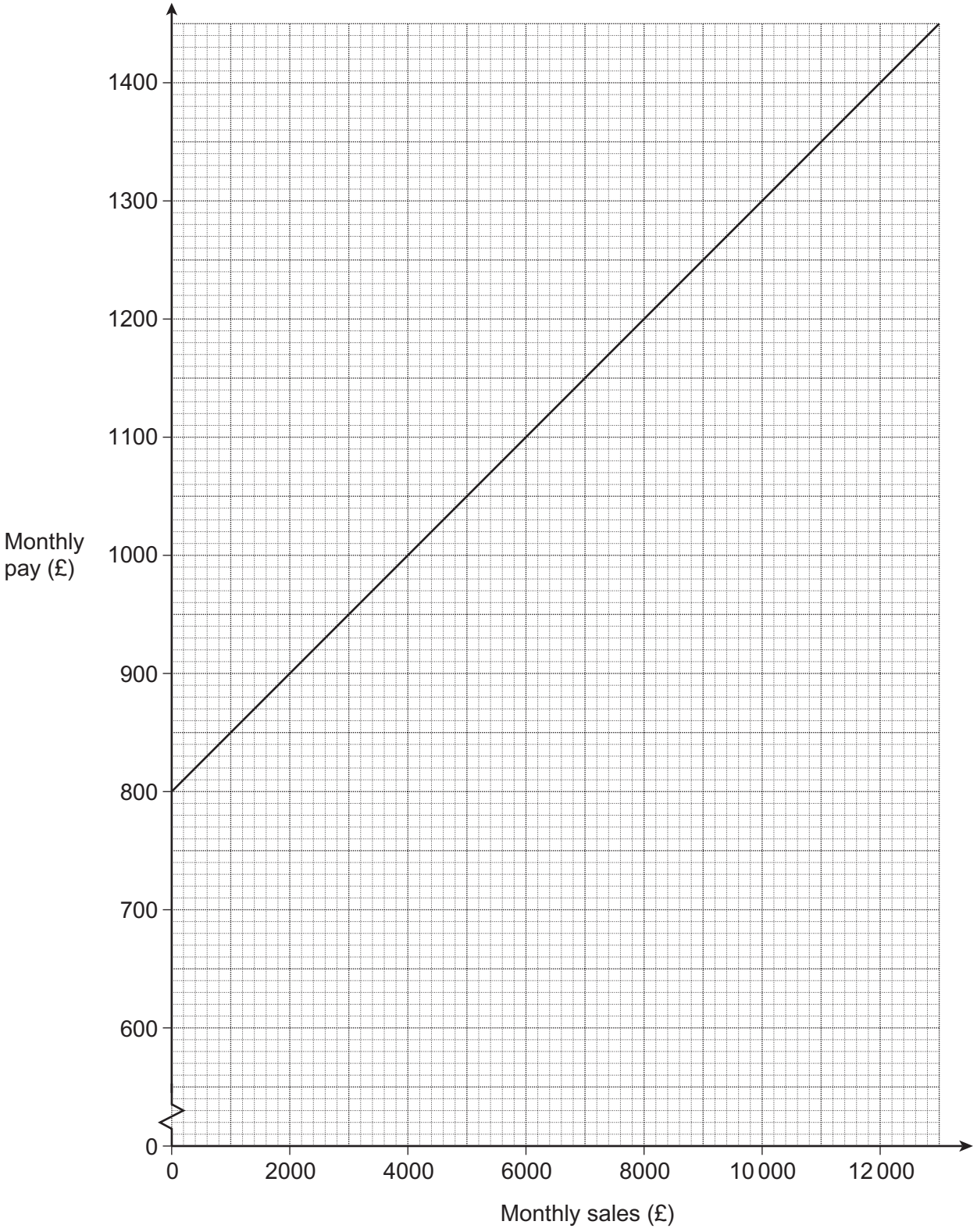
Turn over ▶

8 Ben is a salesman.

His monthly pay has two parts.

A fixed amount of £800

An amount which depends on his monthly sales and increases at a constant rate.



In August, Ben's sales were £18 000

Work out Ben's pay in August.

[3 marks]

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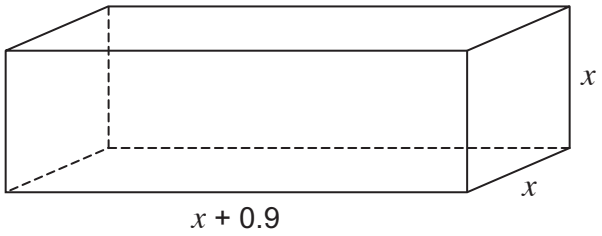
£ .....

Turn over for the next question

3

9 A storage box is a cuboid.
The length, width and height are given in metres.



The formula for the volume, V (m^3), is

$$V = x^3 + 0.9x^2$$

The box has a volume of 8 m^3

Use trial and improvement to work out the value of x for which $V = 8$
Give your answer to **two** decimal places.

Use the table opposite for your trials.

[4 marks]

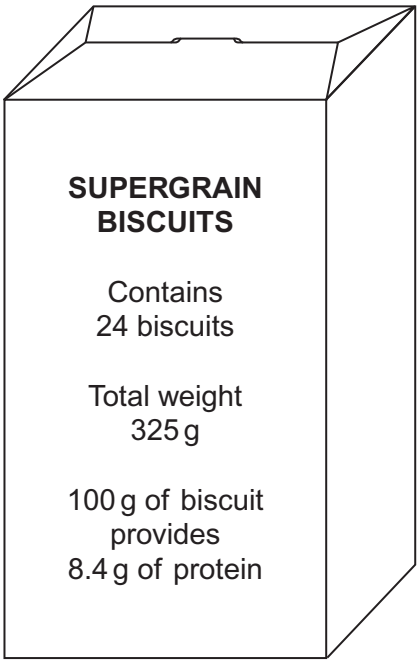
x	$x^3 + 0.9x^2$	V	Comment
1.7	$1.7^3 + 0.9 \times 1.7^2$ $= 4.913 + 2.601$	7.514	Too small

$x =$ .....

4

Turn over ▶

10 The diagram shows a 325 g pack of breakfast biscuits.



The Guideline Daily Amount (GDA) of protein is 55 g

One day, Joe eats three biscuits.

He says,

"This provides me with between 6% and 7% of my GDA of protein."

Show that Joe is correct.

[4 marks]

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11 Rob, Sue and Tilly each have some money.

Rob has £x

Sue has £4 more than Rob.

Tilly has three times the amount Sue has.

The **total** amount of money they have is £92.65

Set up and solve an equation to find x.

[4 marks]

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x = ...

12 The number of people visiting a museum is expected to increase by one-quarter each year.

30 000 people visited the museum in 2013

Work out how many people are expected to visit in 2016
Give your answer to the nearest 100

[3 marks]

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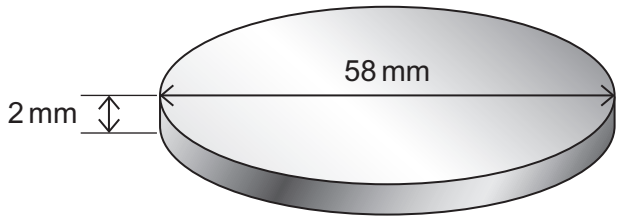
Answer .....

11

13 All the runners who finish the Great North Run get a medal.
The medal can be modelled as a metal cylinder with diameter 58 mm and height 2 mm



The density of the metal is 0.00852 grams per cubic millimetre.
Last year, 56 000 medals were made.

Work out how many **kilograms** of metal were used.

[4 marks]

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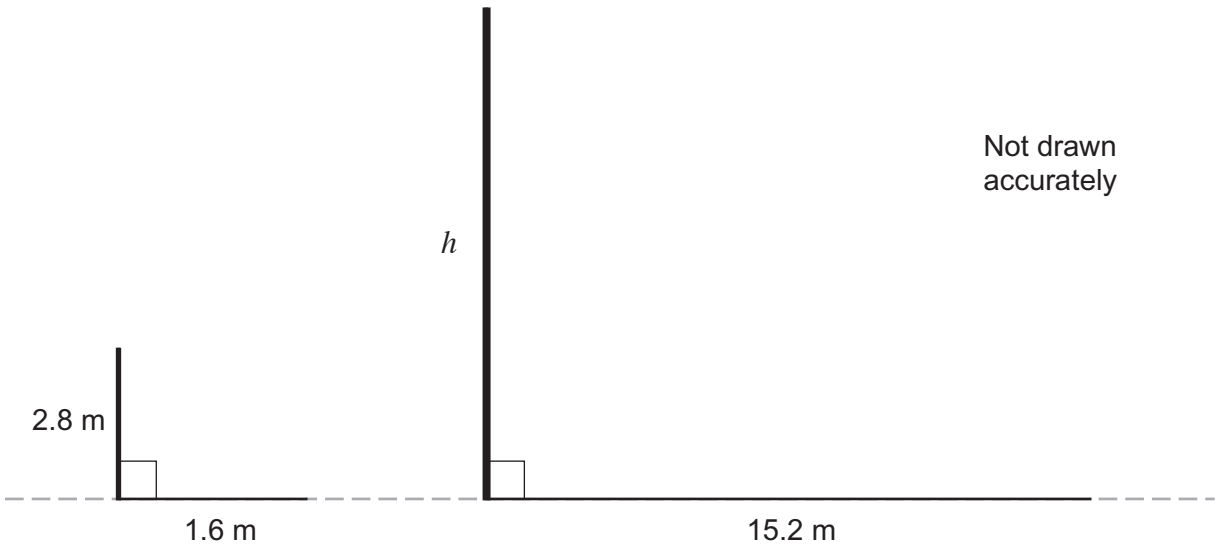
Answer ..... kg

14 A post and a telegraph pole stand near each other on horizontal ground.
The height of the post is 2.8 metres.



- The length of the shadow from the post is 1.6 metres.
- At the same time, the length of the shadow from the telegraph pole is 15.2 metres.

Work out the height, h, of the telegraph pole.

[3 marks]

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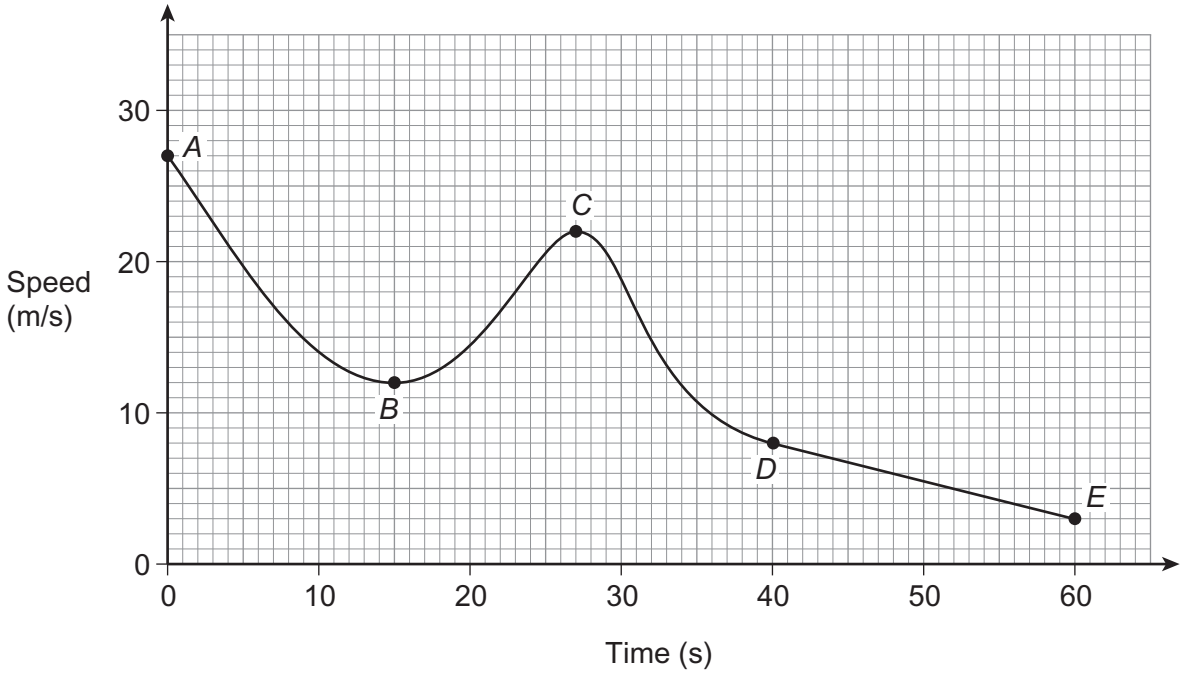
Answer ..... m

7

15 (a) The diagram shows the speed-time graph of a car for 60 seconds.



Which **two** points on the graph show when the car has an acceleration of zero?

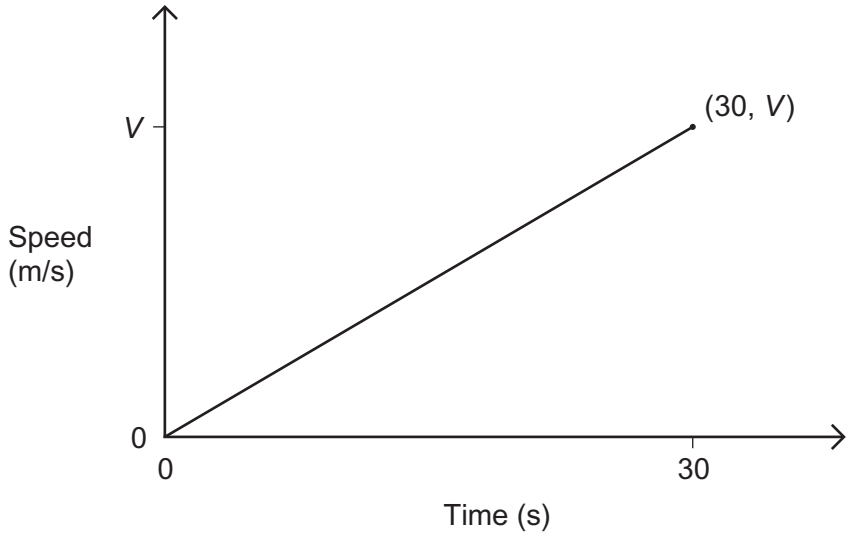
Circle your answers below.

[1 mark]

A *B* *C* *D* *E*

15 (b) This diagram shows the speed-time graph of a lorry for 30 seconds.

After 30 seconds the speed of the lorry is V m/s



The lorry travels a distance of 270 metres in these 30 seconds.

Work out V.

[2 marks]

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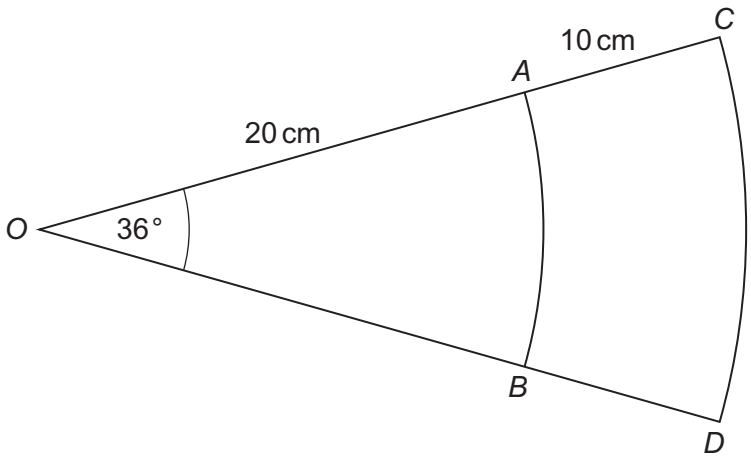
Answer ..... m/s

3

Turn over ▶

16 The diagram shows the metal framework on a window.

AB and *CD* are arcs of circles, each with centre *O*.



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16 (a) Show that the length of arc *AB*, in cm, is 4π.

[2 marks]

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16 (b) Work out the **total** length of metal in the framework.
Give your answer in its simplest form in terms of π.

[3 marks]

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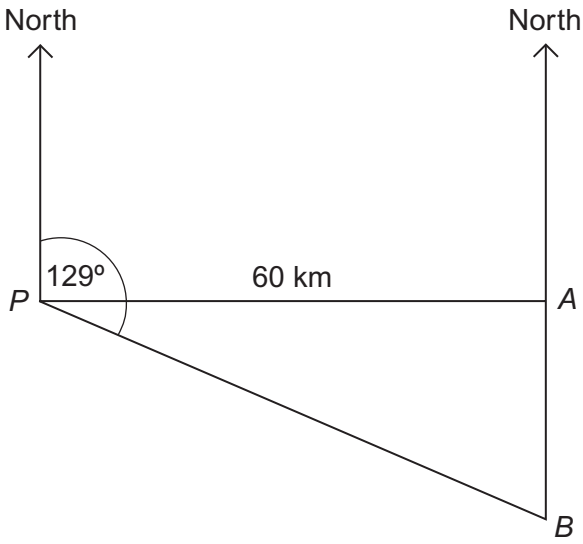
Answer ..... cm

17 At 9 am two ships, *A* and *B*, leave port *P*.

Ship *A* travels due East.

Ship *B* travels on a bearing of 129º at a constant speed.

At 11.30 am Ship *A* is 60 km from *P* and due North of Ship *B*, as shown on the diagram.



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Work out the speed of Ship *B*.

[4 marks]

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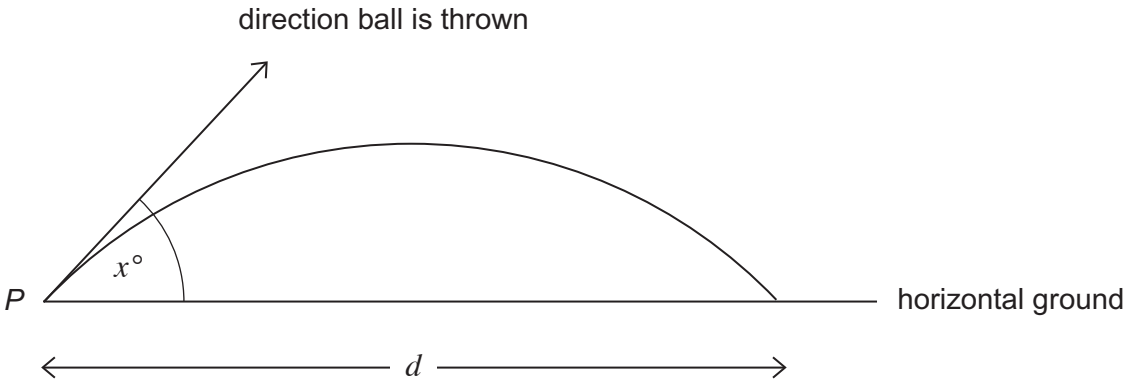
Answer ..... km/h

9

Turn over ▶

18 A ball is thrown from point *P* at an angle $x°$ to horizontal ground.
The ball lands a distance d metres from *P*.
The path of the ball is a curve.



Changing the size of angle x will change the distance d.

The connection between x and d is modelled by

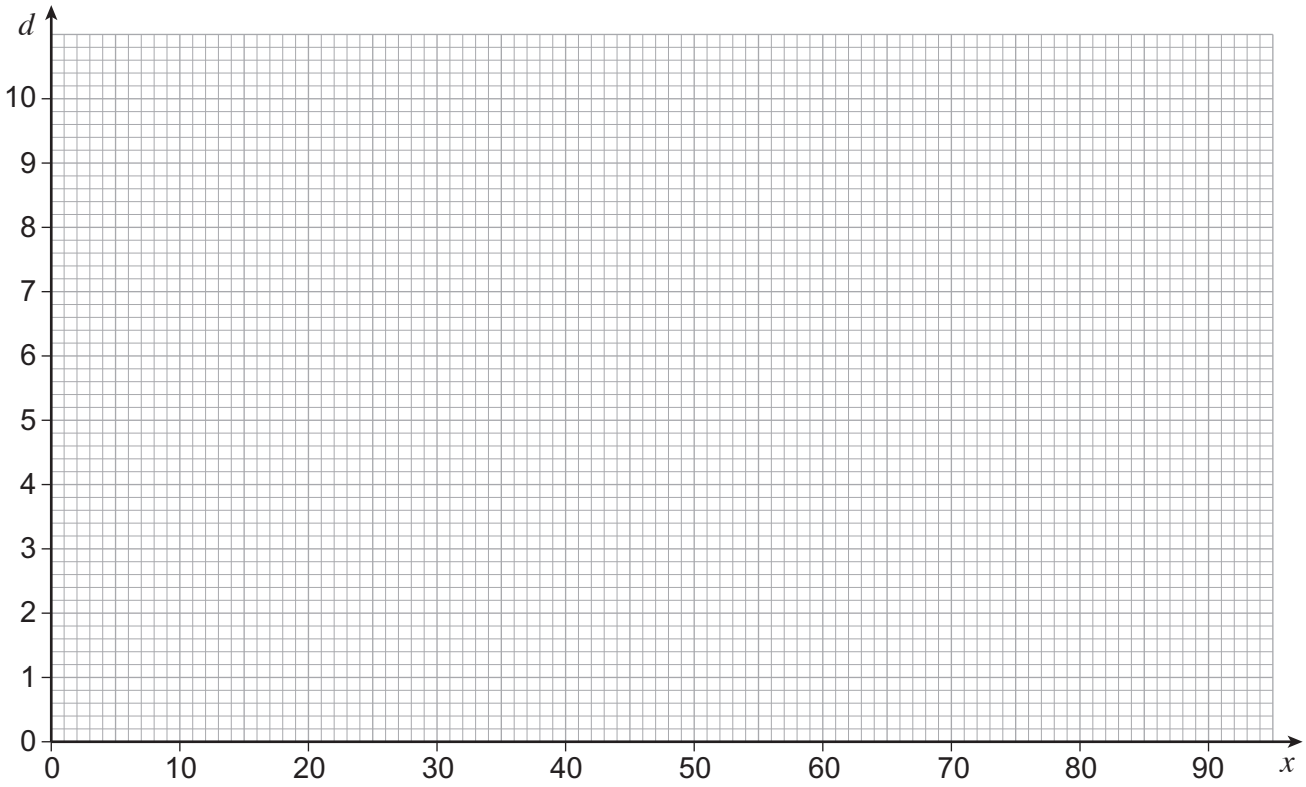
$$d = 20 \times \sin x \times \cos x$$

18 (a) Here is a table of values for x and d.

x	0	10	20	30	40	45	50	60	70	80	90
d	0	3.4	6.4	8.7	9.8	10	9.8	8.7	6.4	3.4	0

On the grid opposite, draw the graph of $d = 20 \times \sin x \times \cos x$ for values of x from 0 to 90

[2 marks]



18 (b) In this question, you **must** show your working on the graph above.

Complete this statement.

[2 marks]

For d to be more than 7 metres, x must be between ..... and .....

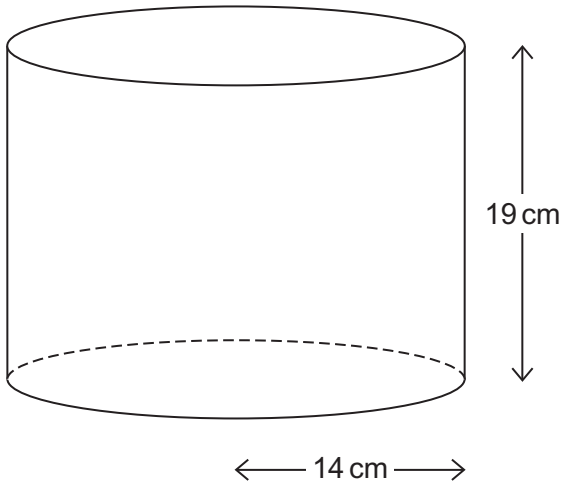
Turn over for the next question

4

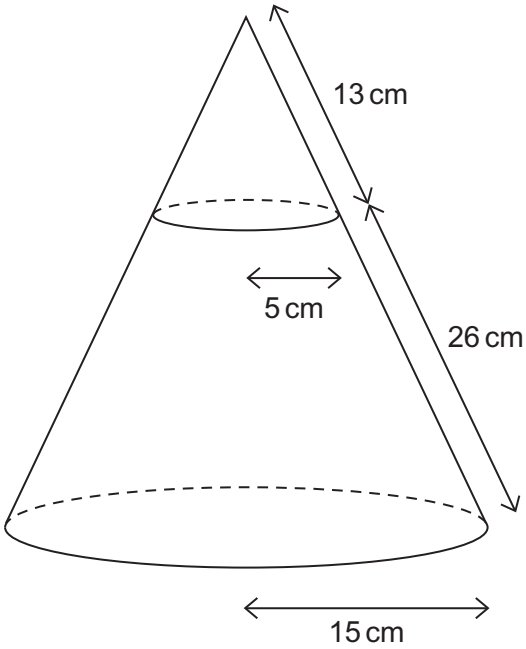
***19** Two lampshades, A and B, are made using the same material.

Lampshade A is the curved surface of a cylinder with radius 14 cm and height 19 cm

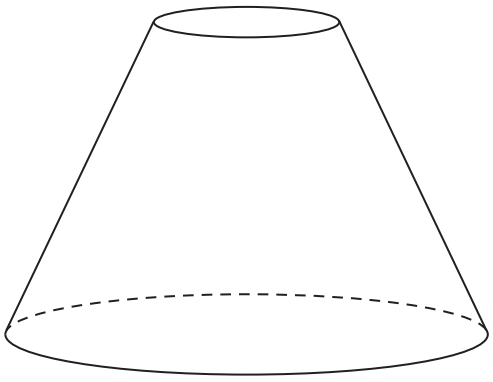
Lampshade A



Lampshade B is the curved surface of a frustum of a cone.
The frustum is the shape remaining when a cone, radius 15 cm, has a smaller cone, radius 5 cm, removed from it as shown.



Lampshade B



Which lampshade has more material?
You **must** show your working.

[4 marks]

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Turn over for the next question

4

20 A dish contains some bacteria.

An antibiotic is added to the dish.

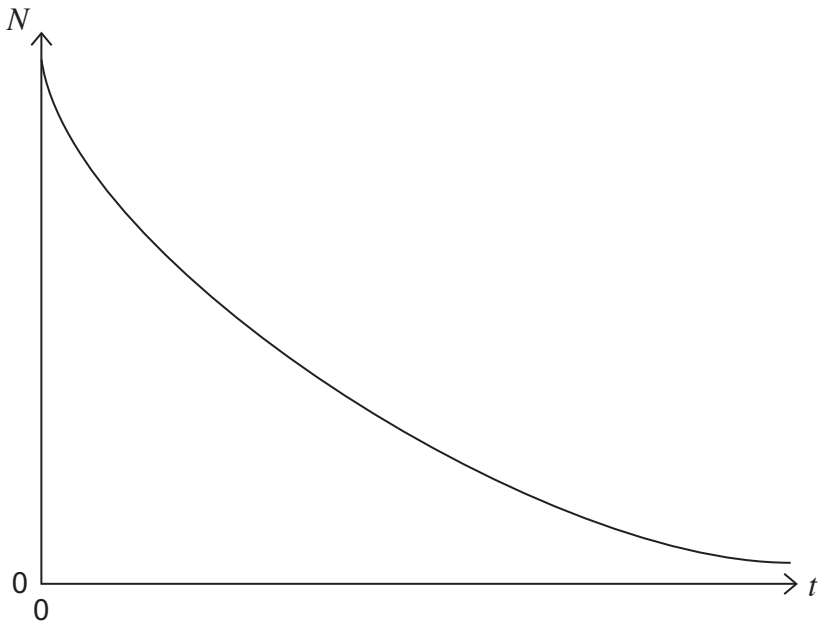
The antibiotic reduces the number of bacteria in the dish.

N is the number of bacteria t hours after the antibiotic is added.

The relationship between N and t is modelled by

$N = 12\,000a^t$ where a is a positive constant.

A sketch graph of $N = 12\,000a^t$ is shown.



20 (a) Show that there are 12 000 bacteria in the dish when the antibiotic is added.

[1 mark]

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20 (b) There are 6144 bacteria in the dish after 3 hours.

Work out the value of a.

[2 marks]

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Answer .....

20 (c) Show that approximately one-sixth of the bacteria are left in the dish after 8 hours.

[1 mark]

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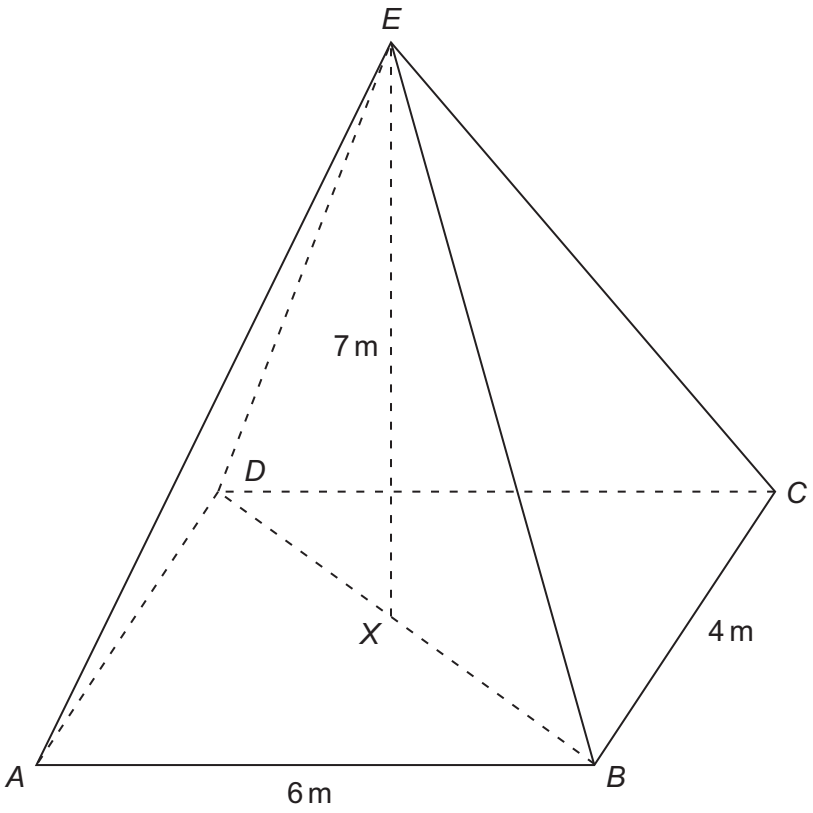
Turn over for the next question

4

21 A tent is in the shape of a pyramid with a horizontal rectangular base *ABCD*.
The vertex, *E*, is directly above the centre of the base, *X*.

The height of the pyramid is 7 m



Work out the size of the angle that *EB* makes with *ABCD*.

[4 marks]

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Answer ..... degrees

END OF QUESTIONS

4

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