

Exercise walk-through

4.8

Similarity ratios and mixed practice

Pearson Edexcel · International GCSE · Mathematics A

1. Topic 4 at a glance

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The largest topic: Foundation 4.1-4.11 (angle facts, polygons, measures, constructions, circle language, Pythagoras and 2D trigonometry, mensuration, similarity); Higher adds the circle-theorem programme, obtuse and non-right trigonometry, 3D problems, sectors, cones, spheres and the k -squared/ k -cubed ratios.

Must-know: $a^2 = b^2 + c^2 - 2bc \cos A$; $a/\sin A = b/\sin B$; area $\frac{1}{2}ab \sin C$; arc and sector from $\theta/360$; cone $\frac{1}{3}\pi r^2 h$; sphere $\frac{4}{3}\pi r^3$ and $4\pi r^2$; lengths k , areas k^2 , volumes k^3 .

9. Similarity ratios

Similarity ratios

Lengths k , areas k^2 , volumes k^3 - and backwards: area ratio 4 : 9 means lengths 2 : 3; volume ratio 64 : 1 means lengths 4 : 1.

June 2024 2HR Q24 family: $k^3 = 125/8$ so $k = 2.5$; a length ratio of 4 gives a volume ratio of 64. Set the ratio on lengths first, then square or cube once.

Check yourself

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Angle facts with reasons; polygon sums and regular angles; symmetry counts. Bearings and the three compound measures. Constructions with arcs left in; locus regions; scale conversions.

The circle-theorem reason bank applied in chains. Pythagoras and SOH CAH TOA; sine rule, cosine rule and the area formula in both directions. 3D triangles extracted and finished. Sectors, cones, spheres and composite areas. The $k : k^2 : k^3$ ladder both ways.

Exercises 2.1·2.3

2.1 Two similar jugs have height ratio $2 : 5$. Write down their volume ratio. [2]

2.2 Two similar photographs have areas 18 cm^2 and 50 cm^2 . Find the ratio of their widths. [3]

2.3 On a $1 : 25\,000$ map a road is 6 cm. Find the real length in km. [2]

Exercises 2.1·2.3

2.1 Two similar jugs have height ratio $2 : 5$. Write down their volume ratio. [2]

2.1 $2^3 : 5^3 = 8 : 125$.

2.2 Two similar photographs have areas 18 cm^2 and 50 cm^2 . Find the ratio of their widths. [3]

2.2 $\sqrt{18} : \sqrt{50} = 3\sqrt{2} : 5\sqrt{2} = 3 : 5$.

2.3 On a $1 : 25\,000$ map a road is 6 cm. Find the real length in km. [2]

2.3 $6 \times 25\,000 = 150\,000 \text{ cm} = 1.5 \text{ km}$.

Exercises 2.4·3.1

2.4 A model car is built at 1 : 48. The real car is 4.2 m long. Find the model length in cm. [3]

2.5 Similar cones have base radii 3 cm and 6 cm. The smaller has volume $12\pi \text{ cm}^3$. Find the larger's volume. [3]

3.1 (*Edexcel 4MA1 2HR June 2024 Q24 family, adapted.*) Solid B is similar to solid A , with every length of B equal to k times the corresponding length of A . The volumes satisfy $V_B = \frac{125}{8}V_A$. (a) Find k . (b) A third solid C has every length 4 times solid A 's. Write down $V_C : V_A$. [4]

Exercises 2.4·3.1

2.4 A model car is built at 1 : 48. The real car is 4.2 m long. Find the model length in cm. [3]

2.4 $4.2 \text{ m} = 420 \text{ cm}$; $420/48 = 8.75 \text{ cm}$.

2.5 Similar cones have base radii 3 cm and 6 cm. The smaller has volume $12\pi \text{ cm}^3$. Find the larger's volume. [3]

2.5 $k = 2$, so volumes scale by 8: $96\pi \text{ cm}^3$.

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3.1 (a) $k^3 = 125/8$, so $k = \sqrt[3]{125/8} = 5/2 = 2.5$. (b) $4^3 = 64$, so $V_C : V_A = 64 : 1$.

Exercises 3.2·3.3

3.2 (*Original.*) Two similar tins of soup have heights 8 cm and 12 cm. The larger tin holds 486 cm^3 . (a) Find the volume of the smaller tin. (b) The larger tin's label wraps its curved surface, area 150 cm^2 . Find the label area of the smaller tin. [6]

3.3 (*Original, mixed transfer.*) A rectangular paddock measures 40 m by 25 m on a plan drawn at 1 : 1000. (a) Find the plan's dimensions in cm. (b) A scale model of a prize cow is 1 : 20; the real cow has volume-equivalent body mass 640 kg and the model uses material of the same density. Find the model's mass in grams. [6]

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3.2 (a) $k = 8/12 = 2/3$; volume factor $k^3 = 8/27$; smaller = $486 \times 8/27 = 144 \text{ cm}^3$. (b) Area factor $k^2 = 4/9$; smaller label = $150 \times 4/9 = 66.7 \text{ cm}^2$ (3 s.f.).

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3.3 (a) 40 m = 4000 cm at 1 : 1000 $\rightarrow$ 4 cm; 25 m $\rightarrow$ 2.5 cm. (b) Volume factor $(1/20)^3 = 1/8000$; mass = $640/8000 = 0.08 \text{ kg} = 80 \text{ g}$.

Local review guidance: the ladder direction stated (length $\rightarrow$ area $\rightarrow$ volume) before multiplying; exact ratios simplified; scale answers carried through the unit conversions. This is authored classroom guidance.