# AQA

# GCSE
# APPLICATIONS OF MATHEMATICS (LINKED PAIR)   **H**

Higher Tier      Unit 2   Geometry and Measures

Thursday 10 November 2016     Morning     Time allowed: 1 hour 30 minutes

## Materials
For this paper you must have:
● a calculator
● mathematical instruments.

## Instructions
● Use black ink or black ball-point pen.  Draw diagrams in pencil.
● 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.

## 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, 6 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.

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

**Formulae Sheet: Higher Tier**

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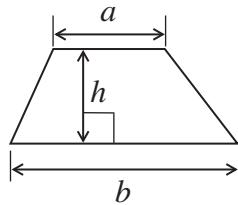
**Volume of prism** = area of cross section × length
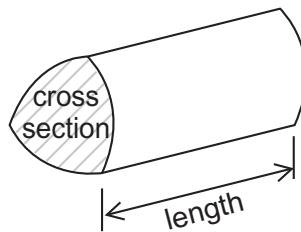
**Volume of sphere** = $\frac{4}{3}\pi r^3$

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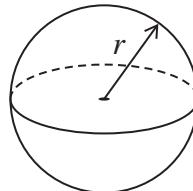
**Volume of cone** = $\frac{1}{3}\pi r^2 h$

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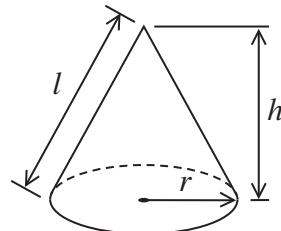
**In any triangle** *ABC*

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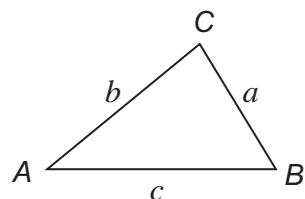
**The Quadratic Equation**

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** Here is Vikram's homework.
His teacher has correctly marked the first two parts.

Complete the marking.

**[2 marks]**

A trapezium has one pair of **parallel** sides. ✓

A rectangle has all **sides** equal. ✗

A rhombus has diagonals that are **equal**. _____

A kite has diagonals that are **perpendicular**. _____

**Turn over for the next question**

**2**

**Turn over ▶**

**2** Rob makes garden storage boxes from wood.
Each box is a cuboid with a lid.
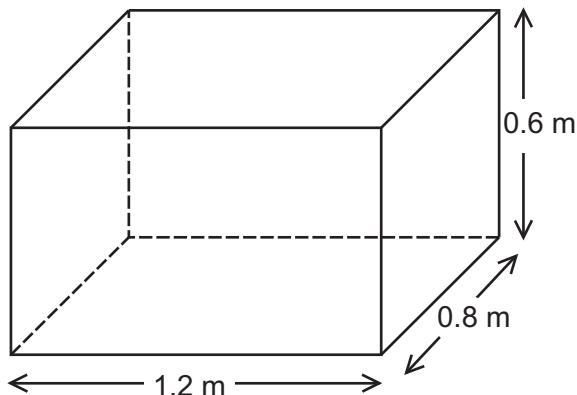


**2 (a)** Show that the total surface area of the outside of one box is 4.32 m$^2$

**[2 marks]**

**2 (b)**     Rob covers the outside of each box with wood preserver.
Here are the instructions for using the wood preserver.

> Cover each surface **three** times
>
> Each litre covers 6.5 m$^2$ once

Rob has 15 litres of wood preserver.

Is this enough to cover 8 boxes?
You **must** show your working.

**[3 marks]**

_____

_____

_____

_____

_____

_____

_____

**Turn over for the next question**

**3** Sophie makes pink paint by mixing red paint and white paint.

For **light** pink she mixes red and white in the ratio 1 : 3
For **dark** pink she mixes red and white in the ratio 2 : 1

She has 20 litres of **light** pink.
She adds some red to make **dark** pink.

How much red does she add?

**[4 marks]**

_____

_____

_____

_____

_____

Answer _____ litres

**4**    Pam has 80 beads.
Ellie has 44 beads.

Ellie gives $x$ beads to Pam.

**4 (a)**    How many beads do Pam and Ellie now have?
Tick a box.

**[1 mark]**

Pam has (80 + $x$) beads
Ellie has (44 + $x$) beads    ☐

Pam has (80 + $x$) beads
Ellie has (44 – $x$) beads    ☐

Pam has (80 – $x$) beads
Ellie has (44 + $x$) beads    ☐

Pam has (80 – $x$) beads
Ellie has (44 – $x$) beads    ☐

**\*4 (b)**    Pam now has three times as many beads as Ellie.

Set up and solve an equation to work out how many beads Ellie gives to Pam.

**[4 marks]**

_____

_____

_____

_____

_____

_____

_____

Answer _____

9

**5** One patty and one bread roll are used to make a vegetable burger.

Patties are sold in packs of 15
Each pack costs £8.24

Bread rolls are sold in packs of 20
Each pack costs £3.25

Nick buys the same number of patties as bread rolls.
He buys enough to make **more than** 100 vegetable burgers.

Work out the least amount he could pay.

**[3 marks]**

Answer £ _____

*6 Shalina makes two cakes.
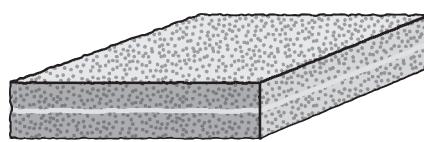
| Cake A | Cake B |
|---|---|
| Cuboid measuring 22 cm by 15 cm by 5 cm | Cylinder of base radius 10 cm and height 5 cm |
| Cost of ingredients is £3.96 | |

The cost of the ingredients, per $cm^3$, is the same for each cake.
Shalina wants to sell cake B and make 50% profit on the cost of its ingredients.

How much should she sell cake B for?

**[6 marks]**

Answer £ _____

9

**7** A box is a triangular prism.
All dimensions are in centimetres.
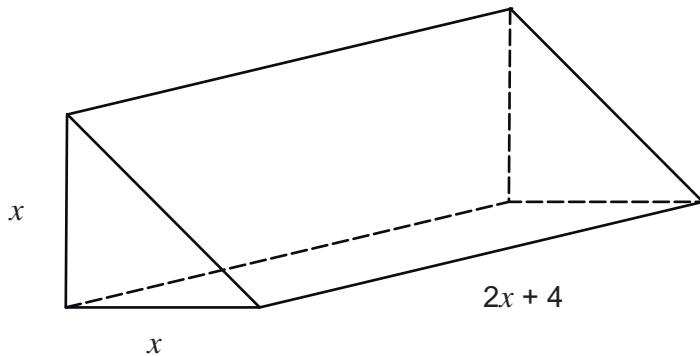


The formula for the volume of the box, $V$ cm$^3$, is

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

Use trial and improvement to work out the value of $x$ when $V = 780$
Give your answer to one decimal place.

Use the table opposite for your trials.
You **must** show your working.

**[4 marks]**

| $x$ | $x^3 + 2x^2$ | $V$ | Comment |
|---|---|---|---|
| 8 | $8^3 + 2 \times 8^2$ <br> $= 512 + 128$ | 640 | Too small |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

Answer = _____

**Turn over ▶**

**8**    Mike makes designs from wire.

**8 (a)**    In this design, two lines are parallel.

Not drawn
accurately

139°

$f$
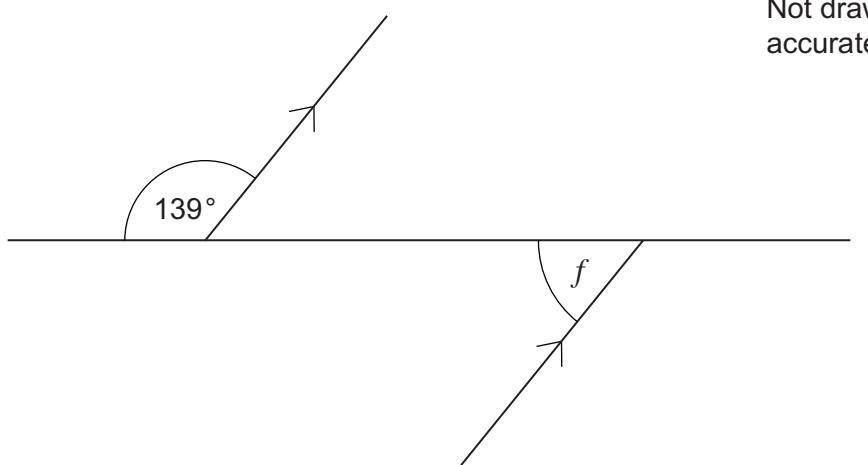
Work out the size of angle $f$.

**[2 marks]**

_____

_____

$f =$ _____degrees

**8 (b)**   This design is a triangle.

Not drawn
accurately

34 cm                          26 cm

42 cm
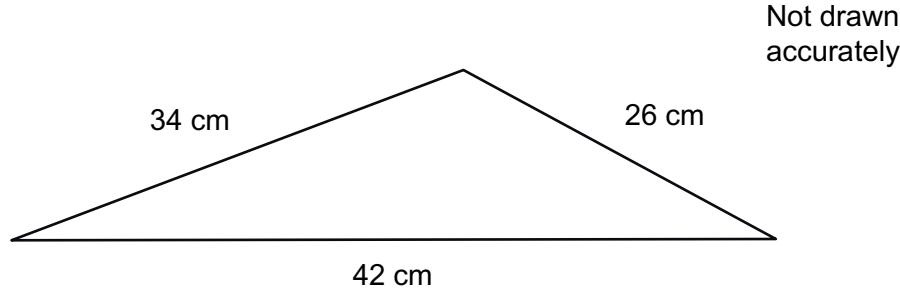
Mike makes a larger, **similar** triangle.
The longest side is 73.5 cm

Work out the **total** length of wire needed for the larger triangle.

**[3 marks]**

Answer _____ cm

**Turn over for the next question**

**5**

**Turn over ▶**

**9** Sue makes an enlargement of this square picture.



Not drawn accurately

7 cm

7 cm
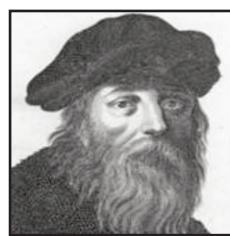
She makes the edges of the square 3.5 times bigger.
She makes a frame for the **enlarged** picture using four identical pieces of wood.



Not drawn accurately

She cuts the pieces from a rectangular strip of width 2 cm

Not drawn accurately



2 cm

$x$
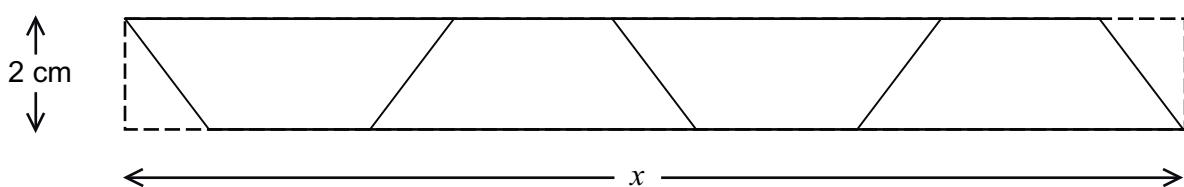
Here is one of the pieces.
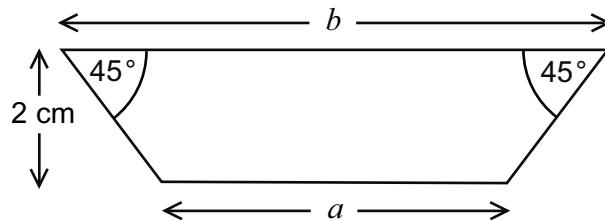
Not drawn accurately

**9 (a)** Work out the lengths of $a$ and $b$.

**[3 marks]**

_____

_____

_____

_____

$a =$ _____ cm   $b =$ _____ cm

**9 (b)** Work out the total length, $x$, of the rectangular strip.

Not drawn accurately
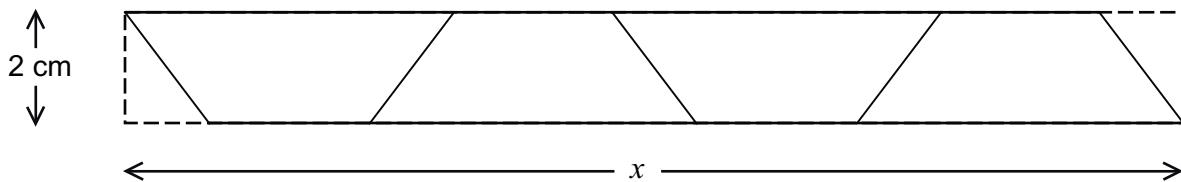
**[2 marks]**

_____

_____

_____

_____

_____

_____

Answer _____ cm

**5**

**Turn over ▶**

**10** A straight section of the steepest railway in the world rises 200 metres.

Not drawn accurately

200 m

$x$

157 m
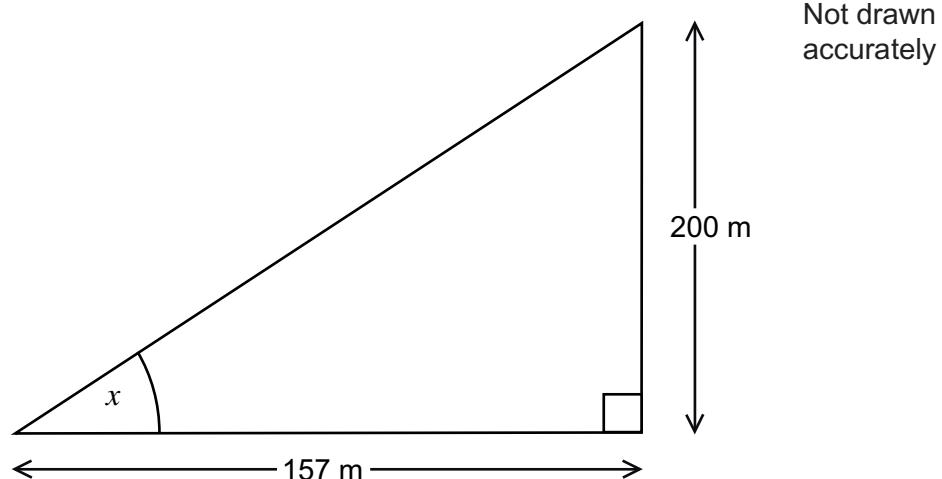
Work out the size of angle $x$.

**[3 marks]**

Answer _____degrees

**11** This silver cube has mass 256 grams.



Silver

2.9 cm

2.9 cm

2.9 cm
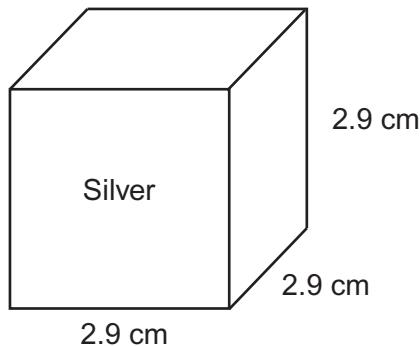
**11 (a)** Work out the density of the silver.
Give your answer to 1 decimal place.

**[3 marks]**

Answer _____ g per cm$^3$

**11 (b)** The volume of a gold bar is 13.2 cm$^3$
The density of gold is 19.3 g per cm$^3$

Is the gold bar heavier than the silver cube?
You **must** show your working.

**[2 marks]**

**8**

**Turn over ▶**

**12** The depth of water in a harbour is $d$ metres.

$$d = 12 - 5\sin(30t)°$$

$t$ is the number of hours after 7.00 am

**12 (a)** Here is a table of values for $\quad d = 12 - 5\sin(30t)°$

| $t$ | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|-----|----|-----|-----|---|-----|-----|----|------|------|----|------|------|
| $d$ | 12 | 9.5 | 7.7 | 7 | 7.7 | 9.5 | 12 | 14.5 | 16.3 | 17 | 16.3 | 14.5 |

Show that when $t$ is 12, the value of $d$ is 12

**[1 mark]**

**12 (b)**   On the grid draw the graph of   $d = 12 - 5\sin(30t)°$   for values of $t$ from 0 to 12

**[2 marks]**
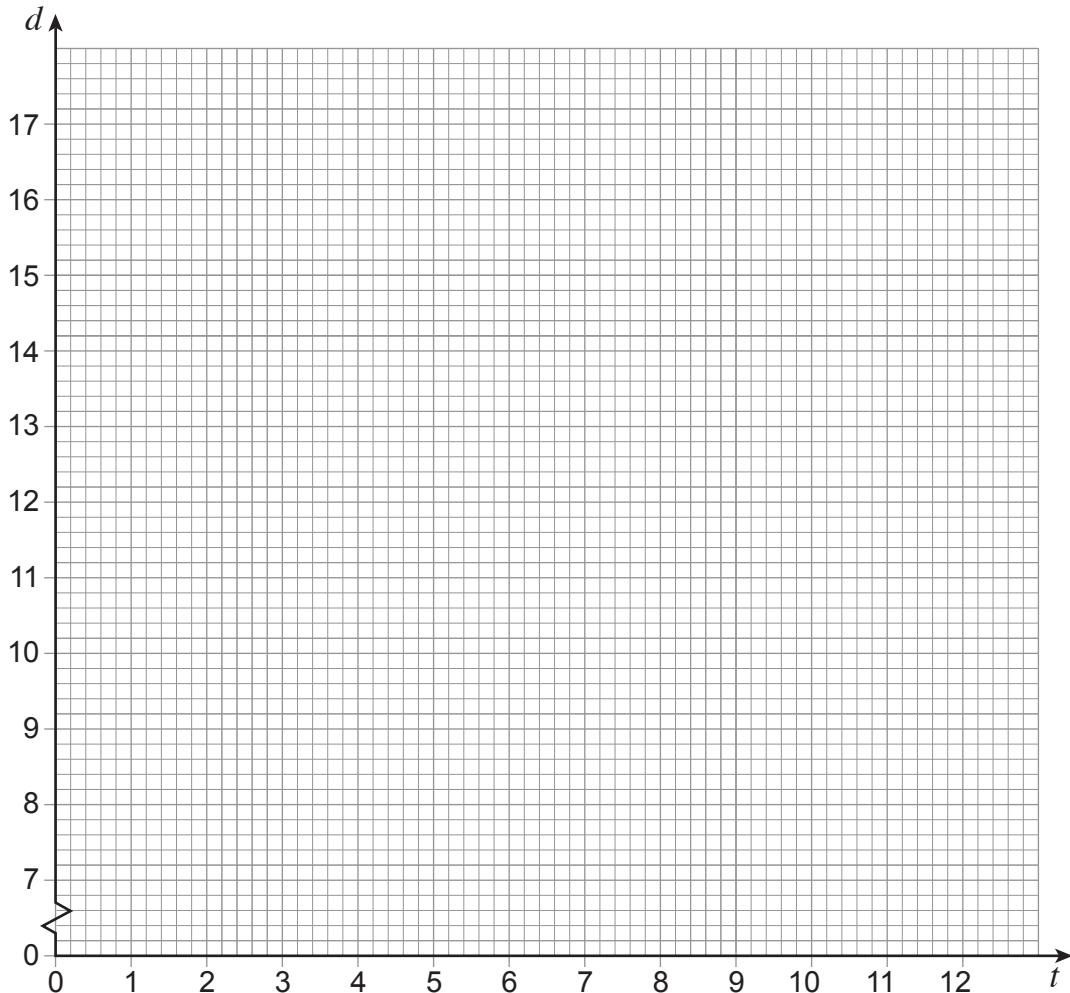


**12 (c)**   A ship can stay in the harbour when the depth of water is 14 metres or more.

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

**[2 marks]**

Answer _____ hours _____ minutes

**Turn over ▶**

**13** The shape of a candle is a pyramid *VABCD* on a cube *ABCDEFGH*.

*X* is the centre of *ABCD* and is vertically below *V*.

The edge of the cube is 5 cm

*VB* = 9 cm
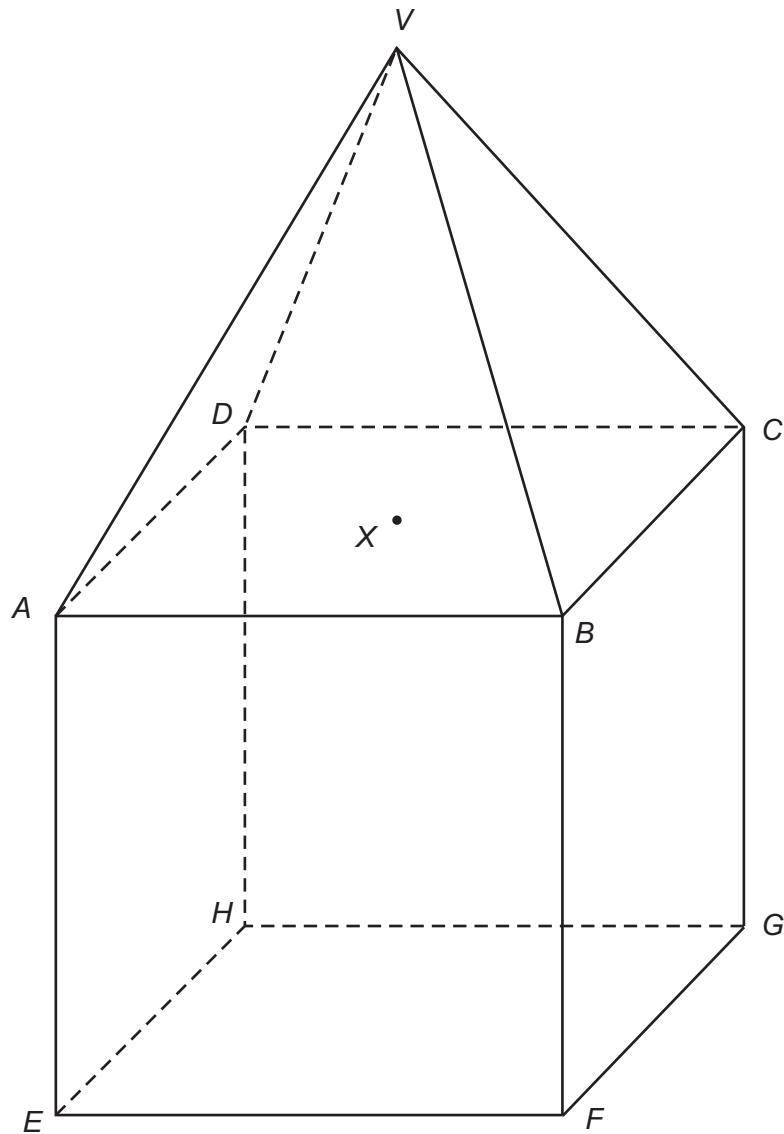
The candle just fits inside a cuboid box.
*EFGH* is put on the base of the box.

Work out the height of the box.

**[4 marks]**

Answer _____ cm

**Turn over for the next question**

4

**14** A flower bed is a sector of a circle with radius 12 m

Not drawn
accurately

12 m    12 m

75°
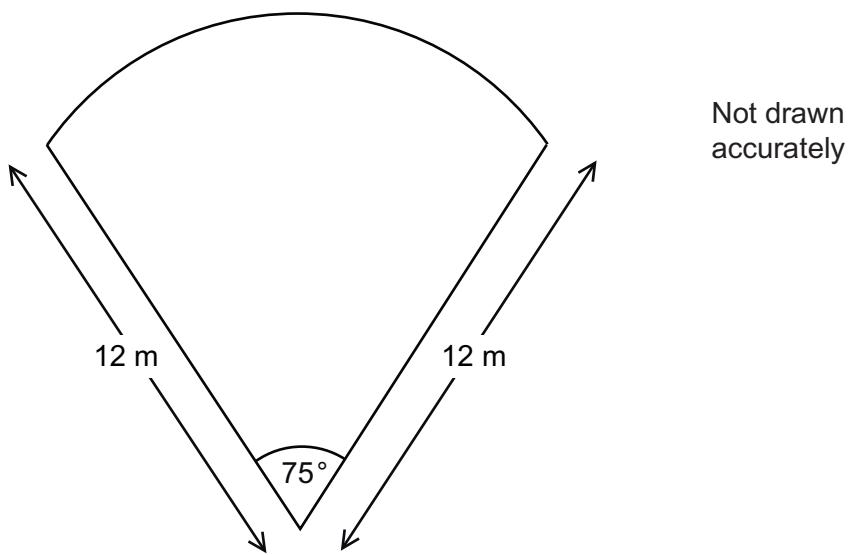
**14 (a)** Edging is to be put around the perimeter of the sector.

Work out the total length of edging needed.

**[3 marks]**

_____

_____

_____

_____

Answer _____ m

**14 (b)** The flower bed is divided into a triangle and a segment by a fence.

fence

Not drawn accurately

12 m

12 m

75°
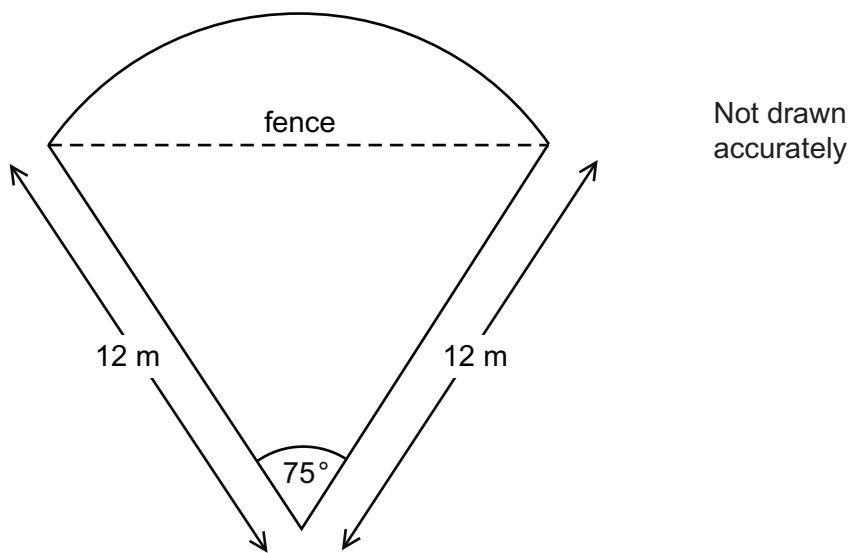
Work out the length of the fence.

**[3 marks]**

_____

_____

_____

_____

Answer _____ m

**Turn over for the next question**

**15** Container A is a frustum of a cone.
The container is made by removing a cone of radius 12 cm and height 27 cm from a cone of radius 20 cm and height 45 cm
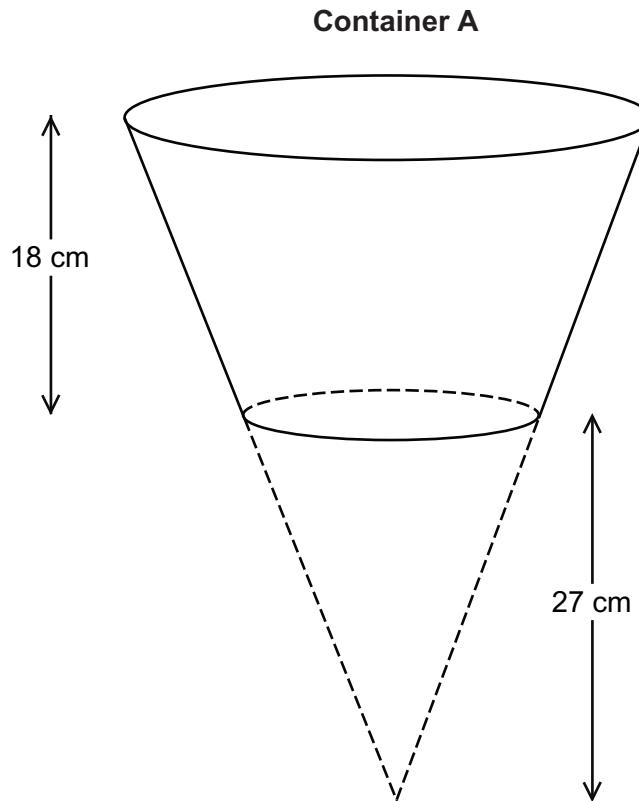
**Container A**



**15 (a)** Show that the volume of container A is $4704\pi$ cm$^3$

**[3 marks]**

**15 (b)**    Container B is a similar frustum to container A.

**Container B**

39.6 cm
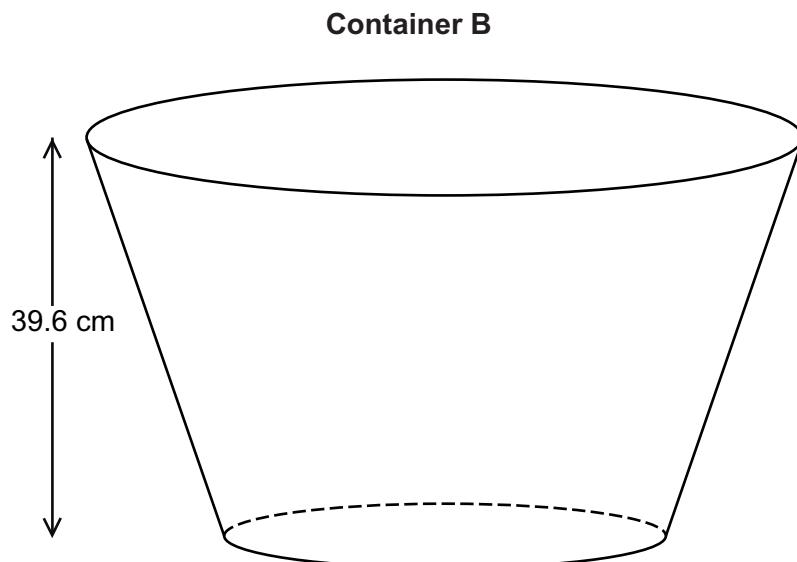
Work out the number of **litres** that container B can hold when full.

**[4 marks]**

Answer _____ litres

**Turn over for the next question**

**16**     Suzy and Joe cycle round a track.
One lap of the track measures 400 metres.

They both start from the same place.
Joe starts 20 seconds after Suzy starts.

Here are the speed-time graphs for their journeys.
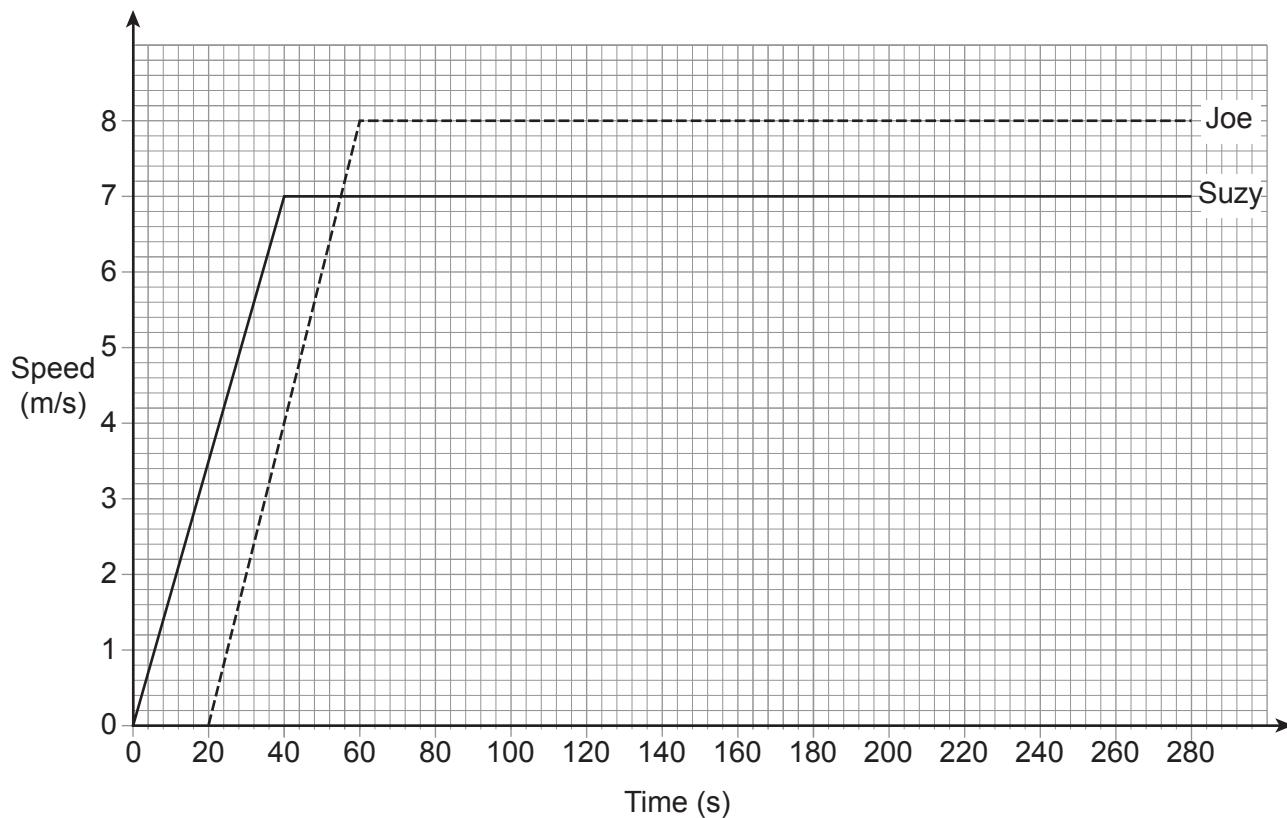
**\*16 (a)**    Show that Joe overtakes Suzy when they are on their third lap of the track.

**[4 marks]**

**16 (b)**    Work out Suzy's acceleration during the first 40 seconds.
State the units of your answer.

**[2 marks]**

Answer _____

**Turn over for the next question**

6

**17** The value of a painting $t$ years after 2012 is £$V$.
The painting increases in value each year.

$V = ka^t$      where $k$ and $a$ are positive constants.

Here is a sketch of   $V = ka^t$
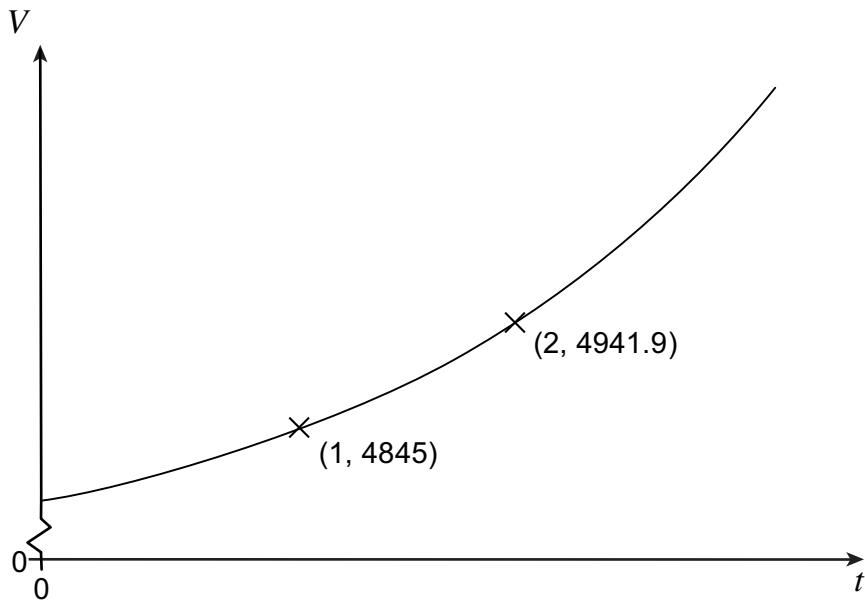


**17 (a)** Use the points (1, 4845) and (2, 4941.9) to work out the value of $a$.

**[3 marks]**

Answer _____

**17 (b)** Work out the value of the painting in 2012

[2 marks]

Answer £ _____

**END OF QUESTIONS**

5

**There are no questions printed on this page**

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

**There are no questions printed on this page**

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

**There are no questions printed on this page**

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