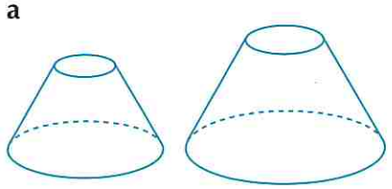
2 Find the volumes and lengths as indicated. Give your answers to the nearest whole number.

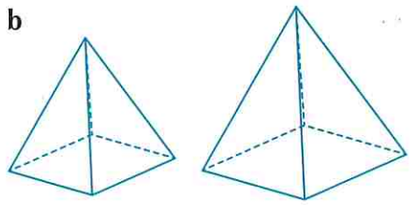
Height	5 cm	
Surface area	22 cm²	32 cm²
Volume	14 cm³	

Height		11 cm
Surface area	160 cm²	300 cm²
Volume		130 cm³

a



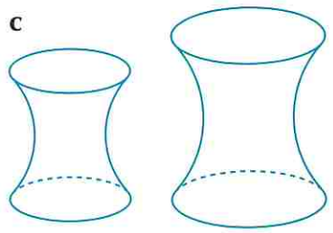
b



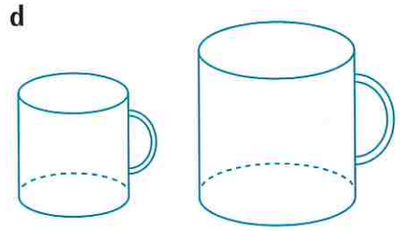
Height	3 cm	
Surface area	45 cm²	80 cm²
Mass		250 g

Height	2.5 cm	
Surface area	30 cm²	50 cm²
Volume		280 cm³

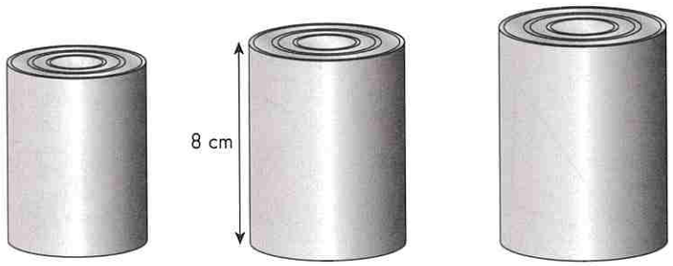
c



d



3 A firm produces three sizes of similar-shaped labels for its cans. Their areas are 150 cm², 250 cm² and 400 cm². The 250 cm² label just fits around a can of height 8 cm. Calculate the heights of similar cans which the other two labels would just fit around.



4 A firm makes similar gift boxes in three different sizes: small, medium and large. The areas of their lids are as follows.

Small: 30 cm² Medium: 50 cm² Large: 75 cm²

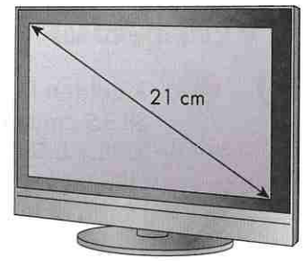
The medium box is 5.5 cm high. Work out the heights of the other two sizes.

MR **5** A cone of height 8 cm can be made from a piece of card with an area of 140 cm². Show that the height of a similar cone made from a similar piece of card with an area of 200 cm² is 9.56 cm.

6 It takes 5.6 litres of paint to paint a chimney that is 3 m high. What is the tallest similar chimney that can be painted with 8 litres of paint?

7 A piece of card, 1200 cm² in area, will make a tube 13 cm long. How long is a similar tube made from a similar piece of card with an area of 500 cm²?

PS **8** If a TV screen with area 220 cm² has a diagonal length of 21 cm, what will be the diagonal length of a similar TV screen with area 350 cm²?



9 Two similar statues, made from the same bronze, are placed in a school. One has a mass of 300 g, the other a mass of 2 kg. The height of the smaller statue is 9 cm. What is the height of the larger statue?

10 A supermarket sells similar cans of pasta rings in three different sizes: small, medium and large. The sizes of the labels around the cans are as follows.

Small can: 24 cm² Medium can: 46 cm² Large can: 78 cm²

The medium size can is 6 cm tall with a mass of 380 g. Calculate these quantities.

a The heights of the other two sizes.

b The masses of the other two sizes.

11 A statue has a mass of 840 kg. A similar statue was made out of the same material but two-fifths the height of the first one. What was the mass of the smaller statue?

12 A model stands on a base of area 12 cm². A smaller but similar model, made of the same material, stands on a base of area 7.5 cm². Calculate the mass of the smaller model if the larger one is 3.5 kg.

PS **13** Steve fills two similar jugs with orange juice.

The first jug holds 1.5 litres of juice and has a base diameter of 8 cm.

The second jug holds 2 litres of juice. Work out the base diameter of the second jug.

CM MR **14** The surface areas of two similar cuboids are 500 cm² and 800 cm².

If the width of one of the cuboids is 10 cm, calculate the two possible widths for the other cuboid.

EV **15** The volumes of two similar cylinders are 256 cm³ and 864 cm³.

Which of the following gives the ratio of their surface areas?

a 2 : 3 **b** 4 : 9 **c** 8 : 27

b Let the mass of the small tin be m.

Then the ratio of (lengths)^3 is the ratio of the volumes and the ratio of the masses is the same as the ratio of the volumes.

Hence:

$$\frac{m}{350} = \left(\frac{5.004\,425}{7}\right)^3$$

$$\Rightarrow m = 350 \times \left(\frac{125.332\,17}{343}\right)$$

$$= 127.889\,97$$

$$= 130 \text{ g (2 sf)}$$

Maisie is correct to 2 sf.

Let the mass of the large tin be M.

Then, as above:

$$\frac{M}{350} = \left(\frac{9.036\,961}{7}\right)^3$$

$$\Rightarrow M = 350 \times \left(\frac{738.018\,48}{343}\right)$$

$$= 753.080\,08$$

$$= 750 \text{ g (2 sf)}$$

Maisie has either rounded incorrectly or she used the rounded figure of 9.0 in the calculation.

Check: using 9.0 gives:

$$M = 350 \times \frac{729}{343}$$

$$= 743.877\,55$$

$$= 740\text{g (2 sf)}$$

So It looks as though Maisie used the rounded earlier figures in this last calculation.

Again, using m and M to represent the respective mass's makes the working clear. You need to calculate the actual accurate answer in order to be able to evaluate Maisie's comments.

Use the most accurate data you can for the calculations. Note down the intermediary answers in case you need to check the answers later.

Show clearly where each ratio has come from and use the accurate figures from part **a** in order to be as accurate as possible in this last part.

Once you have found the accurate answers you can comment on Maisie's answers.

The small mass is a good answer but the large mass is incorrect. Try to suggest why the wrong answer was calculated. Here, it is likely that Maisie used the rounded figure of 9.0. Checking gives the same answer as Maisie had.

This is a reminder not to use rounded figures in the final calculation.

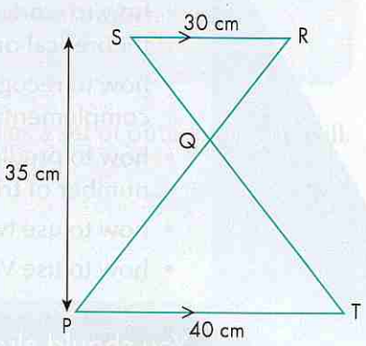
Ready to progress?

I can work out the ratios between two similar shapes.
I can work out unknown lengths, areas and volumes of similar 3D shapes.
I can solve practical problems using similar shapes.
I can solve problems using area and volume ratios.

Review questions

CM **1** SQT and RQP are straight lines.

Show that the vertical height of the larger triangle is 5 cm longer than the smaller triangle.



2 **a** Explain why the volume of a solid shape increases by a factor of 27 when the side lengths are tripled.

b When Alun bought a plant he was told that when it was watered, within 24 hours it would be 27 times larger than it was then! It was 4 cm tall when he brought it home.

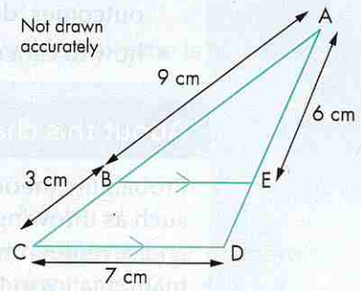
After he watered it, within 24 hours it grew to a similarly shaped plant that was 12 cm tall.

Was the claim about the plant justified?

EV **3** Andrew calculated BE as 5.25 cm.

Eve said that ED is 8 cm.

Evaluate both statements.



PS **4** Two cones, A and B, are mathematically similar.

The curved surface area of cone A is 36 cm^2.

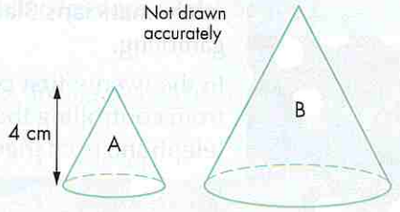
The curved surface area of cone B is 81 cm^2.

The height of cone A is 4 cm.

a What is the height of cone B?

The volume of cone B is 54 cm^3.

b Calculate the volume of cone A.



MR **5** The cylinders A and B are mathematically similar.

The curved surface area of cylinder A is 100 cm^2.

The curved surface area of cylinder B is 324 cm^2.

The length of cylinder A is 5 cm.

a Show that the length of cylinder B is 9 cm.

The volume of cylinder A is 160 cm^3.

b Work out the volume of cylinder B. Give your answer to 3 significant figures.