

Name:

Date:

# SIMILAR SHAPES (AREA & VOLUME)

## GCSE

Edexcel

Mathematics

Grade 6

Mark

Grade

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### Materials

For this paper you must have:

- Ruler
- Pencil and Rubber
- Scientific calculator, which you are expected to use when appropriate

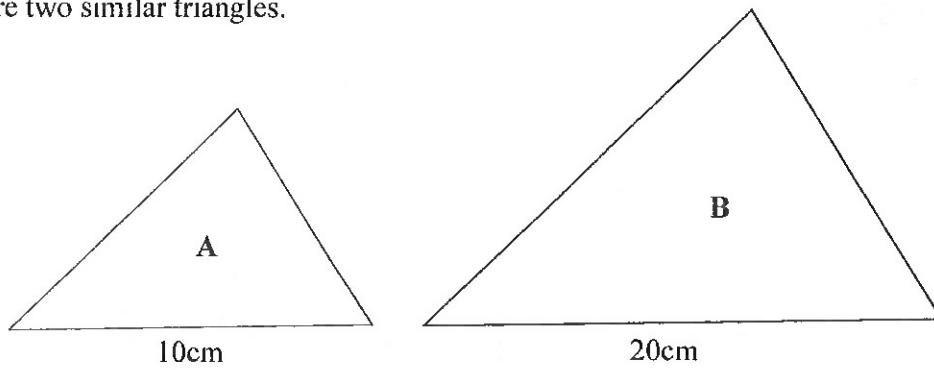
### Instructions

- Answer all questions
- Answer questions in the space provided
- All working must be shown

### Information

- The marks for the questions are shown in brackets

- 1 Below are two similar triangles.



The area of triangle A is  $20\text{cm}^2$   
Work out the area of triangle B.

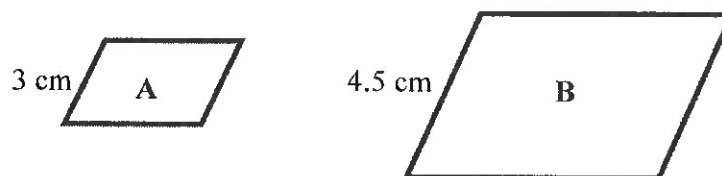
$$\begin{aligned} \text{length scale factor} &= 2 \\ \therefore \text{area scale factor} &= 2^2 = 4 \end{aligned}$$

$$20 \times 4 = 80\text{ cm}^2$$

.....80..... $\text{cm}^2$

(Total for question 1 is 2 marks)

- 2 Below are two similar parallelograms.



The area of parallelogram A is  $41\text{cm}^2$ .

Work out the area of parallelogram B.

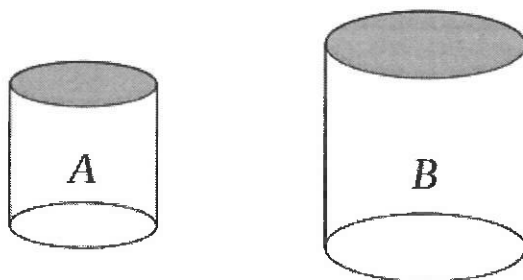
$$\begin{aligned} \text{length scale factor} &= 1.5 \\ \therefore \text{area scale factor} &= 1.5^2 = 2.25 \end{aligned}$$

$$41 \times 2.25 = 92.25\text{ cm}^2$$

.....92.25..... $\text{cm}^2$

(Total for question 2 is 2 marks)

- 3 Two cylinders, A and B, are mathematically similar.  
 The height of B is twice the corresponding height of A.  
 The surface area of A is  $22 \text{ cm}^2$ .



Find the surface area of B.

$$\begin{aligned} \text{length scale factor} &= 2 \\ \therefore \text{area scale factor} &= 2^2 = 4 \\ 22 \times 4 &= 88 \text{ cm}^2 \end{aligned}$$

.....88..... $\text{cm}^2$

(Total for question 3 is 2 marks)

- 4 Cylinder X and cylinder Y are mathematically similar.

The length of cylinder X is 6 cm and the length of cylinder Y is 9 cm.  
 The volume of cylinder X is  $50 \text{ cm}^3$ .

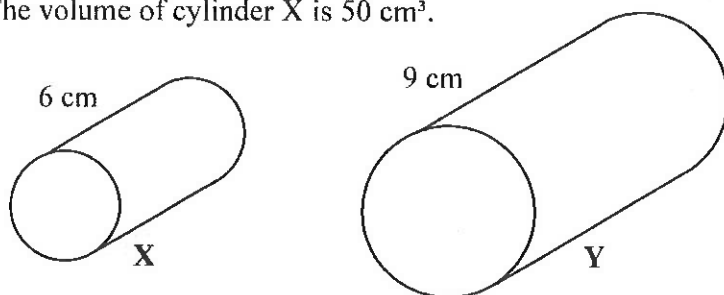


Diagram NOT accurately drawn

Calculate the volume of cylinder Y to 2dp.

$$\begin{aligned} \text{length scale factor} &= 1.5 \\ \text{area scale factor} &= 1.5^2 = 2.25 \\ \text{volume scale factor} &= \cancel{1.5} \cdot 1.5^2 = 3.375 \end{aligned}$$

$$50 \times 3.375 = 168.75 \text{ cm}^3 \text{ (2 dp)}$$

.....168.75..... $\text{cm}^3$

(Total for question 4 is 3 marks)

5

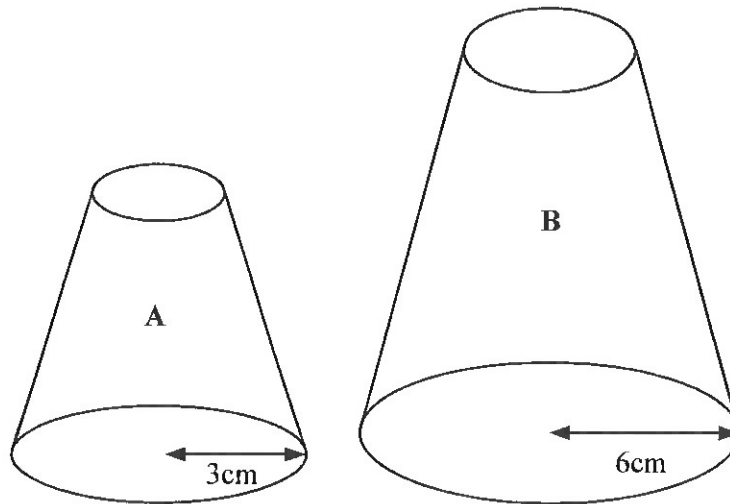
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Diagram NOT accurately drawn

Two solid shapes, **A** and **B**, are mathematically similar.  
 The base of shape **A** is a circle with radius 3 cm.  
 The base of shape **B** is a circle with radius 6 cm.

The surface area of shape **A** is  $210 \text{ cm}^2$ .

- (a) Work out the surface area of shape **B**.

$$\text{length scale factor} = 2$$

$$\text{area scale factor} = 2^2 = 4$$

$$210 \times 4 = 840 \text{ cm}^2$$

$$\dots 840 \dots \text{cm}^2$$

(2)

The volume of shape **B** is  $1200 \text{ cm}^3$ .

- (b) Work out the volume of shape **A**.

$$\text{volume scale factor} = 2^3 = 8$$

$$\frac{1200}{8} = 150 \text{ cm}^3$$

$$\dots 150 \dots \text{cm}^3$$

(2)

(Total for question 5 is 4 marks)

6

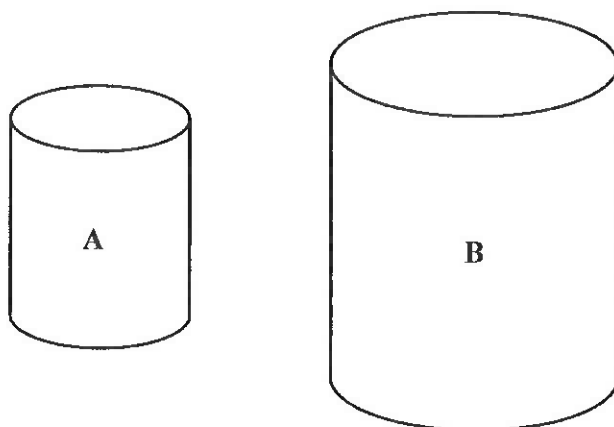


Diagram NOT accurately drawn

Two solid shapes, A and B, are mathematically similar.

The surface area of shape A is  $300\text{cm}^2$

The surface area of shape B is  $675\text{cm}^2$

The height of shape A is 45cm

- (a) Work out the height of shape B.

$$\text{area scale factor} = \frac{675}{300} = 2.25$$

$$\text{length scale factor} = \sqrt{2.25} = 1.5$$

$$45 \times 1.5 = 67.5 \text{ cm}$$

$$\dots\dots 67.5 \dots\dots \text{cm}$$

(3)

The volume of B is  $530\text{cm}^3$ .

- (b) Work out the volume of shape A

$$\text{volume scale factor} = 1.5^3 = 3.375$$

$$\checkmark \frac{530}{3.375} = 157.04 \text{ cm}^3 \text{ (2 d.p.)}$$

$$\dots\dots 157.04 \dots\dots \text{cm}^3$$

(3)

(Total for question 6 is 6 marks)

7

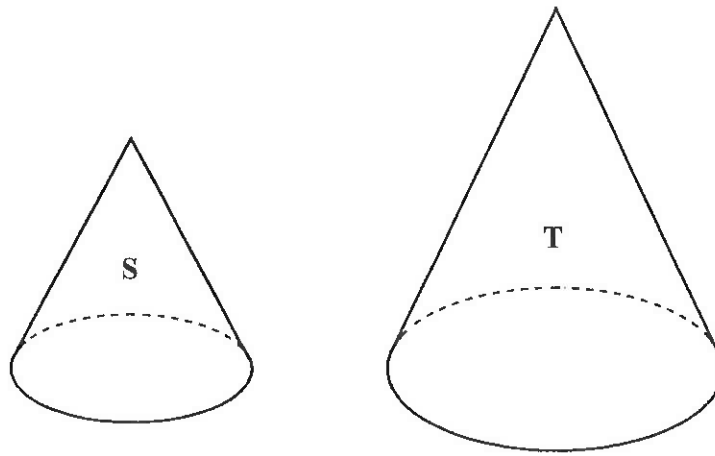
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Diagram **NOT** accurately drawn.

Two solid shapes, S and T, are mathematically similar.

The surface area of shape S is  $120\text{cm}^2$ .

The surface area of shape T is  $750\text{cm}^2$ .

The height of shape S is 27cm.

(a) Work out the height of shape T.

$$\text{area scale factor} = \frac{750}{120} = 6.25$$

$$\text{length scale factor} = \sqrt{6.25} = 2.5$$

$$27 \times 2.5 = 67.5 \text{ cm}$$

.....67.5.....cm

(3)

The volume of T is  $620\text{cm}^3$

(b) Work out the volume of shape S to 2sf.

$$\text{volume scale factor} = 2.5^3 = 15.625$$

$$\frac{620}{15.625} = 40 \text{ cm}^3 \text{ (2 s.f.)}$$

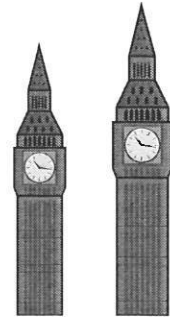
.....40.....cm<sup>3</sup>

(3)

(Total for question 7 is 6 marks)

- 8 Two clay models of Big Ben are mathematically similar.

The smaller model has a height of 18cm.  
The larger model has a height of 24cm.  
The smaller model weighs 310g.



Work out the weight of the larger model to 3 significant figures.

$$(1\text{cm}^3 = 1\text{g})$$

$$\text{length scale factor} = \frac{24}{18} = \frac{4}{3}$$

$$310 \times \left(\frac{4}{3}\right)^3 = 735 \text{ g (3 s.f.)}$$

.....735.....g

(Total for question 8 is 3 marks)

- 9 Two clay models of the Eiffel Tower are mathematically similar.

The smaller model has a height of 21cm.  
The larger model has a height of 36cm.

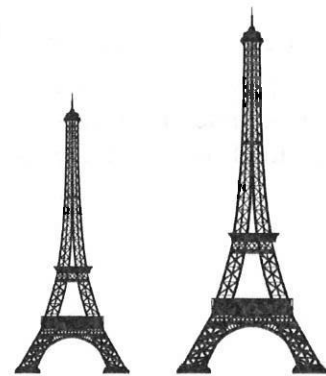
The smaller model weighs 132g.

Work out the weight of the larger model. Hint:

$$1\text{cm}^3 = 1\text{g}$$

$$\text{length scale factor} = \frac{36}{21} = \frac{12}{7}$$

$$132 \times \left(\frac{12}{7}\right)^3 = 665 \text{ g (3 s.f.)}$$

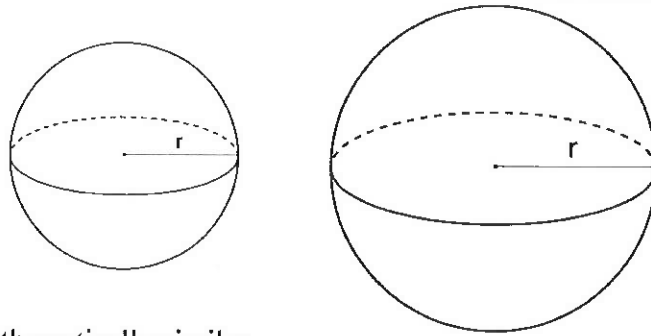


.....665.....g

(3)

(Total for question 9 is 3 marks)

10



Two solids are mathematically similar.  
 The surface area of the smaller solid is  $420 \text{ cm}^2$   
 The surface area of the larger solid is  $1500 \text{ cm}^2$   
 The volume of the larger solid is  $67 \text{ cm}^3$ .

Work out the volume of the smaller solid to 3sf.

$$\text{area scale factor} = \frac{1500}{420} = \frac{25}{7}$$

$$\text{length scale factor} = \sqrt{\frac{25}{7}} = \frac{5\sqrt{7}}{7}$$

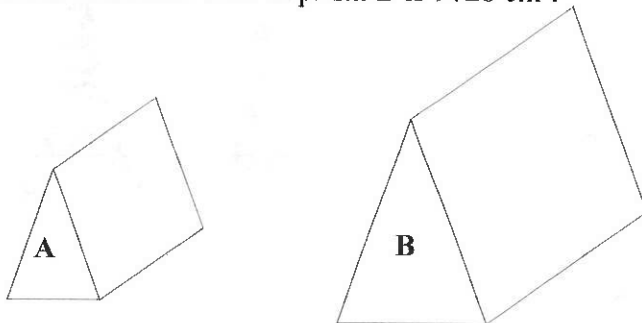
$$\frac{67}{\left(\frac{5\sqrt{7}}{7}\right)^3} = 9.93 \text{ cm}^3 \text{ (3s.f.)}$$

.....9.93..... $\text{cm}^3$

(Total for question 10 is 3 marks)

11 Diagram NOT accurately drawn

Two prisms, A and B, are mathematically similar.  
 The volume of prism A is  $14000 \text{ cm}^3$ . The volume of prism B is  $27344 \text{ cm}^3$ .  
 The total surface area of prism B is  $9728 \text{ cm}^2$ .



Calculate the total surface area of prism A to 3sf.

$$\text{volume scale factor} = \frac{27344}{14000} = \frac{1709}{875}$$

$$\text{length scale factor} = \sqrt[3]{\frac{1709}{875}} = 1.25000381$$

$$\text{area scale factor} = 1.25000381^2 = 1.562509525$$

$$\frac{9728}{1.562509525} = 6225.882047 = 6230 \text{ cm}^2 \text{ (3s.f.)}$$

.....6230..... $\text{cm}^2$

(Total for question 11 is 4 marks)



- 12 Sarmad bought a toy that grows 5 times larger when placed in water.  
Before placing the toy in water it was 3cm tall.  
After placing the toy in water it grew to a similarly shaped toy that was 5cm tall.



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Is the claim reasonable?

$$5:3 = \frac{5}{3} = 1.\bar{6}$$

Volume is 4.62962963 larger, so it's a reasonable claim

(Total for question 12 is 3 marks)

- 13 Two cubes, P and Q, are mathematically similar.  
The volumes of P and Q are  $29 \text{ cm}^3$  and  $453 \text{ cm}^3$ , respectively.  
The height of P is 8 cm.

Find the corresponding height of Q.

$$\text{volume scale factor} = \frac{453}{29} = 15.62068966$$

$$\text{length scale factor} = \sqrt[3]{15.62068966} = 2.499770094$$

$$8 \times 2.499770094 = 20.0 \text{ cm (3 s.f.)}$$

(Total for question 13 is 3 marks)

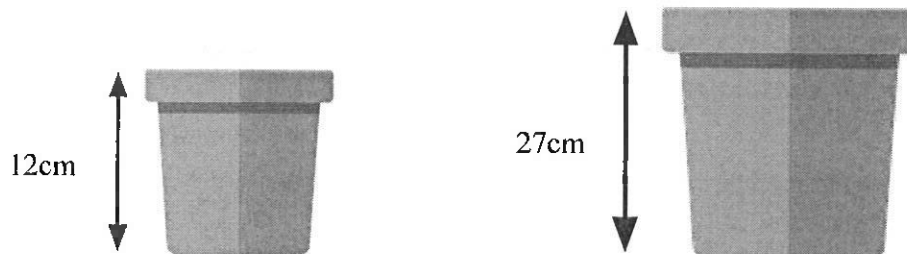
14

Marwa is potting plants.

She is using two mathematically similar pots, the smaller is 12cm tall and the larger 27cm tall.

She has two bags of soil, each containing 35 litres of soil.

With the first bag, Marwa fills 15 small pots using all of the soil in the bag.



How many large pots can be filled completely using the second bag of soil?

$$\frac{35}{15} = 2.3 \text{ Litres}$$

$$\text{length scale factor} = \frac{27}{12} = 2.25$$

$$2.3 \times 2.25^3 = 26.578125 \text{ Litres}$$

$$\frac{35}{26.578125} = 1.316872428$$

Completely,  $\therefore 1$

(Total for question 14 is 4 marks)

- 15 The areas of two mathematically similar shapes are in the ratio 25 : 36  
The length of the smaller shape is 32cm

Work out the length of the larger shape.

$$\text{areas : } 25 : 36$$

$$\text{length : } 5 : 6$$

$$\frac{32}{5} \times 6 = 38.4 \text{ cm}$$

$$\dots 38.4 \dots \text{cm}$$

(Total for question 15 is 3 marks)

- 16 The areas of two mathematically similar shapes are in the ratio 64 : 121  
The length of the smaller shape is 41.5cm

Work out the length of the larger shape.

$$\text{areas : } 64 : 121$$

$$\text{length : } 8 : 11$$

$$\frac{41.5}{8} \times 11 = 57.1 \text{ cm}$$

$$\dots 57.1 \dots \text{cm}$$

(Total for question 16 is 3 marks)

- 17 The volumes of two mathematically similar solids are in the ratio 27 : 216  
The surface area of the smaller solid is 38 cm<sup>2</sup>

Work out the surface area of the larger solid.

$$\text{volume : } 27 : 216$$

$$\text{length : } 3 : 6$$

$$\text{area : } 9 : 36$$

$$\frac{38}{9} \times 36 = 152 \text{ cm}^2$$

$$\dots 152 \dots \text{cm}^2$$

(Total for question 17 is 3 marks)