GCSE · Edexcel · Maths

2 hours 38 questions

Exam Questions

Area & Volume of Similar Shapes

Similar Areas & Volumes

Medium (16 questions)	/50
Hard (15 questions)	/50
Very Hard (7 questions)	/35
Total Marks	**/135**

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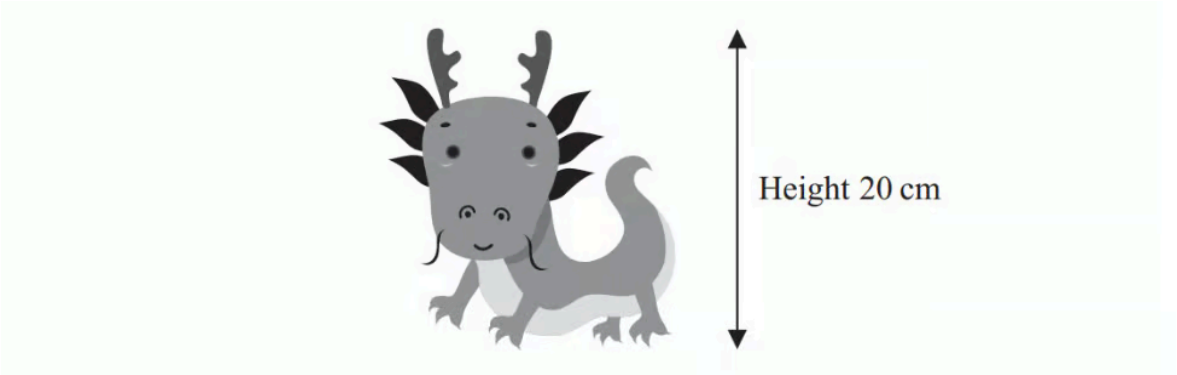
Medium Questions

1 A company makes monsters.

The company makes small monsters with a height of 20 cm.



A small monster has a surface area of 300 cm^2.

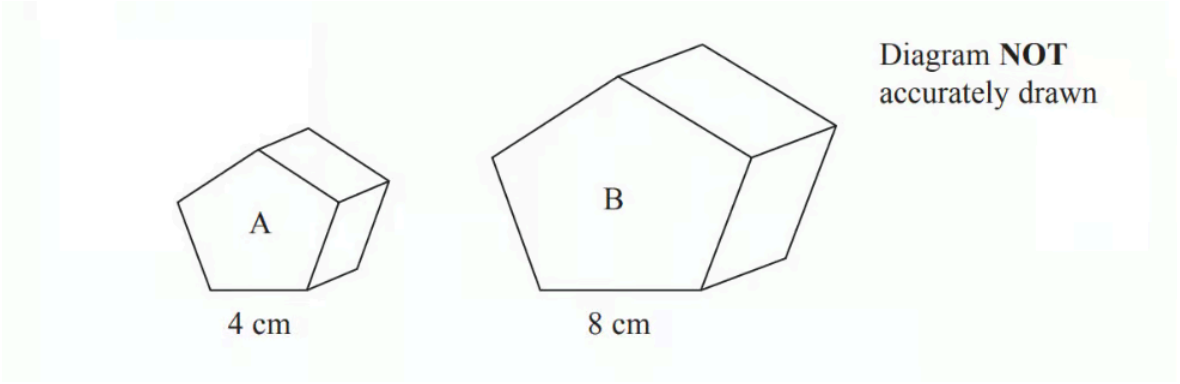
The company also makes large monsters with a height of 120 cm.

A small monster and a large monster are mathematically similar.

Work out the surface area of a large monster.

(3 marks)

2 (a) The diagram shows two similar solids, A and B.



Solid A has a volume of 80 cm^3.

Work out the volume of solid B.

(2 marks)

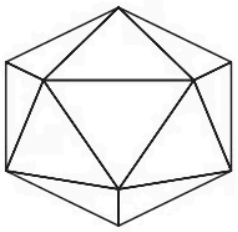
(b) Solid B has a total surface area of 160 cm^2.

Work out the total surface area of solid A.

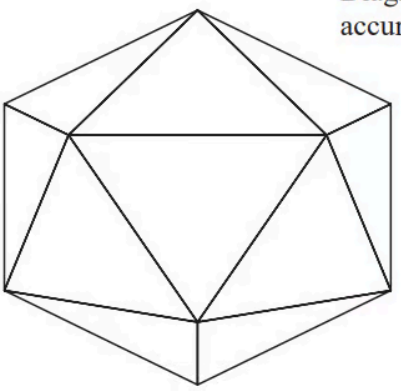
(2 marks)

3 **A** andare two similar solids.

Diagram **NOT** accurately drawn



A



B

A has a volume of 1836 cm^3
has a volume of 4352 cm^3

B has a total surface area of 1120 cm^2
Work out the total surface area of **A**.

..... cm^2

(3 marks)

4 **R** and **S** are two similar solid shapes.

Shape **R** has surface area $108cm^2$ and volume $135cm^3$
Shape **S** has surface area $300cm^2$

Work out the volume of shape **S**.

..... cm^3

(3 marks)

5 (a) **A** and **B** are two similar vases.

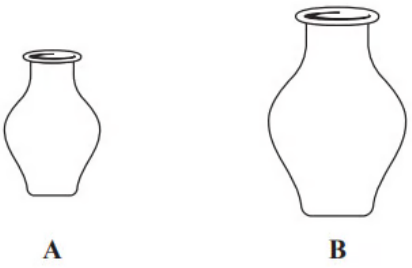


Diagram **NOT** accurately drawn

Vase **A** has height 24 cm.
Vase **B** has height 36 cm.

Vase **A** has a surface area of 960 cm^2

Work out the surface area of vase **B**.

.....cm^2

(2 marks)

(b) Vase **B** has a volume of V cm^3

Find in terms of V, an expression for the volume, in cm^3, of vase **A**.

.....cm^3

(2 marks)

6 Mathematically similar wooden blocks are made in a workshop.

There are small blocks and there are large blocks.

The volume of each small block is 300cm^3

Given that the surface area of each small block : the surface area of each large block = 25 : 36

work out the volume of each large block.

..... cm^3

(3 marks)

7 The diagram shows two mathematically similar vases, **A** and **B**.

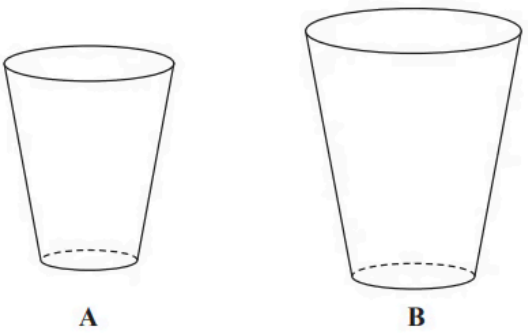


Diagram **NOT** accurately drawn

A has a volume of 405cm^3
B has a volume of 960cm^3

B has a surface area of 928cm^2

Work out the surface area of **A**.

(3 marks)

8 The diagram shows two similar bottles, **A** and **B**.

Diagram **NOT** accurately drawn

Bottle **A** has surface area $240\ \text{cm}^2$
Bottle **B** has surface area 540 cm^2 and volume $2025\ \text{cm}^3$
Work out the volume of bottle **A**.

.....cm^3

(3 marks)

9 A and B are similar solid cylinders.

base area of A : base area of B = 9 : 25

Complete these ratios.

curved surface area of A : curved surface area of B =..... : .....

height of A : height of B =..... : .....

(2 marks)

10 A and B are similar cuboids.

surface area of A : surface area of B = 16 : 25

Work out volume of A : volume of B

A. 4 : 5

B. 16 : 25

C. 64 : 125

D. 256 : 625

(1 mark)

11 Solids X and Y are similar.

X has volume 64 cm^3
Y has volume 343 cm^3

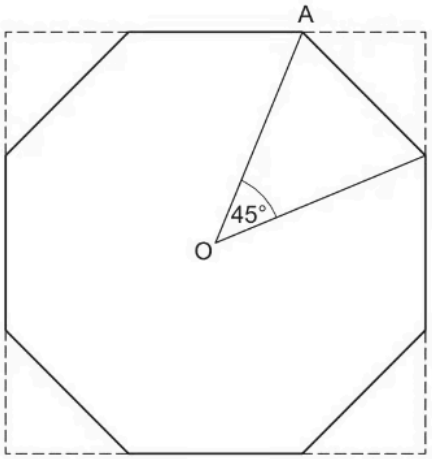
The surface area of X is 176 cm^2
Work out the surface area of Y.

.....cm^2

(3 marks)

12 Simon cuts the corners off a square piece of card to leave the regular octagon shown

below.



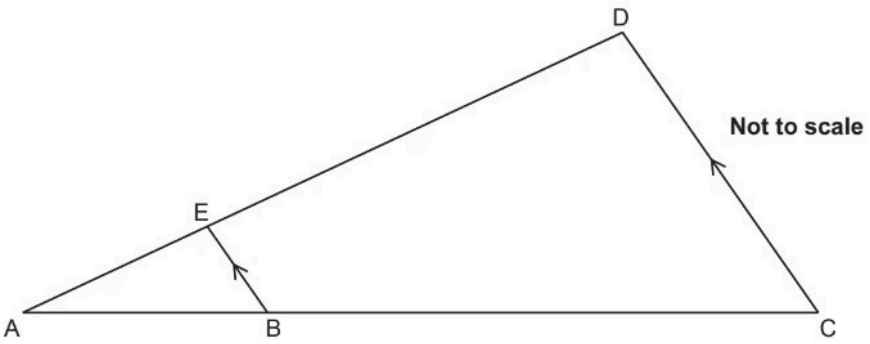
Not to scale

Simon makes a table top using the card as a model.
The sides of the table top are 8 times as long as the sides of the card model.

Find the ratio of the **area** of Simon's table top to the **area** of the card model.

(2 marks)

13 In the diagram, AED and ABC are straight lines and BE is parallel to CD.



Not to scale

The ratio of length AB to length BC is 2 : 3.
Triangle ABE has an area of $8cm^2$.

Work out the area of triangle ACD.

..... cm^2

(4 marks)

14 A transport lorry consists of a cab and a trailer.
The trailer has a volume of $90m^3$.
Alfie makes a model of this lorry using a scale of 1 : 72.

Work out the volume of the trailer in Alfie's model, giving your answer in cm^3.

..... cm^3

(3 marks)

15 Toy building bricks are available in two sizes, small and large.

The small and large bricks are mathematically similar.

A small brick has volume $8cm^3$ and width 2.1cm.

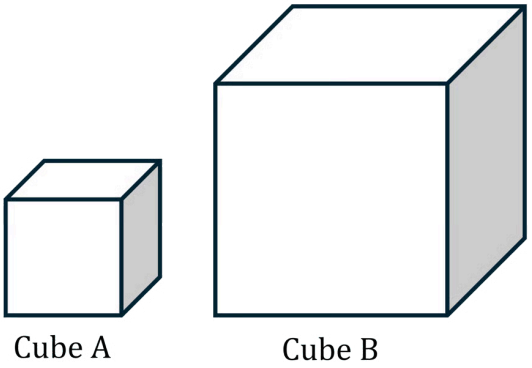
A large brick has volume 15.625 cm^3.

Calculate the width of a large brick.

..... cm

(4 marks)

16 Here are two cubes, A and B.



The area of one of the faces of Cube A is 25% of the area of one of the faces of Cube B.

Express the volume of Cube A as a percentage of the volume of Cube B.

(5 marks)

Hard Questions

1 Fred is making two rectangular flower beds.

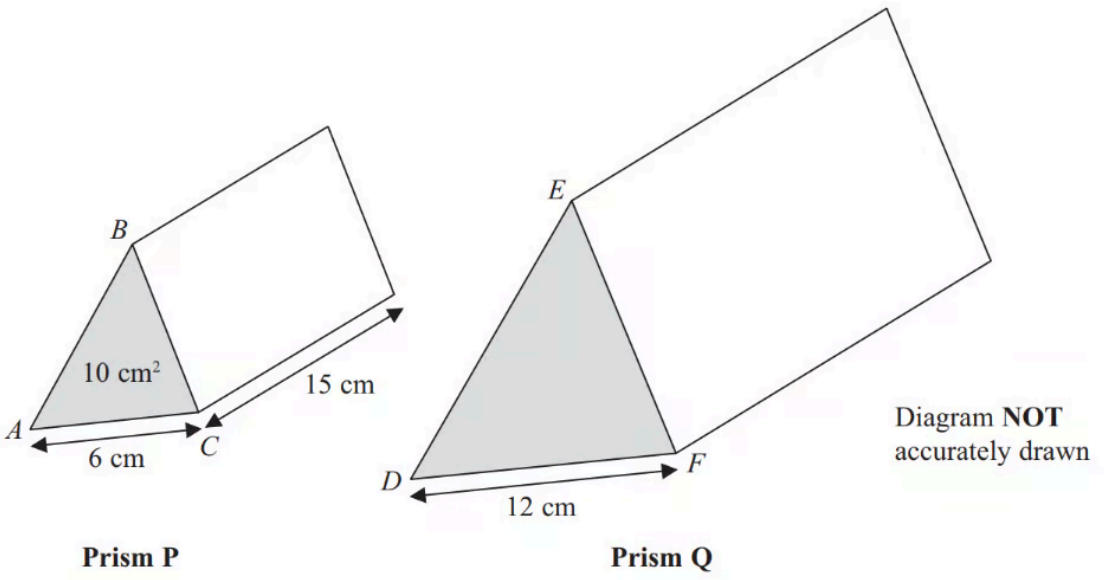
The dimensions of the larger rectangle will be three times the dimensions of the smaller rectangle.

There is going to be the same depth of soil in each flower bed. Fred needs 180 kg of soil for the smaller flower bed.

Work out how much soil Fred needs for the larger flower bed.

(2 marks)

2 **P** and **Q** are two triangular prisms that are mathematically similar.



Prism **P** has triangle ABC as its cross section.
Prism **Q** has triangle DEF as its cross section.

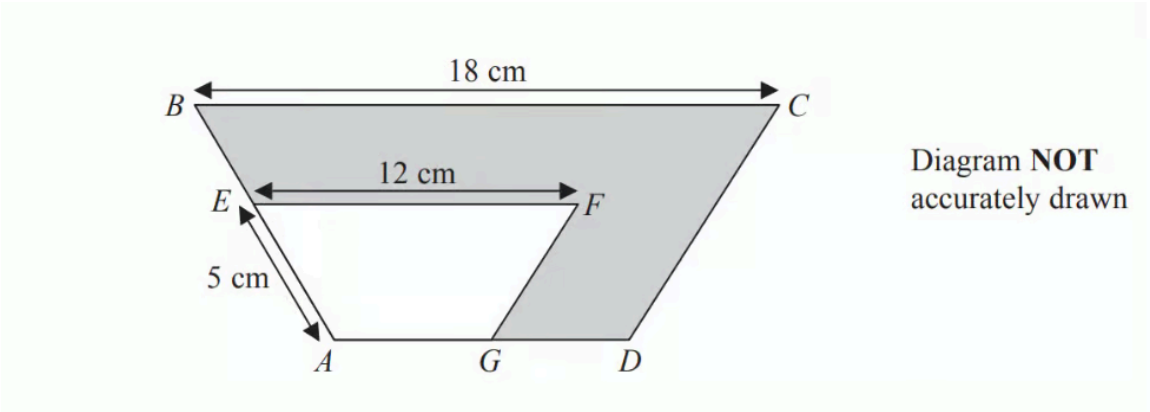
AC = 6 cm
DF= 12 cm

The area of the cross section of prism $\mathbf{P}$ is 10 cm^2.
The length of prism $\mathbf{P}$ is 15 cm.

Work out the volume of prism $\mathbf{Q}$.

(4 marks)

3 (a)



$ABCD$ and $AEFG$ are mathematically similar trapeziums.

$AE = 5$ cm
$EF = 12$ cm
$BC = 18$ cm

Work out the length of AB.

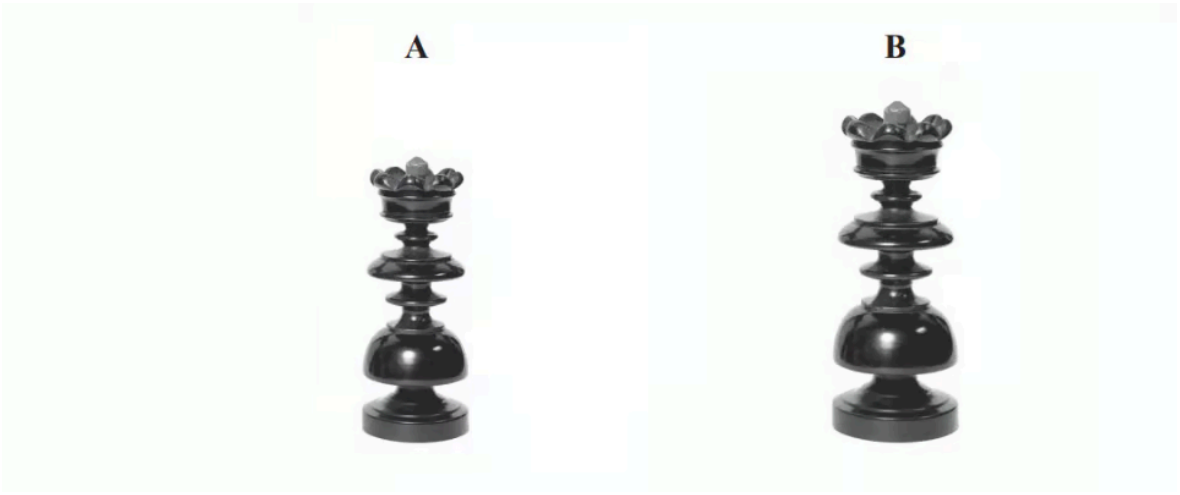
(2 marks)

(b) Trapezium $AEFG$ has an area of 36 cm^2.

Work out the area of the shaded region.

(3 marks)

4 Here are two similar solid shapes.



surface area of shape **A** : surface area of shape **B** = 3:4

The volume of shape **B** is 10 cm^3

Work out the volume of shape **A**.
Give your answer correct to 3 significant figures.

(3 marks)

5 Solid **A** and solid **B** are mathematically similar.
The ratio of the surface area of solid **A** to the surface area of solid **B** is 4: 9

The volume of solid **B** is 405 cm^3.

Show that the volume of solid **A** is 120cm^3.

(3 marks)

6 Mark has made a clay model.
He will now make a clay statue that is mathematically similar to the clay model.

The model has a base area of $6cm^2$
The statue will have a base area of $253.5\ cm^2$

Mark used 2kg of clay to make the model.

Clay is sold in 10kg bags.
Mark has to buy all the clay he needs to make the statue.

How many bags of clay will Mark need to buy?

(3 marks)

7 Cone **A** and cone **B** are mathematically similar.
The ratio of the volume of cone **A** to the volume of cone **B** is 27:8

The surface area of cone **A** is $297\ cm^2$

Show that the surface area of cone **B** is $132\ cm^2$

(3 marks)

8 (a) The circumference of circle **B** is 90% of the circumference of circle **A**.

Find the ratio of the area of circle **A** to the area of circle **B**.

(2 marks)

(b) Square **E** has sides of length e cm.
Square **F** has sides of length f cm.

The area of square **E** is 44% greater than the area of square **F**.

Work out the ratio $e : f$

(2 marks)

9 The three solids $\mathbf{A}$, $\mathbf{B}$ and C are similar such that

- the surface area of $\mathbf{A}$: the surface area of $\mathbf{B} = 4 : 9$
- and the volume of $\mathbf{B}$: the volume of $\mathbf{C} = 125 : 343$

Work out the ratio

the height of $\mathbf{A}$: the height of $\mathbf{C}$

Give your ratio in its simplest form.

(4 marks)

10 $ABCDEF$ and $GHIJKL$ are regular hexagons each with centre O.

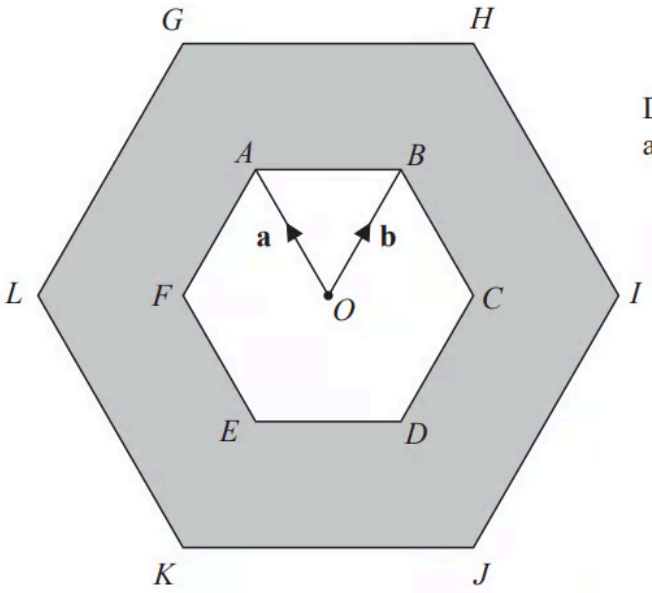


Diagram **NOT** accurately drawn

$GHIJKL$ is an enlargement of $ABCDEF$, with centre O and scale factor 2

The triangle OAB has an area of 5 cm^2

Calculate the area of the shaded region.

..... cm^2

(3 marks)

11 $ABCDE$ and $AFGHJ$ are regular pentagons.

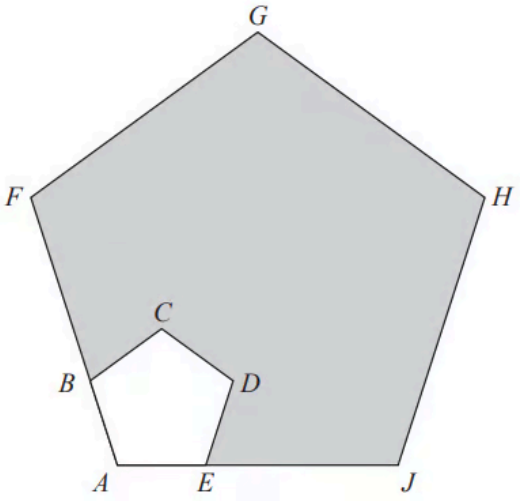


Diagram **NOT** accurately drawn

AEJ and ABF are straight lines.

$EJ = 4AE$

The area of $ABCDE$ is $8\ \text{cm}^2$

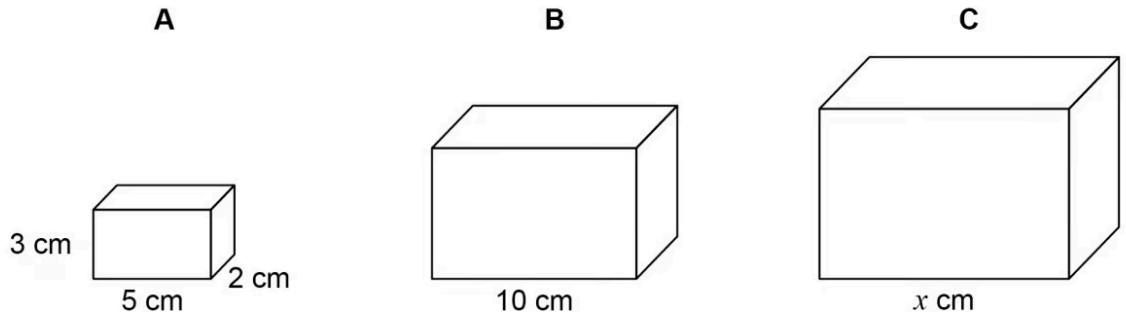
Calculate the area of the shaded region.

.....cm^2

(3 marks)

12 (a) Here are three similar cuboids, A, B and C.

A has length 5 cm, width 2 cm and height 3 cm
B has length 10 cm
C has length x cm



The total surface area of A is 62 cm^2

Tim wants to work out the total surface area of B.
Here is his working.

$$10 \div 5 = 2$$
$$62 \times 2 = 124$$
$$\text{Total surface area of B} = 124 \text{ cm}^2$$

Make one criticism of Tim's method.

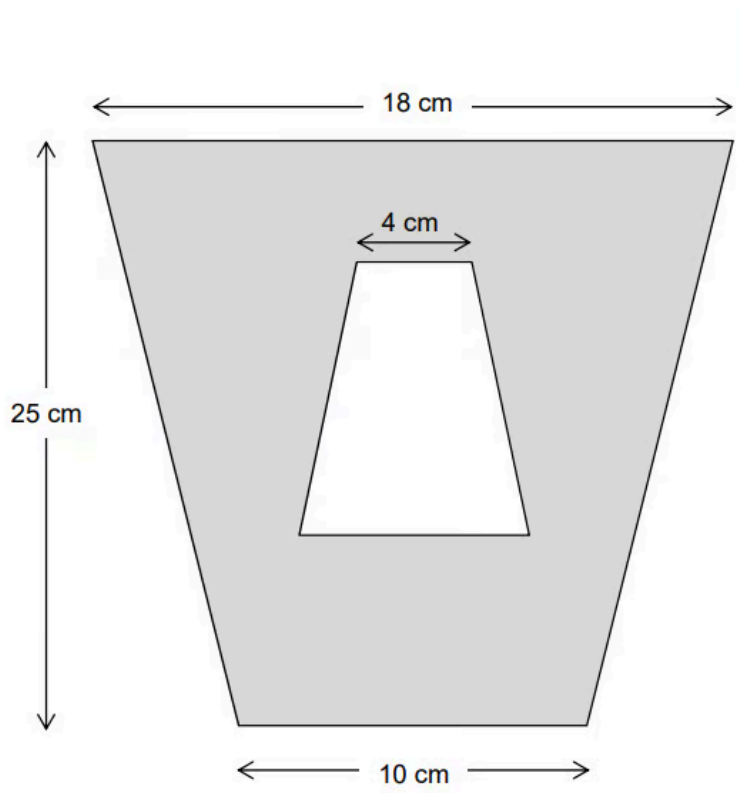
(1 mark)

(b) Volume of $A \times \frac{125}{8}$ = Volume of C

Work out the value of x.

(3 marks)

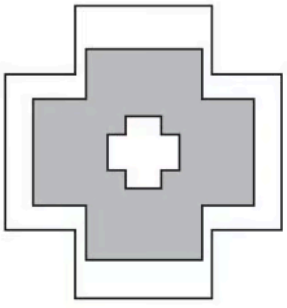
13 A pattern is made from two **similar** trapeziums.



Show that the shaded area is 294 cm^2

(1 mark)

14 The diagram consists of three mathematically similar shapes. The heights of the shapes are in the ratio 1 : 4 : 5.



Not to scale

Find the ratio

total shaded area : total unshaded area.

Give your answer in its simplest form.

total shaded area : total unshaded area ..... : .....

(4 marks)

15 Prism P and prism Q are similar.
The ratio of the surface area of prism P to the surface area of prism Q is 1 : 3.

i) Jay says

The height of prism P is one third of the height of prism Q.

Explain why he is wrong.

[1]

ii) The volume of prism Q is 86 cm^3.

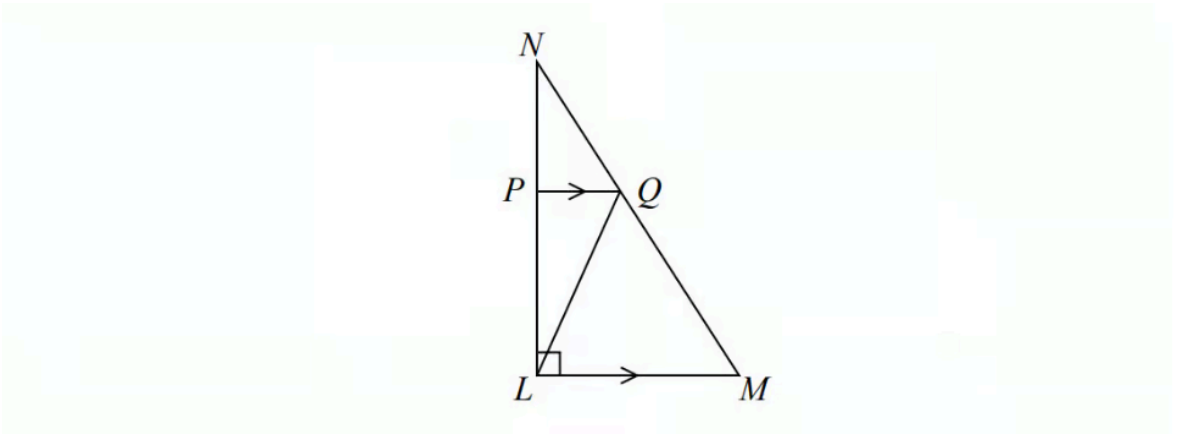
Calculate the volume of prism P.

..... cm^3 [3]

(4 marks)

Very Hard Questions

1 LMN is a right-angled triangle.



Angle NLM= 90°
PQ is parallel to LM.

The area of triangle PNQ is 8 cm^2
The area of triangle LPQ is 16 cm^2

Work out the area of triangle LQM.

(4 marks)

2 The diagram shows two similar vases, **A** and **B**.

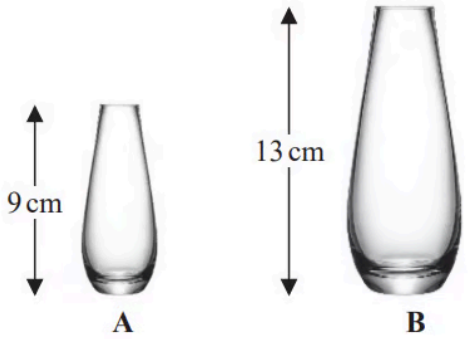


Diagram **NOT** accurately drawn

The height of vase **A** is 9cm and the height of vase **B** is 13 cm.

Given that

surface area of vase **A** + surface area of vase **B** = 1800cm^2

calculate the surface area of vase **A**.

.....cm^2

(4 marks)

3 A sphere of radius r has a surface area of $4\pi r^2$ and a volume of $\frac{4}{3}\pi r^3$.

A cylinder of radius r and height h has a curved surface area of $2\pi rh$ and a volume of $\pi r^2 h$.

The total surface area of a solid hemisphere is equal to the curved surface area of a cylinder.

The radius of the hemisphere is r cm.
The radius of the cylinder is twice the radius of the hemisphere.

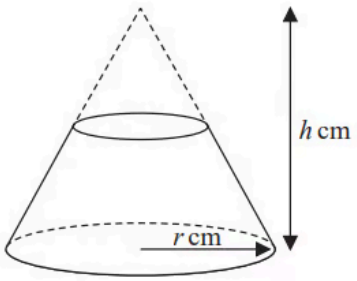
Given that

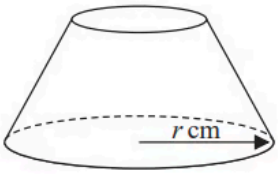
$$\text{volume of hemisphere} : \text{volume of cylinder} = 1 : m$$

find the value of m.

(4 marks)

4 A frustum is made by removing a small cone from a large cone. The cones are mathematically similar.





Frustum

Diagram **NOT** accurately drawn

The large cone has base radius r cm and height h cm. Given that

$$\frac{\text{volume of frustum}}{\text{volume of large cone}} = \frac{98}{125}$$

find an expression, in terms of h, for the height of the frustum.

..... cm

(4 marks)

5 **A** and **B** are two similar vases.

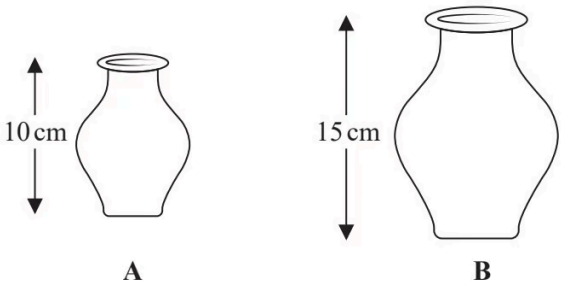


Diagram **NOT** accurately drawn

Vase **A** has height 10 cm.
Vase **B** has height 15 cm.

The difference between the volume of vase **A** and the volume of vase **B** is 1197 cm^3

Calculate the volume of vase **A**

..... cm^3

(4 marks)

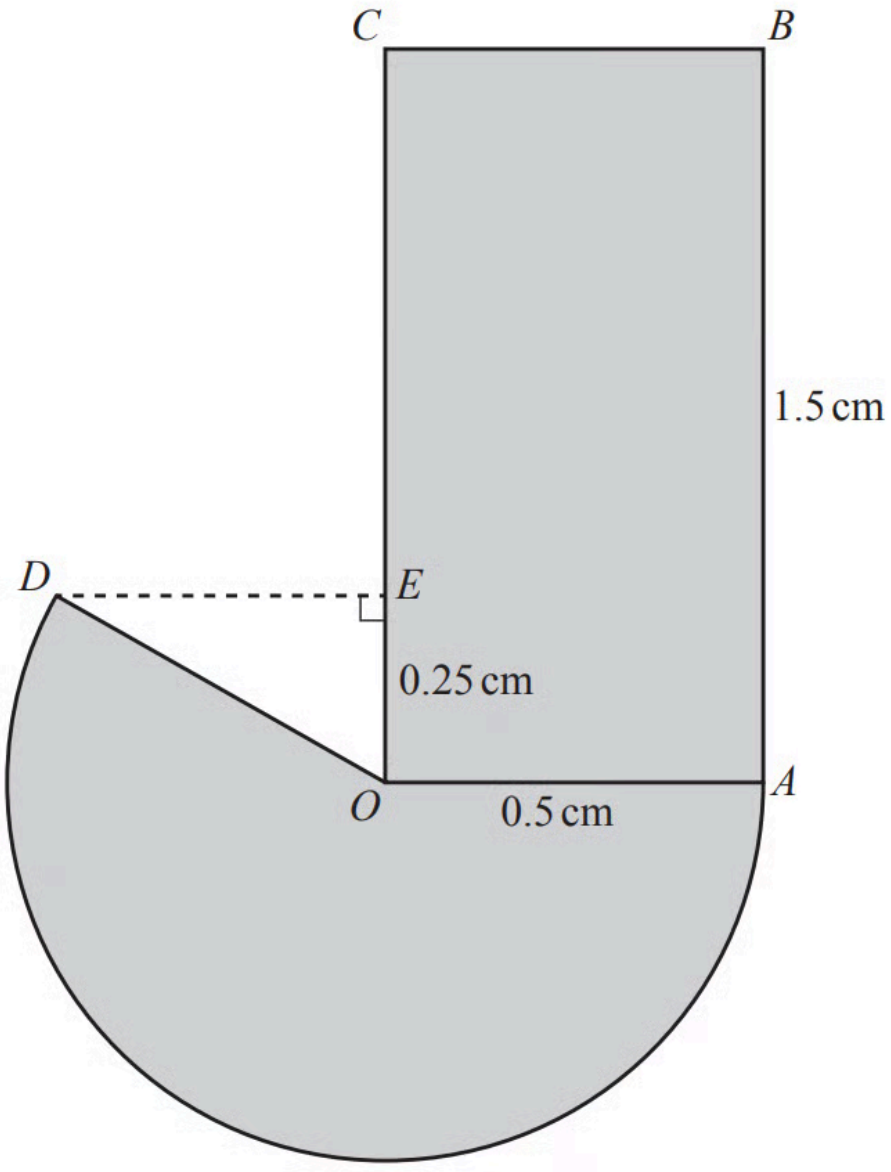
6 A standard tin and a large tin are mathematically similar.
The **volume** of the large tin is 50% more than the volume of the standard tin.
Both tins are cylinders.
The radius of the standard tin is 10cm.

Calculate the radius of the large tin.

..... cm

(4 marks)

7 (a)



The diagram shows a company logo made from a rectangle and a major sector of a circle.
The circle has centre O and radius OA.
$OA = OD = 0.5$ cm and $AB = 1.5$ cm.
E is a point on OC such that $OE = 0.25$ cm and angle $OED = 90°$.

Calculate the perimeter of the logo.

..... cm

(5 marks)

(b) Calculate the area of the logo.

..... cm^2

(3 marks)

(c) A mathematically similar logo is drawn.
The area of this logo is 77.44 cm^2.

Calculate the radius of the major sector in this logo.

..... cm

(3 marks)