Cambridge IGCSE · Mathematics 0580 · Notes

Similarity

Read online at **pastopic.com/cambridge/mathematics-0580/notes/similarity**

Last checked 30 September 2026

Read first: **Ratio, proportion and rates**, **Geometrical terms and symmetry**

What you need to know

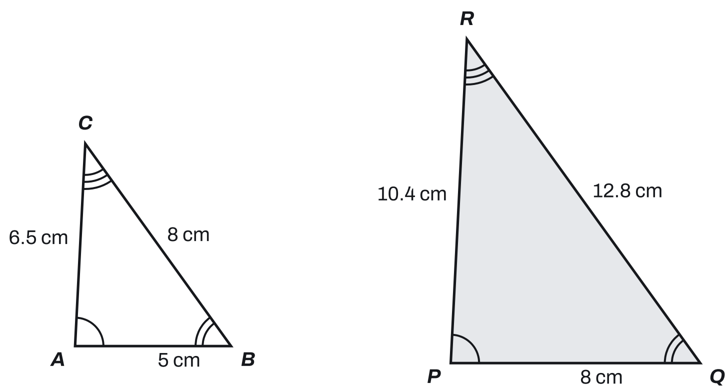
By the end of this topic you should be able to:

1. **Use the words** *similar*, *congruent* and *scale factor* correctly. Similar shapes have the same shape (equal angles, all lengths in the same ratio); congruent shapes have the same shape **and** size. (You are not asked to prove that two shapes are congruent.)
2. **Calculate lengths in similar shapes**: find the scale factor from a pair of matching sides, then use it to find a missing side on either shape.
3. **Extended only: use the link between lengths, areas and volumes.** If the lengths are multiplied by k, areas (including surface areas) are multiplied by k^2 and volumes (including capacities) by k^3. Use this in both directions: from lengths to areas and volumes, and from an area or volume ratio back to lengths.
4. **Extended only: solve problems and give simple explanations involving similarity**, including showing that two triangles are similar by giving a geometric reason for each pair of equal angles.

Understand it

What "similar" means

Two shapes are **similar** when one is an **enlargement** of the other: every length is multiplied by the same number, the **scale factor** k, and every angle stays the same. A photo and a bigger print of it are similar; a photo that has been stretched sideways is not.



× 1.6 for every length; the angles do not change

$$k = \frac{\text{a length on the new shape}}{\text{the matching length on the old shape}}$$

In the diagram, $k = \frac{PQ}{AB} = \frac{8}{5} = 1.6$, and every other pair gives the same: $\frac{12.8}{8} = \frac{10.4}{6.5} = 1.6$.

- **Going up** (small to big): multiply by k. A side of 2.5 cm on ABC matches $2.5 \times 1.6 = 4$ cm on PQR.
- **Going down** (big to small): divide by k. A side of 14.4 cm on PQR matches $14.4 \div 1.6 = 9$ cm on ABC.
- **Congruent** shapes are the special case $k = 1$: same shape, same size.

The key idea is that similar shapes are linked by **multiplying**, never by adding. One side grows from 5 to 8 (plus 3), but the side of 6.5 does not become 9.5; it becomes $6.5 \times 1.6 = 10.4$.

Matching the right sides

The whole method depends on pairing each side with its **matching** (corresponding) side. Diagrams are often turned round or flipped, so don't pair sides by position on the page. Use:

- **the angles**: matching sides are opposite equal angles. In the diagram, BC is opposite the one-arc angle A, so it matches QR, opposite the one-arc angle P;
- **the letters**: "triangle ABC is similar to triangle PQR" pairs A with P, B with Q and C with R, so AB matches PQ, BC matches QR and AC matches PR;
- **size order**: the shortest side matches the shortest side, and the longest matches the longest.

A quick check: if the missing side is on the bigger shape, your answer must be bigger than its partner; if it is on the smaller shape, it must be smaller.

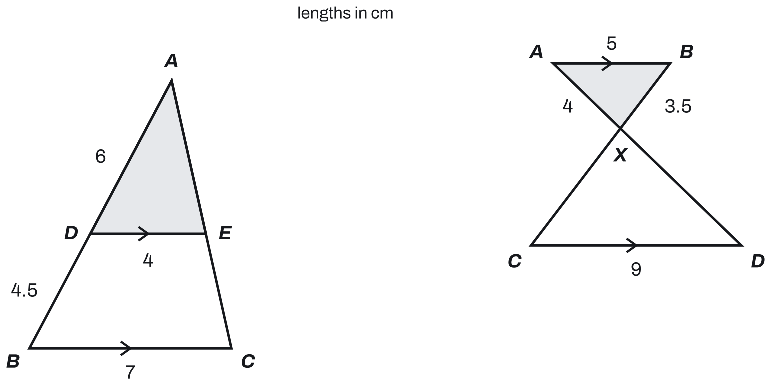
When are shapes similar?

- **Triangles:** if the three angles of one triangle equal the three angles of another, the triangles are similar. (Two pairs are enough, since the third angle then matches too.) Equally, if all three pairs of sides are in the same ratio, they are similar.
- **Other shapes** need **both** equal angles **and** sides in the same ratio. All rectangles have 90° angles, but a 3×5 rectangle is not similar to a 6×9 one, because $\frac{6}{3} = 2$ but $\frac{9}{5} = 1.8$.
- **Solids** are similar when every length (height, radius, width...) is multiplied by the same k. Two cylinders with radii 5 and 9 and heights 7 and 12.6 are similar, because $\frac{9}{5} = \frac{12.6}{7} = 1.8$.
- All circles are similar to each other, and so are all squares, all cubes and all spheres.

Triangles made by parallel lines

Extended only for the explanations; Core papers use the same pictures for lengths.

Two classic pictures hide a pair of similar triangles.



A triangle inside a triangle (left). DE is parallel to BC, so:

- angle ADE = angle ABC (**corresponding angles**, DE parallel to BC);
- angle AED = angle ACB (**corresponding angles**);
- angle A is in both triangles (**common angle**).

All three angles match, so triangle ADE is similar to triangle ABC. The matching sides are AD with AB, and AB is the **whole** side $6 + 4.5 = 10.5$, not $DB = 4.5$. So $k = \frac{10.5}{6} = 1.75$, and $BC = 4 \times 1.75 = 7$ cm.

Crossing lines (right). AB is parallel to CD, and AD and BC cross at X:

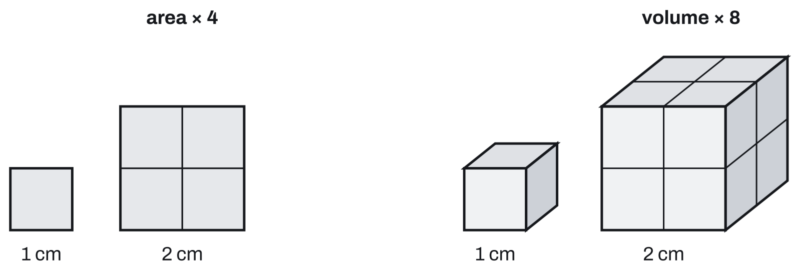
- angle BAX = angle CDX (**alternate angles**, AB parallel to CD);
- angle ABX = angle DCX (**alternate angles**);
- angle AXB = angle DXC (**vertically opposite angles**).

So triangle ABX is similar to triangle DCX with $k = \frac{CD}{AB} = \frac{9}{5} = 1.8$. The side matching AX is DX (both are opposite the angles at B and C), so $XD = 4 \times 1.8 = 7.2$ cm; similarly $XC = 3.5 \times 1.8 = 6.3$ cm, and the whole line $BC = 3.5 + 6.3 = 9.8$ cm.

Tip: sketch the two triangles separately, the same way round, with their lengths marked. It makes the matching sides obvious.

Areas and volumes of similar shapes

Extended only. Double every length of a square and it holds 4 copies of the original; double every edge of a cube and it holds 8 copies.



An area is a length times a length, so it is multiplied by $k \times k = k^2$. A volume is a length times a length times a length, so it is multiplied by k^3. With a length scale factor of 5, areas are multiplied by 25 and volumes by 125.

If lengths are multiplied by	areas are multiplied by	volumes are multiplied by
k	k^2	k^3

This works for **every** kind of area (surface area, the area of a face, the area of a cross-section, the area of glass or paint) and **every** kind of volume (capacity in ml or litres, the amount of liquid it holds, the volume of material). If two similar solids are made of the **same material**, their **masses** are in the volume ratio too: a copy of a 5 kg statue that is 1.6 times as tall weighs $5 \times 1.6^3 = 20.48$ kg.

Going backwards. Always get back to the **length** scale factor first:

- from an area ratio, **square-root**: areas 45 and 125 give $\frac{125}{45} = \frac{25}{9}$, so $k = \sqrt{\frac{25}{9}} = \frac{5}{3}$;
- from a volume ratio, **cube-root**: volumes 54 and 686 give $\frac{686}{54} = \frac{343}{27}$, so $k = \sqrt[3]{\frac{343}{27}} = \frac{7}{3}$.

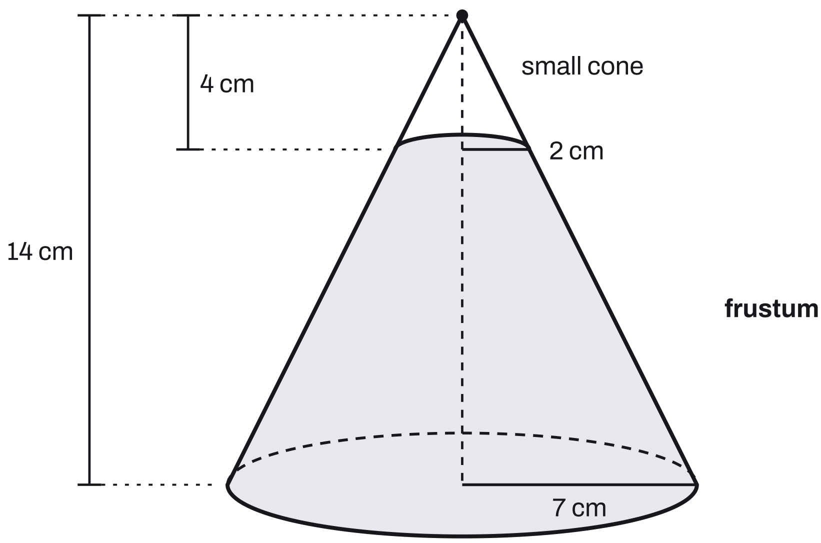
Then go forward to whatever you need. From volumes 54 and 686, the area factor is $\left(\frac{7}{3}\right)^2 = \frac{49}{9}$. Never go straight from one ratio to the other.

A percentage change is a multiplier. "The volume is 33.1% greater" means the volume factor is 1.331, so the length factor is $\sqrt[3]{1.331} = 1.1$.

Scale drawings and plans work the same way: a plan at $1 : 80$ has lengths divided by 80, so areas are divided by $80^2 = 6400$. A floor of 480 m² $= 4\,800\,000$ cm² is $4\,800\,000 \div 6400 = 750$ cm² on the plan.

A cone with its top cut off

Extended only. Cut a cone parallel to its base and the small cone you remove is **similar** to the whole cone. The part left is a **frustum**.



The scale factor from the whole cone to the small cone is $\frac{4}{14} = \frac{2}{7}$, so the small radius is $7 \times \frac{2}{7} = 2$ cm. Then

$$\text{volume of frustum} = \tfrac{1}{3}\pi \times 7^2 \times 14 - \tfrac{1}{3}\pi \times 2^2 \times 4 = \tfrac{686}{3}\pi - \tfrac{16}{3}\pi = \tfrac{670}{3}\pi \approx 702\ \text{cm}^3.$$

(The small cone's volume is $\left(\frac{2}{7}\right)^3 = \frac{8}{343}$ of the whole: $\frac{686}{3}\pi \times \frac{8}{343} = \frac{16}{3}\pi$, a good check.) Watch which height is given: often it is the frustum's height, and you add it to the small cone's height to get the whole cone's.

Key facts and formulas

"Given" means it is on the List of formulas printed on page 2 of the exam paper.

Formula	Status
Scale factor $k = \dfrac{\text{new length}}{\text{matching old length}}$; new length $=$ old length $\times k$	Learn it
Similar shapes: all matching angles equal and all matching lengths in the same ratio	Learn it
Triangles with three equal pairs of angles are similar	Learn it
Extended only: $\dfrac{\text{area}_B}{\text{area}_A} = k^2 = \left(\dfrac{\text{length}_B}{\text{length}_A}\right)^2$	Learn it
Extended only: $\dfrac{\text{volume}_B}{\text{volume}_A} = k^3 = \left(\dfrac{\text{length}_B}{\text{length}_A}\right)^3$ (also capacity, and mass for the same material)	Learn it
Extended only: from an area ratio $k = \sqrt{\text{area ratio}}$; from a volume ratio $k = \sqrt[3]{\text{volume ratio}}$	Learn it
Parallel-line angle facts: corresponding angles equal, alternate angles equal; vertically opposite angles equal	Learn it
Volume of a cone $V = \frac{1}{3}\pi r^2 h$	Given
Volume of a pyramid $V = \frac{1}{3}Ah$	Given

How to do it

In the questions we have tagged for this topic (48 questions, 2021–2025; one of them was printed on two papers), the types came up this often. 11 of the 48 questions have parts of more than one type, so the counts add up to more than 48.

Question type	Questions
Lengths in similar shapes	23
Volumes, capacities and masses of similar solids	14
Areas of similar shapes	12

Question type	Questions
Explaining or showing that shapes are similar	7
Triangles inside triangles and crossing lines	5
Cones cut parallel to the base (frustums)	3

1. Lengths in similar shapes (23 questions)

1. **Pair the sides**: find two matching sides whose lengths you **both** know. Use the equal angles, the order of the letters, or size order.
2. **Scale factor** $k = \dfrac{\text{big}}{\text{small}}$ (or set up an equal-ratio equation: $\dfrac{x}{7} = \dfrac{9}{5}$).
3. **Missing side**: on the bigger shape, multiply its partner by k; on the smaller shape, divide by k.
4. **Sense check**, and give the answer exactly or to 3 significant figures. Keep the scale factor unrounded (use the fraction or the calculator memory).

For example, sides 5 and 9 match, so $k = 1.8$: a side of 7 on the small shape gives $7 \times 1.8 = 12.6$, and a side of 13.5 on the big shape gives $13.5 \div 1.8 = 7.5$.

Variations you will meet:

- **"Show that $QR = 20.4$"**: write the calculation, such as $\dfrac{17}{6} \times 7.2 = 20.4$. Saying "it is about 2.8 times as big" is not enough.
- **Rectangles and other shapes**: the same method, as long as they are stated to be similar.
- **Right-angled similar triangles**: use the scale factor for the side; trigonometry or Pythagoras only for angles or a third side if asked. Similar triangles have the **same angles**, so an angle found in one is the same in the other.
- **Perimeters** are lengths, so they scale by k too.
- **Is the shape similar?** Check that **every** pair of lengths gives the same ratio.

2. Volumes, capacities and masses of similar solids (14 questions)

Extended only.

1. **Write down what you know**: which ratio is given (lengths, areas or volumes) and which is wanted.
2. **Find the length factor** k: straight from lengths; $\sqrt{\ }$ of an area ratio; $\sqrt[3]{\ }$ of a volume ratio.
3. **Raise it to the power you need**: k for a length, k^2 for an area, k^3 for a volume, capacity or mass.
4. **Multiply** (small to big) or **divide** (big to small). Check the answer is bigger or smaller as it should be.

For example, similar solids with volumes 64 cm³ and 343 cm³: $k = \sqrt[3]{\dfrac{343}{64}} = \dfrac{7}{4}$, area factor $\dfrac{49}{16}$. If the smaller has surface area 48 cm², the larger has $48 \times \dfrac{49}{16} = 147$ cm².

Variations you will meet:

- **Volume to length**: volumes 250 cm³ and 1458 cm³, small height 15 cm: large height $= 15 \times \sqrt[3]{\frac{1458}{250}} = 15 \times 1.8 = 27$ cm.
- **Area to volume** (or back): surface areas 36 and 121, so $k = \sqrt{\frac{121}{36}} = \frac{11}{6}$; a volume of 216 becomes $216 \times \left(\frac{11}{6}\right)^3 = 1331$.
- **A percentage**: "119.7% greater volume" means a factor of $1 + 1.197 = 2.197$, so $k = \sqrt[3]{2.197} = 1.3$.
- **Mass and density**: for the same material, mass scales like volume. Find a volume from mass ÷ density, use k^3, and change units as needed (1000 g $= 1$ kg; 1 litre $= 1000$ cm³).
- **Prisms with similar cross-sections**: if the prisms are similar, volumes use k^3 from the cross-section's length factor.
- **Units**: keep both volumes in the same unit (both ml, or both litres) before dividing.

3. Areas of similar shapes (12 questions)

Extended only (a Core question may only ask for lengths).

1. Find the **length factor** k from matching sides (or $\sqrt{}$ of an area ratio).
2. **Area factor** $= k^2$. Multiply or divide the known area.

For example, triangles with matching sides 4 and 7: the larger has area 98 cm², so the smaller has $98 \times \left(\frac{4}{7}\right)^2 = 32$ cm².

Variations you will meet:

- **Area to length**: areas 18 and 50, small side 6: $k = \sqrt{\frac{50}{18}} = \frac{5}{3}$, so the big side is $6 \times \frac{5}{3} = 10$.
- **The piece left over** (a trapezium or quadrilateral): the area of the big triangle minus the small one inside it. If the lengths are multiplied by 1.6 and the small triangle has area A, the big one has $2.56A$, so the piece left over is $2.56A - A = 1.56A$. Answers "in terms of" a letter keep the letter.
- **"Complete the ratio of the areas"**: square the length ratio: $3 : 7$ becomes $9 : 49$.
- **Several similar shapes** with heights $2 : 3 : 7$ have areas $4 : 9 : 49$; then add or subtract areas as the diagram shows.
- **Enlargements** and **scale plans**: an enlargement with scale factor 1.3 multiplies the area by 1.69; a plan at $1 : 80$ divides areas by 6400 (change m² to cm² first: 1 m² $= 10\,000$ cm²).

4. Explaining or showing that shapes are similar (7 questions)

Extended only for triangles with reasons.

1. **Name each pair of equal angles** with three letters: "angle PST = angle PQR".
2. **Give the reason** for each: *corresponding angles*, *alternate angles* (say which lines are parallel), *vertically opposite angles*, *common angle*, *angles in the same segment*, *opposite angles of a cyclic quadrilateral*, and so on.
3. **Conclude**: "all three pairs of angles are equal, so the triangles are similar".

Variations you will meet:

- **"Complete the statement: triangle ABX is ______ to triangle DCX"**: *similar* (not "congruent" unless the sizes are equal).
- **"Show that the two cylinders are similar"**: work out the ratio of the radii and the ratio of the heights and show they are equal.
- **Pick the similar (not congruent) shape** from a set: same angles, different size.
- **Circle theorems** give equal angles, for example angles in the same segment, or an angle between a tangent and a radius being 90° (see the circle theorem topics for the facts; the similarity step is the same).

5. Triangles inside triangles and crossing lines (5 questions)

1. **Spot the parallel lines** and the two triangles they make (nested, or an X shape).
2. **Sketch the triangles separately**, the same way round, with their lengths.
3. **Use whole sides**: in a nested triangle, the big triangle's side is the small side **plus** the extra piece ($AB = AD + DB$).
4. Find k, then the length, then **add or subtract** if the question asks for a piece (such as DB or EC) or a whole line through X (such as $BC = BX + XC$).

Variations you will meet:

- **Area of the piece between**: area of the big triangle minus area of the small one (k^2).
- **Finding a piece from its part**: with AE and AC given, $EC = AC - AE$.

6. Cones cut parallel to the base (frustums) (3 questions)

Extended only.

1. **Heights**: the whole cone's height $=$ small cone's height $+$ frustum's height.
2. **Scale factor** from the small cone to the whole cone, from the heights (or the radii).
3. **Missing radius** (or height) from the scale factor.
4. **Frustum volume** $=$ volume of the whole cone $-$ volume of the small cone, using $V = \frac{1}{3}\pi r^2 h$ (given). Or use $V_{\text{small}} = V_{\text{whole}} \times \left(\frac{h_{\text{small}}}{h_{\text{whole}}}\right)^3$.

For a cone of radius 10 and height 25, a top cone of height 10 has radius $10 \times \frac{10}{25} = 4$.

Worked examples

The bold codes show where marks are earned, as in Cambridge mark schemes. The number is how many marks.

- **M1** method mark: for a correct method, even if the numbers slip.
- **A1** accuracy mark: for a correct answer; it needs the M mark before it.
- **B1** mark for a correct result on its own, with no method needed.

Example 1

Triangle ABC is mathematically similar to triangle PQR, with A matching P, B matching Q and C matching R. $AB = 3.6$ cm, $BC = 6.6$ cm, $PQ = 8.28$ cm and $PR = 13.57$ cm.

(a) Calculate QR. **[2]**

(b) Calculate AC. **[2]**

(c) Show that the perimeter of PQR is 2.3 times the perimeter of ABC. **[2]**

(a) $k = \frac{PQ}{AB} = \frac{8.28}{3.6} = 2.3$ **M1**

$QR = 6.6 \times 2.3 = 15.18$ cm **A1**

(b) AC is on the smaller triangle, so divide: $13.57 \div 2.3$ **M1** $= 5.9$ cm **A1**

(c) Perimeter $ABC = 3.6 + 6.6 + 5.9 = 16.1$ cm; perimeter $PQR = 8.28 + 15.18 + 13.57 = 37.03$ cm **M1**. $16.1 \times 2.3 = 37.03$ **A1**, so it is 2.3 times.

Example 2

Extended. In triangle ABC, D is on AB and E is on AC, with DE parallel to BC. $AD = 4$ cm, $DB = 3$ cm, $DE = 6$ cm and $AC = 14$ cm.

(a) Explain why triangle ADE is similar to triangle ABC. Give a geometric reason for each statement you make. **[3]**

(b) Calculate BC. **[2]**

(c) Calculate EC. **[2]**

(d) The area of triangle ADE is 16 cm². Calculate the area of the quadrilateral $DBCE$. **[3]**

(a) Angle ADE = angle ABC: corresponding angles, as DE is parallel to BC. **B1**

Angle AED = angle ACB: corresponding angles. **B1**

Angle DAE = angle BAC: common angle. All three pairs of angles are equal, so the triangles are similar. **B1**

(b) $AB = 4 + 3 = 7$, so $k = \dfrac{7}{4} = 1.75$. **M1** $BC = 6 \times 1.75 = 10.5$ cm **A1**

(c) $AE = 14 \div 1.75 = 8$ **M1**, so $EC = 14 - 8 = 6$ cm **A1**

(d) Area factor $= 1.75^2 = 3.0625$. **M1** Area $ABC = 16 \times 3.0625 = 49$ cm². **M1**

Area $DBCE = 49 - 16 = 33$ cm² **A1**

Example 3

Extended. Two vases are mathematically similar. Their surface areas are 90 cm² and 250 cm². The smaller vase is 12 cm tall.

(a) Calculate the height of the larger vase. **[2]**

(b) The smaller vase holds 0.54 litres. Calculate how much the larger vase holds. **[2]**

(c) A third vase, also similar, holds 0.16 litres. Calculate its surface area. **[3]**

(a) Area factor $\dfrac{250}{90} = \dfrac{25}{9}$, so $k = \sqrt{\dfrac{25}{9}} = \dfrac{5}{3}$. **M1** Height $= 12 \times \dfrac{5}{3} = 20$ cm **A1**

(b) $0.54 \times \left(\dfrac{5}{3}\right)^3$ **M1** $= 0.54 \times \dfrac{125}{27} = 2.5$ litres **A1**

(c) Compare with the smaller vase: $\dfrac{0.16}{0.54} = \dfrac{8}{27}$, so $k = \sqrt[3]{\dfrac{8}{27}} = \dfrac{2}{3}$. **M1**

Area factor $\left(\dfrac{2}{3}\right)^2 = \dfrac{4}{9}$ **M1**, so the surface area is $90 \times \dfrac{4}{9} = 40$ cm² **A1**.

Example 4

Extended. A solid cone has base radius 10 cm and height 24 cm. A cut parallel to the base removes a small cone of height 6 cm from the top, leaving a frustum.

(a) Find the radius of the small cone. **[2]**

(b) Calculate the volume of the frustum. Give your answer correct to 3 significant figures. **[3]**

(c) What percentage of the cone's volume is left in the frustum? **[2]**

[The volume, V, of a cone with radius r and height h is $V = \frac{1}{3}\pi r^2 h$.]

(a) $k = \dfrac{6}{24} = \dfrac{1}{4}$ **M1**; radius $= 10 \times \dfrac{1}{4} = 2.5$ cm **A1**

(b) Whole cone $\frac{1}{3}\pi \times 10^2 \times 24 = 800\pi$; small cone $\frac{1}{3}\pi \times 2.5^2 \times 6 = 12.5\pi$. **M1 M1**

Frustum $= 800\pi - 12.5\pi = 787.5\pi = 2474.00\ldots \approx 2470$ cm³ **A1**

(c) The small cone is $\left(\frac{1}{4}\right)^3 = \frac{1}{64}$ of the cone, so the frustum is $\frac{63}{64}$ of it **M1**: $\frac{63}{64} \times 100 = 98.4\%$ **A1**

Common mistakes

- **Adding or subtracting instead of multiplying.** The most common error every year: using the difference between two sides ($11 - 7 = 4$, so "add 4"). Similar shapes are linked by a scale factor, so multiply or divide.
- **Multiplying when you should divide.** If the missing side is on the smaller shape, divide by k. Examiners often see answers larger than the side they came from; always check the size makes sense.
- **Pairing the wrong sides**, especially when one triangle is rotated or flipped. Use the angles or the letters, not the position on the page.
- **Using a part instead of the whole side** in a triangle inside a triangle (DB instead of $AB = AD + DB$), or forgetting to add or subtract at the end.
- **Rounding the scale factor too early** ($5.3 \div 3.7$ written as 1.43), which gives an answer that is close but not accurate enough. Use fractions or the full calculator value.
- **Rounding an exact answer.** If the working gives exactly 8.25, write 8.25, not 8.3.
- **Treating an area or volume ratio as the length factor.** With areas 25 and 64, the length factor is $\sqrt{\frac{64}{25}} = 1.6$, not $\frac{64}{25} = 2.56$. Many answers square an area ratio, or use the volume ratio for areas; always go back to the length factor first.
- **Mixing up squaring, square-rooting, cubing and cube-rooting.** Length to area: square. Area to length: square-root. Length to volume: cube. Volume to length: cube-root. Area to volume: square-root, then cube.
- **Map and plan areas scaled like lengths.** An area on a $1 : n$ plan uses n^2.
- **Vague reasons for similarity**, such as "they share an angle" or "they both have a right angle" without naming which angles, or "Z angles" instead of *alternate angles*. Name each pair of angles and give the proper reason.
- **Using trigonometry** (sine and cosine rules) when similar triangles are quicker. It works, but rounding along the way often loses the accuracy mark.

How to get the marks

- **Lengths (2 marks)**: the method mark is for a correct equal-ratio statement such as $\dfrac{x}{11} = \dfrac{9}{4}$, or the scale factor used the right way. Write it down before working it out.
- **Areas and volumes (3 marks)**: typically **M1** for the length factor (or the right root of a ratio), **M1** for raising it to the right power and applying it, and **A1** for the answer. A statement such as $\left(\dfrac{h}{6}\right)^2 = \dfrac{245}{80}$ earns method marks on its own.
- **"Show that"**: the calculation must be seen, such as $\dfrac{17}{6} \times 7.2 = 20.4$. Words like "about 2.8 times as big" do not earn the mark.

- **Explaining similarity (3 marks)**: one mark for each pair of equal angles **with** a correct reason. Finish with "so the triangles are similar". Reasons must be proper geometric language.
- **"In terms of" a letter**: the answer is an expression such as $1.56A$; don't substitute a number.
- **Accuracy**: exact answers stay exact; otherwise give 3 significant figures (angles to 1 decimal place). Give units where asked (cm, cm², cm³, ml, litres).
- **nfww** on a mark scheme means "not from wrong working": a right answer from a wrong method scores nothing, so show a correct method.

Quick check

1. A rectangle 5 cm by 8 cm is similar to a rectangle 9 cm by x cm, with the 5 cm side matching the 9 cm side. Find x.
2. *Extended.* Two similar triangles have matching sides in the ratio $3 : 4$. The smaller triangle has area 27 cm². Find the area of the larger triangle.
3. *Extended.* Two similar bottles hold 216 ml and 1000 ml. The smaller bottle is 9 cm tall. How tall is the larger bottle?
4. *Extended.* The volume of a large box is 15.7625% greater than the volume of a mathematically similar small box. The small box is 8 cm long. How long is the large box?
5. *Extended.* A floor has area 96 m². Find its area on a plan drawn to a scale of $1 : 200$, in cm².
6. AB is parallel to CD, and AD and BC cross at X. $AB = 5$ cm, $CD = 11$ cm, $AX = 3$ cm and $CX = 8.8$ cm. Find XD and BX.

Answers

1. $k = \dfrac{9}{5} = 1.8$, so $x = 8 \times 1.8 = 14.4$.
2. Area factor $\left(\dfrac{4}{3}\right)^2 = \dfrac{16}{9}$, so the area is $27 \times \dfrac{16}{9} = 48$ cm².
3. $\dfrac{1000}{216} = \dfrac{125}{27}$, so $k = \sqrt[3]{\dfrac{125}{27}} = \dfrac{5}{3}$ and the height is $9 \times \dfrac{5}{3} = 15$ cm.
4. Volume factor 1.157625, so $k = \sqrt[3]{1.157625} = 1.05$ and the length is $8 \times 1.05 = 8.4$ cm.
5. 96 m² $= 960\,000$ cm². Divide by $200^2 = 40\,000$: 24 cm².
6. Triangles ABX and DCX are similar with $k = \dfrac{11}{5} = 2.2$. XD matches AX: $3 \times 2.2 = 6.6$ cm. BX matches CX on the big triangle, so divide: $8.8 \div 2.2 = 4$ cm.

Past questions to try

- **0580/42/M/J/25 Q13**: a missing side, then the volume of a similar prism.
- **0580/22/F/M/23 Q10**: crossing lines with parallel sides, then a whole length.
- **0580/42/M/J/22 Q9**: explaining why two triangles are similar, a length, then an area.
- **0580/42/O/N/21 Q11**: lengths and areas of similar triangles, then capacity to surface area.