

G56... (H) Similar Shapes - Area and Volume

OCR

- (b) 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.

G55
G56

- (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.

(b)(ii) cm^3 [3]

Video created by W Neill

- (b) 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.

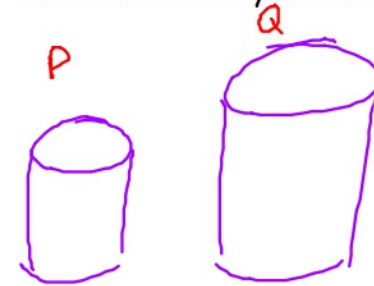
G55
G56

- (i) Jay says

A

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

L

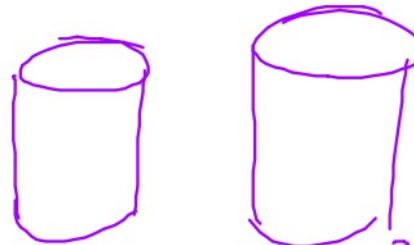


Explain why he is wrong.

x3 is an area scale factor
 you need to $\sqrt{\quad}$ it to get length sf $\sqrt{\quad}$ [1]
 SF $\sqrt{3}$
 A x3

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

Calculate the volume of prism P.



86cm^3

$\times 3\sqrt{3}$

$$\begin{aligned} L &= \sqrt{3} \\ A &= 3 \\ V &= 3\sqrt{3}L \end{aligned}$$

$$\frac{86}{3\sqrt{3}}$$

16.55 cm^3 [3] ✓

(b)(ii)

(b) The volume of a full-size train carriage is 220 m^3 .

G36 Trevor calculates the volume of a model train carriage to be 334 cm^3 correct to 3 significant figures.

G56 Is Trevor's calculation correct?
Show how you decide.

..... [3]

(b) The volume of a full-size train carriage is 220 m^3 .
Trevor calculates the volume of a model train carriage to be 334 cm^3 correct to 3 significant figures.

G3b
G5b Is Trevor's calculation correct?
Show how you decide.

$$\begin{array}{l} 334.09\text{ cm}^3 \\ 334 \checkmark \end{array} \quad \leftarrow \quad \begin{array}{l} 220\text{ m}^3 \\ 220,000,000\text{ cm}^3 \\ \div 87^3 \end{array}$$

Length sf $\times 87$

Area sf $\times 87^2$

Volume sf $\times 87^3$

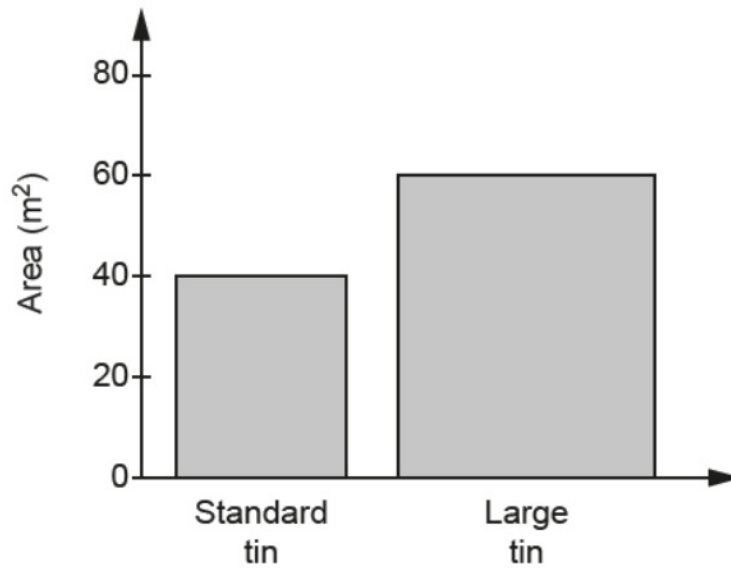
$$1000000\text{ cm}^3 = 1\text{ m}^3$$

18 Percy sells paint in standard tins and large tins.
The standard tin covers 40 m^2 and the large tin covers 60 m^2 .

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(a) Percy publishes this chart showing the area that can be covered with each tin of paint.

G55/56



Explain why the chart is misleading.

.....
..... [1]

- (b) The standard tin and the large tin are mathematically similar.
G55 The **volume** of the large tin is 50% more than the volume of the standard tin.
G56 Both tins are cylinders.
G56 The radius of the standard tin is 10 cm.

Calculate the radius of the large tin.

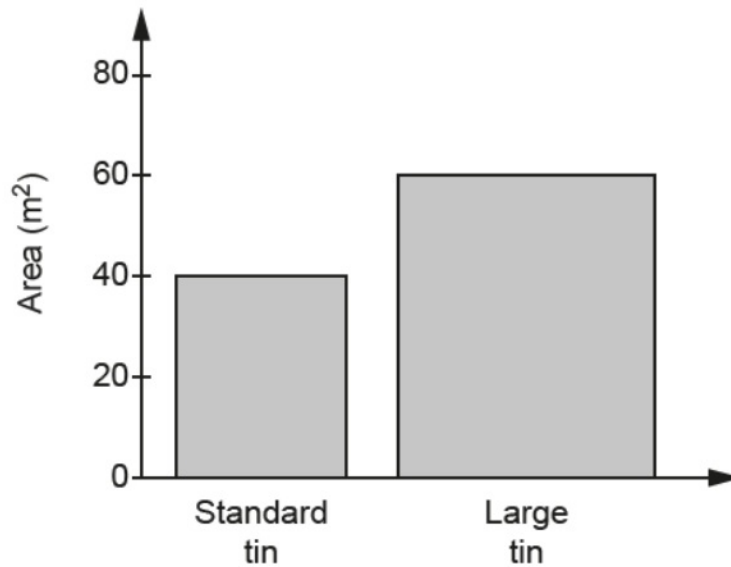
(b) cm [4]

18 Percy sells paint in standard tins and large tins.
The standard tin covers 40 m^2 and the large tin covers 60 m^2 .

Created by W Neill

(a) Percy publishes this chart showing the area that can be covered with each tin of paint.

G55/56



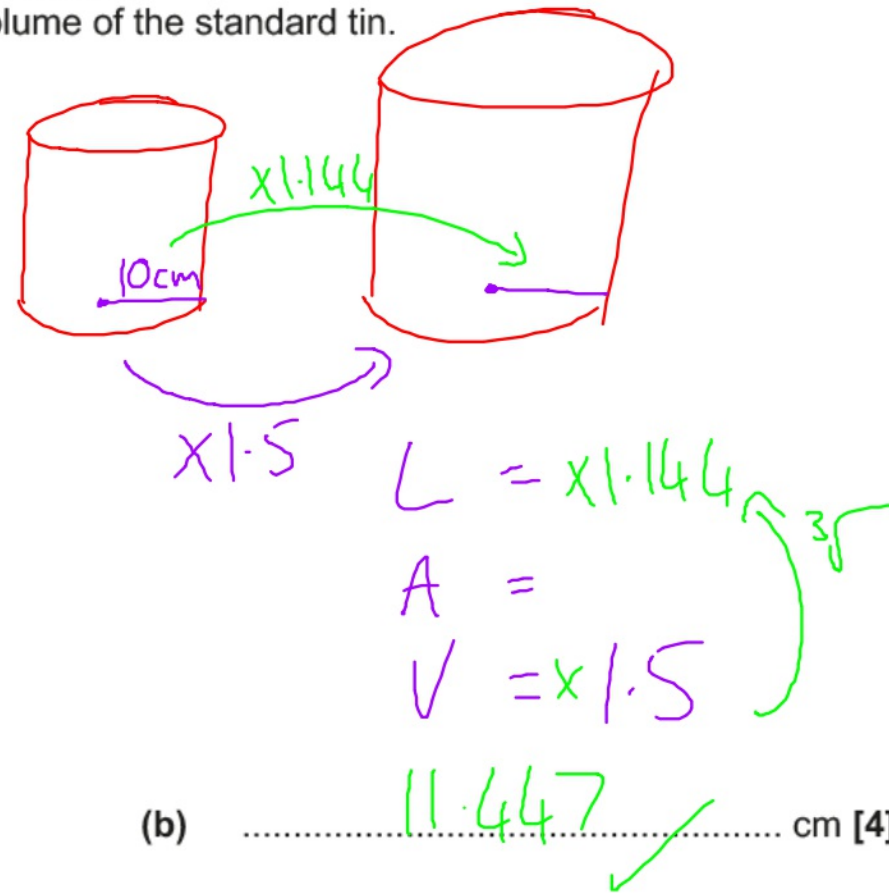
Explain why the chart is misleading.

width of bars need to be equal

[1]

- (b) The standard tin and the large tin are mathematically similar.
The **volume** of the large tin is 50% more than the volume of the standard tin.
G55 Both tins are cylinders.
G56 The radius of the standard tin is 10 cm.

Calculate the radius of the large tin.



19 Two cylinders, A and B, are mathematically similar.

G56 Cylinder A has volume 2400 cm^3 and height 12 cm.
Cylinder B has volume 750 cm^3 .

Find the height of cylinder B.

Give your answer correct to an appropriate degree of accuracy.

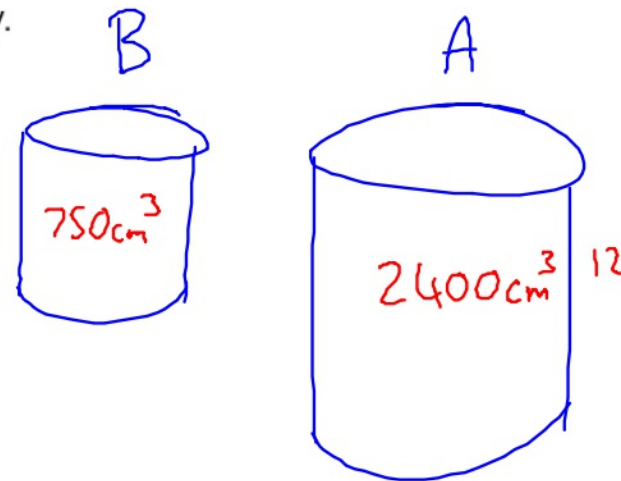
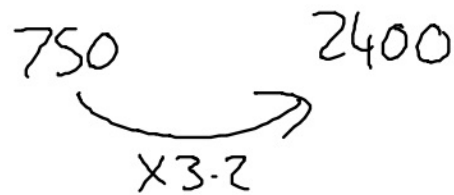
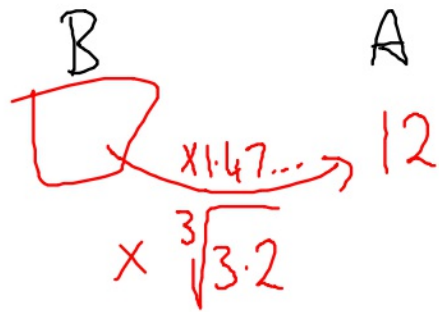
.....cm **[5]**

19 Two cylinders, A and B, are mathematically similar.

G56 Cylinder A has volume 2400 cm^3 and height 12 cm.
Cylinder B has volume 750 cm^3 .

Find the height of cylinder B.

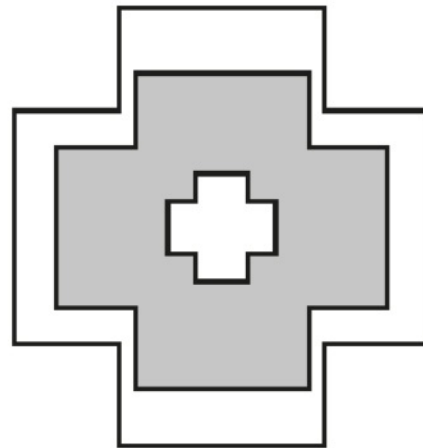
Give your answer correct to an appropriate degree of accuracy.



8.14 cm ✓
.....cm [5]

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

G56
R13



Not to scale

Find the ratio

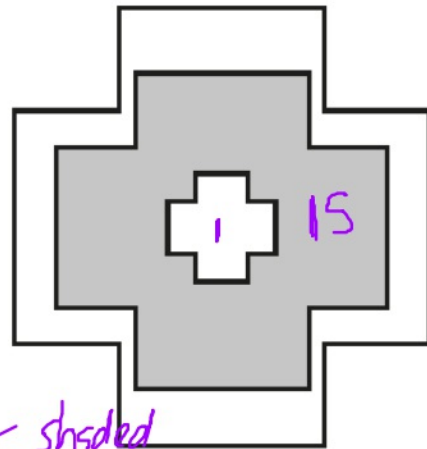
total shaded area : total unshaded area.

Give your answer in its simplest form.

total shaded area : total unshaded area : [4]

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

G56
R13



Not to scale
L
x²
A

$$1 : 4 : 5$$

$$1^2 : 4^2 : 5^2$$

$$1 : 16 : 25$$

Area scale factors
= 1 : 16 : 25

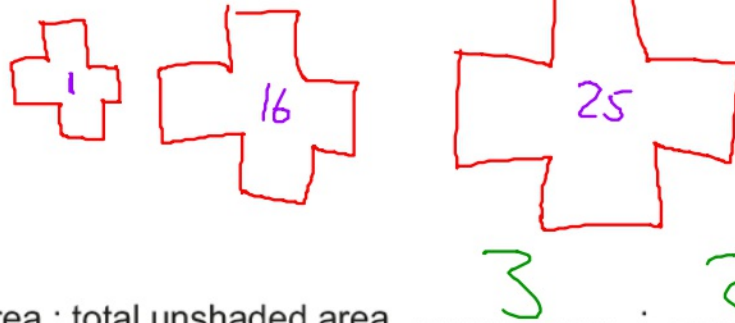
shaded
= 16 - 1

unshaded = Total - shaded
25 - 15 = 10

Find the ratio

total shaded area : total unshaded area.

Give your answer in its simplest form.



shaded : unshaded

15 : 10

3 : 2 ✓

total shaded area : total unshaded area : [4] ✓

EDEXCEL

18 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 120 cm^3 .

Video created by W Neill

(Total for Question 18 is 3 marks)

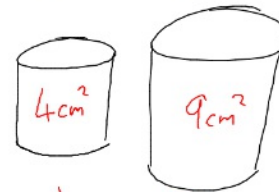
18 Solid A and solid B are mathematically similar.

Video created by W Neill

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 120 cm^3 .



$4 \times 9 = 36 \dots \sqrt{36} = 6$
 $4 \times 9 = 36 \dots \sqrt[3]{36} = 3.375$

$\frac{1}{8} = 0.125$
 $\frac{3}{8} = 0.375$

$405 \div 3.375 = 120$ ✓

$120 \times 3.375 = 405$
 same thing ✓

$120 \times 3\frac{3}{8}$ $8 \overline{) 120} \begin{matrix} 15 \\ \end{matrix}$

$120 \times 3 = 360$

$120 \times \frac{3}{8} \dots \frac{3}{8} \text{ of } 120 = 45$

$\begin{array}{r} 360 \\ + 45 \\ \hline 405 \end{array}$ ✓

$L = x$ $L = 1.5$
 $A = x^2$ $A = 2.25$
 $V = x^3$ $V = 3.375$

$\frac{1.5 \times 1.5 \times 1.5}{2.25 \times 1.5}$

$\begin{array}{r} 225 \\ \times 15 \\ \hline 1125 \\ 2250 \\ \hline 3375 \end{array}$

(Total for Question 18 is 3 marks)

Video created by W Neill

20 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 6 cm^2

The statue will have a base area of 253.5 cm^2

Mark used 2 kg of clay to make the model.

Clay is sold in 10 kg bags.

Mark has to buy all the clay he needs to make the statue.

How many bags of clay will Mark need to buy?

.....
(Total for Question 20 is 3 marks)

20 Mark has made a clay model.

He will now make a clay statue that is mathematically similar to the clay model.

Video created by W Neill

The model has a base area of 6cm^2

The statue will have a base area of 253.5cm^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?

Clay needed (Volume)

$$2\text{Kg} \xrightarrow{\times 6.5^3} 549.25\text{Kg needed}$$

$$6\text{cm}^2 \xrightarrow{\times 42.25} 253.5\text{cm}^2$$

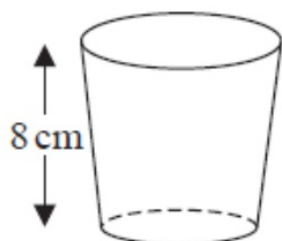
$$\begin{array}{l} L \dots \times SF \quad \times 6.5 \\ A \dots \times SF^2 \quad (\times 42.25) \\ V \dots \times SF^3 \quad \times 274.625 \end{array}$$

$$\begin{aligned} \text{Bags needed} &= 549.25 \div 10 \\ &= 54.925 \dots \dots 55 \checkmark \end{aligned}$$

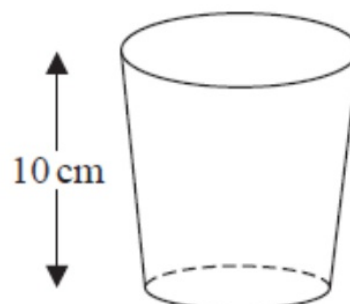
(Total for Question 20 is 3 marks)

15 Here are two pots.

Video created by W Neill



Pot A



Pot B

Pot A and pot B are mathematically similar.

The area of the base of pot B is 160 cm^2 .

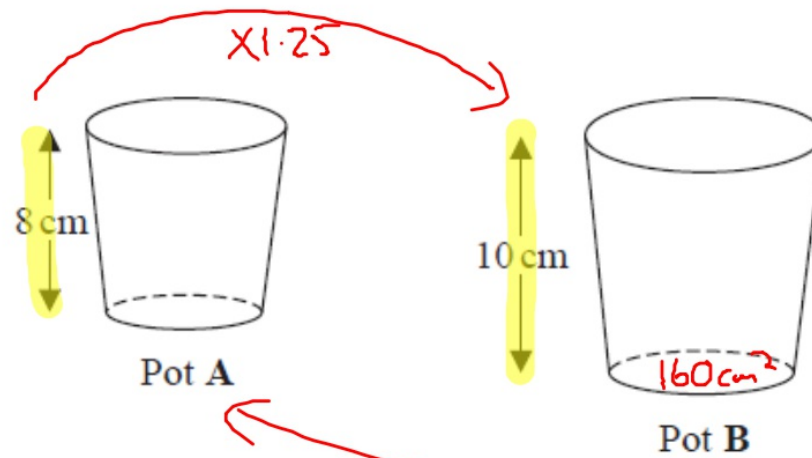
Work out the area of the base of pot A.

..... cm^2

(Total for Question 15 is 2 marks)

15 Here are two pots.

Video created by W Neill



Pot A and pot B are mathematically similar.

The area of the base of pot B is 160 cm².

Work out the area of the base of pot A.

$$160 \text{ cm}^2 \div 1.25^2$$
$$=$$

$$\text{Length} = \times 1.25$$

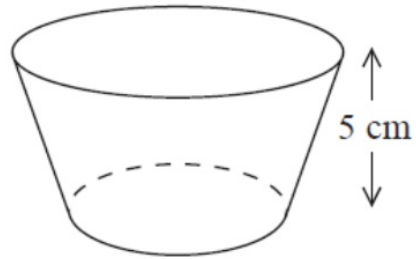
$$\text{Area} \times 1.25^2$$

$$\text{Volume} \times 1.25^3$$

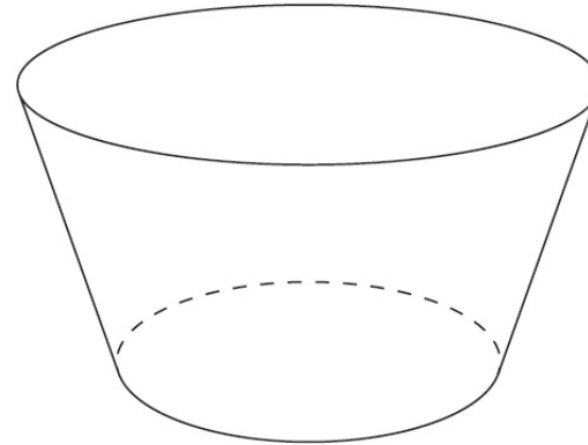
$$102.4 \text{ cm}^2$$

(Total for Question 15 is 2 marks)

17 A factory makes ice cream tubs in two sizes, small and large.



small



large

The tubs are similar in shape.

The height of the small tub is 5 cm

The volume of the small tub is 150 cm^3

The volume of the large tub is 500 cm^3

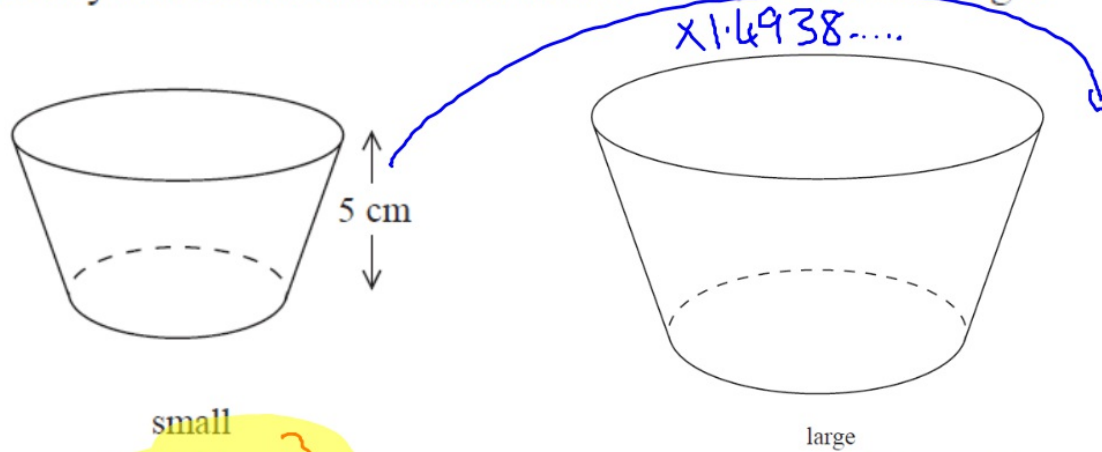
Work out the height of the large tub.

Give your answer correct to 3 significant figures.

.....cm

(Total for Question 17 is 2 marks)

17 A factory makes ice cream tubs in two sizes, small and large.



small

150 cm³

large

500 cm³

The tubs are similar in shape.

The height of the small tub is 5 cm

The volume of the small tub is 150 cm³

The volume of the large tub is 500 cm³

Work out the height of the large tub.

Give your answer correct to 3 significant figures.

$$\begin{aligned} L &= Sf = 1.4938 \\ A &= (Sf)^2 \\ V &= (Sf)^3 = 3.3 \end{aligned}$$

$\sqrt[3]{3.3}$

7.47 ✓ cm

(Total for Question 17 is 2 marks)

Created by W Neill

14 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

(Total for Question 14 is 3 marks)

14 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 cm²

Show that the surface area of cone B is 132 cm²

^{3√}

$$L = 1.5$$

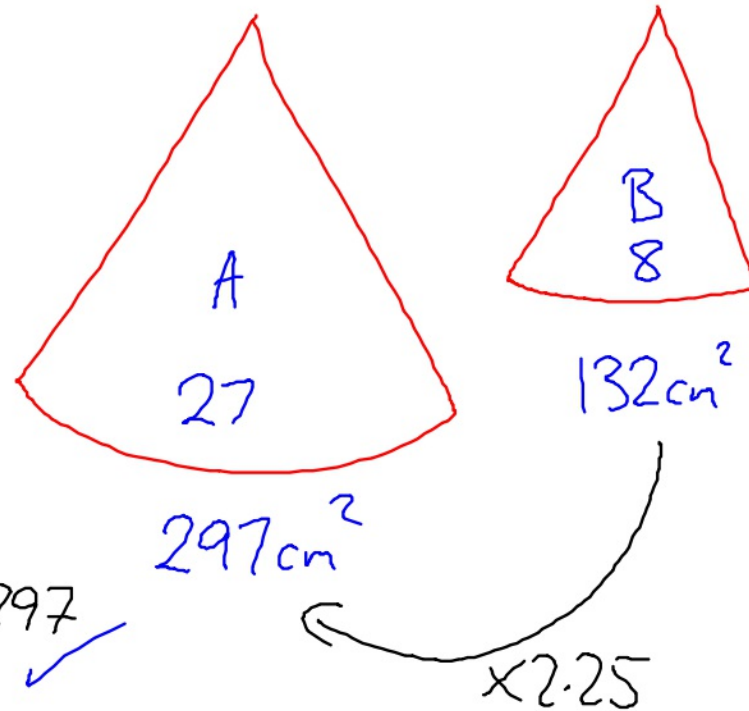
$$A = 2.25$$

$$V = 3.375$$

(Note: A curved arrow on the right side of the equations indicates a multiplier of 1.5² for area and 1.5³ for volume.)

$$8 \xrightarrow{\times 3.375} 27$$

$$\leftarrow \div 3.375$$



(Total for Question 14 is 3 marks)

13 Here are two similar solid shapes.

Video created by W Neill

GS6

A



B



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.

..... cm^3

(Total for Question 13 is 3 marks)

13 Here are two similar solid shapes.

Video created by W Neill

GS6

Area $\times 1.3$
 \rightarrow
3 : 4



Length $\rightarrow \times Sf \frac{2\sqrt{3}}{3}$
Area $\rightarrow \times Sf 1.3$
Volume $\rightarrow \times Sf \frac{8\sqrt{3}}{9}$
or 1.5396

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.

A B
 6.495 cm^3 10 cm^3
 $\div 1.5396$ 6.50 cm^3

(Total for Question 13 is 3 marks)

15 Three solid shapes **A**, **B** and **C** are similar.

Video Created by W Neill

R15a The surface area of shape **A** is 4 cm^2

G56 The surface area of shape **B** is 25 cm^2

The ratio of the volume of shape **B** to the volume of shape **C** is $27:64$

Work out the ratio of the height of shape **A** to the height of shape **C**.

Give your answer in its simplest form.

.....
(Total for Question 15 is 4 marks)

15 Three solid shapes A, B and C are similar.

Video Created by W Neill

R15a The surface area of shape A is 4cm^2

G56 The surface area of shape B is 25cm^2

The ratio of the volume of shape B to the volume of shape C is $27:64$

Work out the ratio of the height of shape A to the height of shape C.

Give your answer in its simplest form.

Handwritten work for surface area and volume ratios:

	A	:	B	:	C
L	2	:	5	:	4
			3	:	
A	4	:	25		
V			27	:	64

Arrows indicate relationships: a blue arrow from L to A, a blue arrow from V to the volume ratio, and a red arrow from the volume ratio to the length ratio. A red $\sqrt[3]{\quad}$ symbol is written next to the volume ratio.

Handwritten work for length ratios:

A	:	B	:	C
2	:	5	:	
		3	:	4
<hr/>				
6	:	15	:	20
A : C				
6 : 20				
3 : 10				

Annotations: A red arrow labeled 'x3' points from the first two rows to the third row. A purple arrow labeled 'x5' points from the third row to the fourth row.

(Total for Question 15 is 4 marks)

AQA

17

A and B are **similar** solids.

Video created by W Neill

[1 mark]

G56

Solid	length (cm)
A	l
B	$2l$

Alex says,

“The volume of B is double the volume of A
because the length of B is double the length of A.”

Is he correct?

Tick a box.

Yes

No

Give a reason for your answer.

17 A and B are **similar** solids.

[1 mark]

G56

Solid	length (cm)
A	1
B	21

↪ SF x 2

Alex says,

"The volume of B is double the volume of A
because the length of B is double the length of A."

Is he correct?

Tick a box.

Yes

No

8 times bigger ✓

Give a reason for your answer.

Should be scale factor³ ... ie $2^3 = 8$

Video created by W Neill

13 Circle the volume that is the same as 15 cm^3

[1 mark]

G56

$15\ 000 \text{ mm}^3$

1.5 mm^3

0.0015 mm^3

150 mm^3

13 Circle the volume that is the same as 15 cm^3 [1 mark]

G56

- $15\,000 \text{ mm}^3$ 1.5 mm^3 0.0015 mm^3 150 mm^3

$$\text{cm}^3 \xrightarrow{\times 10^3} \text{mm}^3$$

$$\times 1000$$

$$15 \times 1000$$

$$= 15000$$

23

Solids X and Y are similar.

X has volume 64 cm^3

656

Y has volume 343 cm^3

The surface area of X is 176 cm^2

Work out the surface area of Y.

[3 marks]

Answer _____ cm^2

23

Solids X and Y are similar.

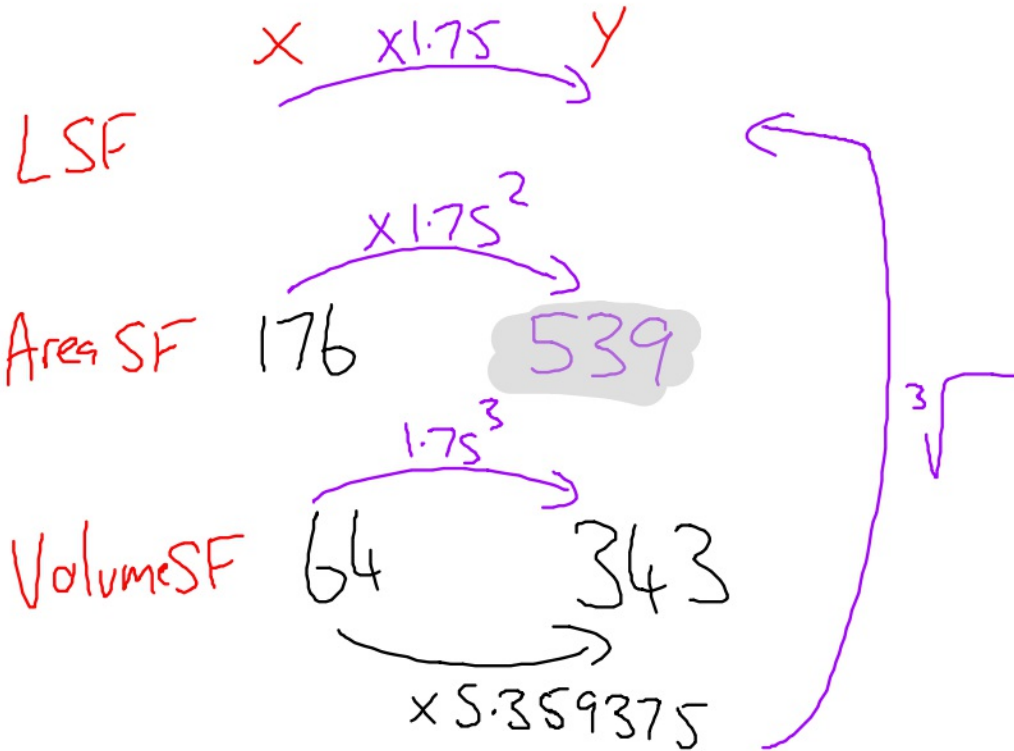
X has volume 64 cm^3

Y has volume 343 cm^3

The surface area of X is 176 cm^2

Work out the surface area of Y.

656



Answer 539 ✓ cm^2

23

Prisms A and B are similar.

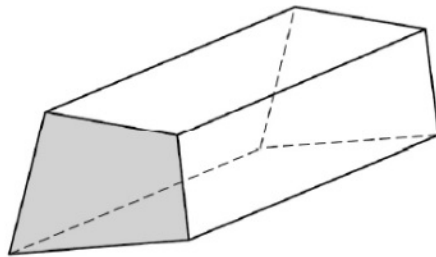
The cross sections are shaded.

G56

G32

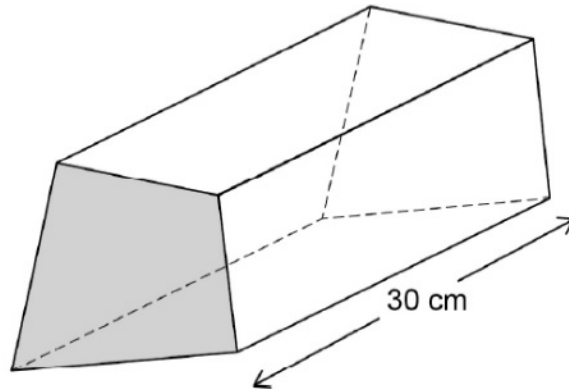
Prism A

volume = 480 cm^3



Prism B

length = 30 cm



area of the cross section of A : area of the cross section of B = 4 : 9

Work out the area of the cross section of B. **[5 marks]**

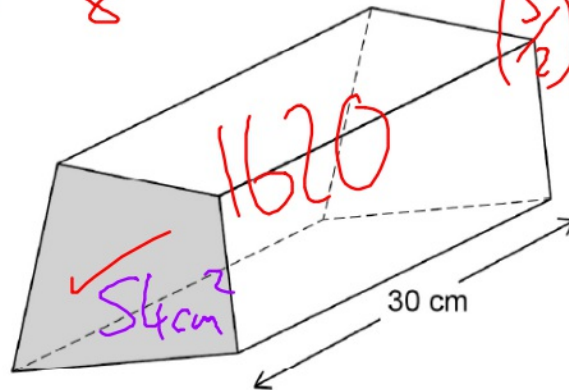
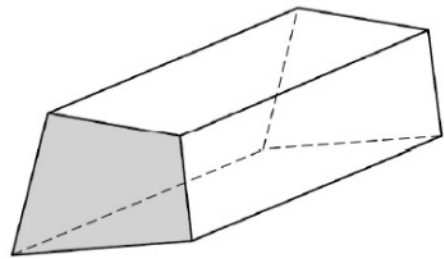
Prisms A and B are similar.
The cross sections are shaded.

G56 Prism A
G32 volume = 480 cm^3

$$\sqrt{\frac{9}{4}} = \frac{3}{2}$$

$$\left(\frac{3}{2}\right)^3 = \frac{27}{8}$$

Prism B
length = 30 cm



A B

$\left(\frac{3}{2}\right)^3$ L
A
V

$\times \frac{3}{2}$
4 9
 $\times \frac{9}{4}$
 $\times \frac{27}{8}$

area of the cross section of A : area of the cross section of B = 4 : 9

Work out the area of the cross section of B. [5 marks]

$$3 \overline{) 162} \begin{array}{r} 54 \\ \underline{162} \\ 0 \end{array}$$

$$\begin{array}{r} 60 \\ \times 27 \\ \hline 420 \\ 1200 \\ \hline 1620 \end{array}$$

Volume of B

$$CS = \frac{1620}{30} = 54 \text{ cm}^2$$

$$480 \times \frac{27}{8} = 1620$$