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GCSE MATHEMATICS • RATIO & PROPORTION

Similar Shapes

Worked Solutions

Pearson Edexcel GCSE (1MA1) & International GCSE (4MA1) • Calculator allowed

Full worked solutions for the free Similar Shapes worksheet, GCSE and iGCSE Maths



Tap a section to jump straight to it

Full worked solutions for every question on the Similar Shapes worksheet, in the same order and with the same question numbers.

How to mark your work. Tick each step you got right, not just the final answer. In the exam, method marks are given for correct working even when the final answer is wrong. If you lost marks, find the *first* line where your working is different from ours. That is the thing to fix.

In Section E: **M** = method mark, **P** = process mark, **A** = accuracy mark, **B** = independent mark, **C** = communication mark.

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A**Your turn answers**

Compare each line of your working with the solution.

FOUNDATION

A1 Scale factor = $14 \div 6 = \frac{7}{3}$ $9 \times \frac{7}{3} = \boxed{21 \text{ cm}}$

A2 $AB = 5 + 3 = 8$, so the scale factor is $8 \div 5 = 1.6$ $BC = 7.5 \times 1.6 = \boxed{12}$

Compare AD with AB , the whole side, not with DB

A3 AC matches CE : scale factor from EDC to ABC is $9 \div 6 = 1.5$ $AB = 12 \times 1.5 = \boxed{18}$

HIGHER

A4 Length factor = $10 \div 4 = 2.5$, area factor = $2.5^2 = 6.25$ $150 \div 6.25 = \boxed{24 \text{ cm}^2}$

A5 Length factor = $14 \div 10 = 1.4$, volume factor = $1.4^3 = 2.744$ $250 \times 2.744 = \boxed{686 \text{ cm}^3}$

A6 Volume factor = $250 \div 128 = 1.953125$, so $k = \sqrt[3]{1.953125} = 1.25$ and the area factor is $1.25^2 = 1.5625$
 $96 \times 1.5625 = \boxed{150 \text{ cm}^2}$

A7 $AB : AD = 4 : 3$, so the length factor from ABC to ADE is $\frac{3}{4}$ $48 \times \left(\frac{3}{4}\right)^2 = \boxed{27 \text{ cm}^2}$

B**Fluency solutions**

One mark for each correct part. The notes in italics explain why each sequence was chosen.

FOUNDATION

B1 Length is $2.5 \times$ width. (a) $\boxed{20 \text{ cm}}$ (b) $\boxed{10 \text{ cm}}$ (c) $\boxed{15 \text{ cm}}$ (d) $\boxed{2 \text{ cm}}$

B2 (a) $\boxed{\text{yes}}$, $\times 2$ (b) $\boxed{\text{no}}$ (c) $\boxed{\text{yes}}$, $\times 2.5$ (d) $\boxed{\text{yes}}$, $\times 3$

Adding the same amount to each side does not keep the shape. In (d) the sides are written the other way round.

B3 (a) $AB = 6$, so $6 \div 4 = \boxed{1.5}$ (b) $5 \times 1.5 = \boxed{7.5 \text{ cm}}$ (c) $9 \div 1.5 = \boxed{6 \text{ cm}}$ (d) $9 - 6 = \boxed{3 \text{ cm}}$



B4 (a) $9 \div 6 = 1.5$ (b) CE matches AC : $4 \times 1.5 = 6 \text{ cm}$ (c) CD matches BC : $5 \times 1.5 = 7.5 \text{ cm}$ (d) $4 + 6 = 10 \text{ cm}$

B5 (a) 2.5 (b) 0.4 (c) $12 \div 7.5 = 1.6$ A scale factor less than 1 is a reduction.

B6 (a) 12.5 cm (b) $12 \times 2.5 = 30 \text{ cm}$ (c) 90° (d) $12 : 30 = 2 : 5$

Lengths and perimeters scale; angles stay the same.

HIGHER

B7 (a) $\times 4$: 20 cm^2 (b) $\times 9$: 45 cm^2 (c) $\times \frac{1}{4}$: 15 cm^2 (d) $1.5^2 = 2.25$: 27 cm^2

Doubling the lengths multiplies the area by 4, not 2.

B8 (a) $\times 8$: 40 cm^3 (b) $\times 27$: 54 cm^3 (c) $\times \frac{1}{8}$: 10 cm^3 (d) $1.5^3 = 3.375$: 81 cm^3

B9 (a) $\sqrt{9} = 3$ (b) $3^3 = 27$ (c) $\sqrt[3]{8} = 2$, $2^2 = 4$ (d) $\sqrt[3]{1.728} = 1.2$, $1.2^2 = 1.44$

Always go back to the length factor first.

B10 (a) $4 : 25$ (b) $8 : 125$ (c) $3 : 4$ (d) $27 : 64$

C

Reasoning solutions

Your wording can be different. Check that your reason makes the same point.

FOUNDATION

C1 **No.** Similar shapes are multiplied, not added. $5 \div 3 = 1.66\dots$ but $7 \div 5 = 1.4$, so the sides are not in the same ratio.

C2 (a) All the angles of a square are 90° and all its sides are equal, so one square is always an enlargement of another.

(b) The angles are the same, but the ratio of length to width can be different, for example 1 cm by 2 cm and 1 cm by 3 cm.



C3 (a) Kim compared DB with AD . She should compare the whole side AB with AD

(b) $AB = 9$, so the scale factor is $9 \div 3 = 3$ $BC = 4 \times 3 = 12 \text{ cm}$

C4 $9 \div 6 = 1.5$, $12 \div 8 = 1.5$, $15 \div 10 = 1.5$ All three pairs of sides are in the same ratio, scale factor 1.5 , so the triangles are similar.

HIGHER

C5 Paint covers the surface: area factor $2^2 = 4$, so 4 times as much paint.

Clay fills the volume: volume factor $2^3 = 8$, so 8 times as much clay.

C6 Each half is w by $\frac{l}{2}$. Similar means $\frac{l}{w} = \frac{w}{l/2}$ $\frac{l^2}{2} = w^2$, so $l^2 = 2w^2$ and $l = \sqrt{2}w$ $l : w = \sqrt{2} : 1$

C7 Angle $ACB =$ angle ECD (vertically opposite angles are equal).

Angle $BAC =$ angle DEC (alternate angles, because AB is parallel to DE).

Angle $ABC =$ angle EDC (alternate angles). All three angles match, so the triangles are similar.

proved

C8 (a) Angle A is in both triangles. Angle $ADB = 90^\circ =$ angle ABC . So the third angles are equal too, and triangle ABD is similar to triangle ACB .

(b) Matching sides: $\frac{AB}{AC} = \frac{AD}{AB}$, so $AB^2 = AD \times AC$ **as required**

(c) $36 = AD \times 10$ $AD = 3.6 \text{ cm}$

D

Problem solving solutions

There is often more than one correct method. Any complete, correct method scores full marks.

FOUNDATION

D1 Scale factor $= 30 \div 2 = 15$ Height $= 1.6 \times 15 = 24 \text{ m}$

D2 Small perimeter $= 12 \text{ m}$. Scale factor $= 30 \div 12 = 2.5$ Longest side $= 5 \times 2.5 = 12.5 \text{ m}$

D3 The post and the top end make similar triangles with the ramp. Height factor $= 1.2 \div 0.5 = 2.4$

Distance $= 2 \times 2.4 = 4.8 \text{ m}$



D4 $\frac{AD}{AB} = \frac{DE}{BC}$: $\frac{x}{x+6} = \frac{4}{10}$ $10x = 4x + 24$ $6x = 24$ $x = 4$

HIGHER

D5 Length factor 3. Paint (area): $0.3 \times 3^2 = 2.7$ litres Mass (volume): $2 \times 3^3 = 54$ kg

D6 Small cone: length factor $\frac{4}{12} = \frac{1}{3}$, volume factor $\frac{1}{27}$, volume = $480 \div 27 = 17.77... \text{ cm}^3$

Piece left = $480 - 17.77... = 462.22...$ 462 cm^3

D7 Volume factor = $2000 \div 250 = 8$, so the length factor is $\sqrt[3]{8} = 2$ and the area factor is 4

Height = $8 \times 2 = 16 \text{ cm}$ Label = $60 \times 4 = 240 \text{ cm}^2$

D8 (a) The liquid is a similar cone with half the height: volume factor $\left(\frac{1}{2}\right)^3 = \frac{1}{8}$ $900 \div 8 = 112.5 \text{ ml}$

(b) Volume factor $\frac{1}{2}$, so the length factor is $\sqrt[3]{0.5} = 0.7937...$ 79.4% of the height

Half the height holds only an eighth of the volume, because the narrow part is at the bottom.

E

Exam practice solutions

Marks are shown on the right of each line.

FOUNDATION

Foundation and Higher crossover

E1 (a) $10 \div 4 = 2.5$ B1

(b) 6×2.5 M1

15 cm A1

E2 (a) $AB = 10$, so the scale factor is $10 \div 4 = 2.5$ M1

$BC = 5 \times 2.5 = 12.5 \text{ cm}$ A1

(b) $AE = 15 \div 2.5 = 6$ M1

$EC = 15 - 6 = 9 \text{ cm}$ A1

E3 Q: $7.5 \div 3 = 2.5$, $10 \div 4 = 2.5$, $12.5 \div 5 = 2.5$ M1

R: $6 \div 3 = 2$ but $9 \div 5 = 1.8$ M1

P and Q are similar C1



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E4 Scale factor = $12 \div 8 = 1.5$ M1
 CE matches AC : 6×1.5 M1
9 cm A1

E5 $16 \div 2.4 = \frac{20}{3}$ M1
 $1.8 \times \frac{20}{3}$ M1
12 m A1

E6 **A and C** ($\times 3$) **B and D** (both 1 : 2) B2

HIGHER

E7 Length factor = $9 \div 6 = 1.5$ M1
Volume factor = $1.5^3 = 3.375$ M1
 $160 \times 3.375 = \mathbf{540} \text{ cm}^3$ A1

E8 Area factor = $180 \div 80 = 2.25$ P1
Length factor = $\sqrt{2.25} = 1.5$ P1
Volume factor = $1.5^3 = 3.375$ P1
 $400 \times 3.375 = \mathbf{1350} \text{ ml}$ A1

E9 $AB : AD = 5 : 2$, so the length factor is 2.5 and the area factor is 6.25 M1
Area ABC = $12 \times 6.25 = 75$ M1
Trapezium = $75 - 12 = \mathbf{63} \text{ cm}^2$ A1

E10 Volumes are in the ratio $3^3 : 5^3 = 27 : 125$ P1
The difference is $125 - 27 = 98$ parts = 1960, so 1 part = 20 P1
Larger volume = $125 \times 20 = \mathbf{2500} \text{ cm}^3$ A1
Area factor = $\left(\frac{5}{3}\right)^2 = \frac{25}{9}$ P1
Larger surface area = $270 \times \frac{25}{9} = \mathbf{750} \text{ cm}^2$ A1

