



- 1 Two solid ornaments, P and Q, are mathematically similar.

P has height 4 cm and Q has height 12 cm.

The volume of P is 20 cm^3 .

Work out the volume of Q.

(3 marks)

$$\text{Length scale factor} = 12 \div 4 = 3$$

Every length is multiplied by 3. Volume scales in three dimensions, so the multiplier is $3 \times 3 \times 3 = 27$; an area would instead scale by $3 \times 3 = 9$

$$\text{Volume scale factor} = 3^3 = 27$$

$$\text{Volume of Q} = 20 \times 27 = 540 \text{ cm}^3$$

$$\boxed{540 \text{ cm}^3}$$

- 2 Two mathematically similar signs are made for a shop.

The small sign is 5 cm wide and has area 50 cm^2 .

The large sign is 8 cm wide.

Work out the area of the large sign.

(3 marks)

$$\text{Length scale factor} = 8 \div 5 = 1.6$$

$$\text{Area scale factor} = 1.6^2 = 2.56$$

$$\text{Area of the large sign} = 50 \times 2.56 = 128 \text{ cm}^2$$

$$\boxed{128 \text{ cm}^2}$$

3

A shop sells two mathematically similar tins of paint. The small tin is 12 cm tall and holds 0.8 litres. The large tin is 18 cm tall.

- Work out the capacity of the large tin.
- The small tin costs £5.60. The price of paint is the same per litre for both tins. Work out the cost of the large tin.

(4 marks)

a)

$$\text{length scale factor} = \frac{18}{12} = 1.5$$

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

$$\text{capacity} = 0.8 \times 3.375$$

2.7 litres

b) same price per litre, so same scale factor

$$\text{cost} = 5.60 \times 3.375$$

£18.90

4

Two mathematically similar solids, A and B, have volumes in the ratio 64 : 343.

Find the ratio of the surface area of A to the surface area of B.

Give your answer in its simplest form.

(3 marks)

Cube root the volume ratio to get the length ratio

$$\sqrt[3]{64} : \sqrt[3]{343} = 4 : 7$$

Square the length ratio to get the area ratio

$$4^2 : 7^2 = 16 : 49$$

16 : 49

5

Two mathematically similar candles, C and D, are made from the same wax.

C has surface area 36 cm^2 and D has surface area 81 cm^2 .

The volume of C is 24 cm^3 .

Work out the volume of D.

(3 marks)

Area ratio C

$$O = 36 : 81 = 4 : 9$$

$$\text{Length ratio} = \sqrt{4} : \sqrt{9} = 2 : 3$$

$$\text{Volume ratio} = 2^3 : 3^3 = 8 : 27$$

$$\text{Volume of D} = 24 \times 27 \div 8 = 81 \text{ cm}^3$$

81 cm^3

- 6 Two mathematically similar statues are to be painted.

The small statue has height 10 cm and surface area 80 cm^2 .

The large statue has height 25 cm.

Work out the surface area of the large statue.

(4 marks)

$$\text{Length scale factor} = 25 \div 10 = 2.5$$

$$\text{Area scale factor} = 2.5^2 = 6.25$$

$$\text{Surface area of the large statue} = 80 \times 6.25 = 500 \text{ cm}^2$$

$$\boxed{500 \text{ cm}^2}$$

- 7 Two solid trophies are mathematically similar and are made from the same metal.

The small trophy has height 6 cm and mass 120 g.

The large trophy has height 9 cm.

Work out the mass of the large trophy.

(4 marks)

$$\text{Length scale factor} = 9 \div 6 = 1.5$$

$$\text{Mass is proportional to volume, so the mass scale factor} = 1.5^3 = 3.375$$

$$\text{Mass of the large trophy} = 120 \times 3.375 = 405 \text{ g}$$

$$\boxed{405 \text{ g}}$$

- 8 Two mathematically similar bottles hold 250 ml and 686 ml of juice when full.

The small bottle has height 15 cm.

Work out the height of the large bottle.

(4 marks)

$$\text{Volume ratio} = 250 : 686 = 125 : 343$$

$$\text{Length ratio} = \sqrt[3]{125} : \sqrt[3]{343} = 5 : 7$$

$$\text{Height of the large bottle} = 15 \times 7 \div 5 = 21 \text{ cm}$$

$$\boxed{21 \text{ cm}}$$

9

Two mathematically similar solids, S and T, have volumes 135 cm^3 and 320 cm^3 .

The surface area of S is 180 cm^2 .

Work out the surface area of T.

(4 marks)

The solids are similar. Their volume ratio is 135

$$320 = 27 : 64$$

Take cube roots to find the corresponding length ratio: 3 : 4

Square the length ratio to find the surface-area ratio: 9 : 16

$$\text{Surface area of T} = 180 \times 16 \div 9 = 320 \text{ cm}^2$$

320 cm^2

10

In triangle ABC, D lies on AB and E lies on AC so that DE is parallel to BC.

$AD : DB = 2 : 1$.

The area of triangle ADE is 24 cm^2 .

Work out the area of the trapezium DBCE.

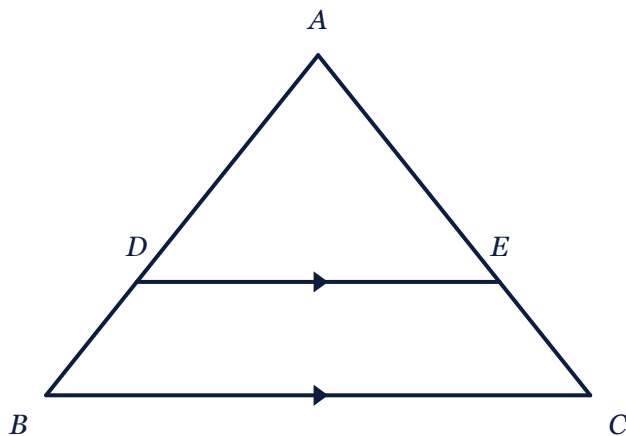


Diagram NOT accurately drawn

(4 marks)

DE is parallel to BC, so triangles ADE and ABC are similar

AD

$AB = 2 : 3$, so the length scale factor from
ADE to ABC is $\frac{3}{2}$

$$\text{Area scale factor} = \left(\frac{3}{2}\right)^2 = \frac{9}{4}$$

$$\text{Area of ABC} = 24 \times \frac{9}{4} = 54 \text{ cm}^2$$

$$\text{Area of trapezium DBCE} = 54 - 24 = 30 \text{ cm}^2$$

$$\boxed{30 \text{ cm}^2}$$

11

Two mathematically similar containers, A and B, have volumes 400 cm^3 and 1350 cm^3 .

a. Container A has height 12 cm. Work out the height of container B.

b. Container B has surface area 468 cm^2 . Work out the surface area of container A.

(5 marks)

Volume ratio A

$$B = 400 : 1350 = 8 : 27$$

$$\text{Length ratio} = \sqrt[3]{8} : \sqrt[3]{27} = 2 : 3$$

$$\text{a) Height of B} = 12 \times 3 \div 2 = 18 \text{ cm}$$

$$\text{Area ratio} = 2^2 : 3^2 = 4 : 9$$

$$\text{b) Surface area of A} = 468 \times 4 \div 9 = 208 \text{ cm}^2$$