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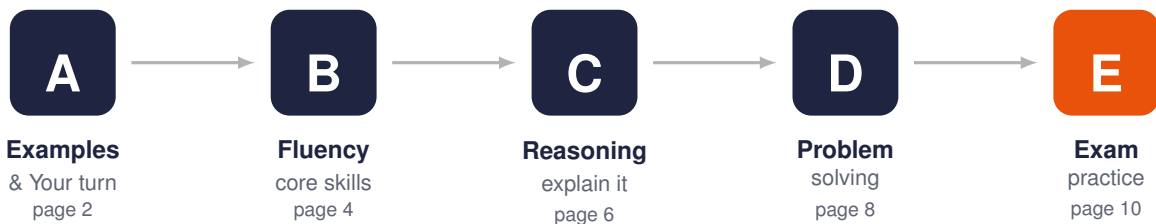
GCSE MATHEMATICS • RATIO & PROPORTION

Similar Shapes

Worksheet

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

Free Similar Shapes worksheet for GCSE and iGCSE Maths, with full worked solutions



Tap a section to jump straight to it

By the end of this worksheet you can: decide whether shapes are similar and find the scale factor • find missing lengths in similar shapes, including triangles with parallel lines • solve similar-triangle problems in context • *Higher:* use area and volume scale factors, and prove that triangles are similar.

Which questions are for me?

FOUNDATION Everyone starts here. These skills appear on both tiers.

HIGHER Higher only: area and volume scale factors of similar shapes and solids, and proving triangles are similar. Grades 6 to 9.

Every section has both, clearly labelled. Questions get harder as you go, and every skill in Sections A to D is needed in Section E.

Track your progress

Section	B	C	D	E
Foundation marks	23	10	14	18
Higher marks	16	14	17	15
My score				

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A

Worked examples & Your turn

Read each example carefully. Cover it up, then answer the question beside it using the same method.

FOUNDATION

Everyone starts here

Worked example A1

Rectangle A is 3 cm by 5 cm. Rectangle B is similar to A, with length 12.5 cm. Find the width of B.

Scale factor = new length $\div$ old length.

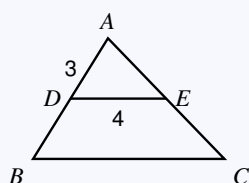
$$12.5 \div 5 = 2.5 \quad 3 \times 2.5 = 7.5$$

7.5 cm

Your turn A1

Two triangles are similar. The small one has sides 6 cm and 9 cm. In the large one, the side matching 6 cm is 14 cm. Find the side matching 9 cm.

Worked example A2



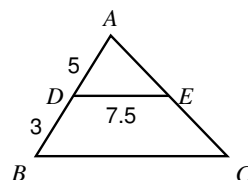
DE is parallel to BC.
 $AD = 3$, $AB = 7.5$, $DE = 4$
 Find BC .

Triangles ADE and ABC are similar. Compare AD with AB .

$$7.5 \div 3 = 2.5 \quad 4 \times 2.5 = 10$$

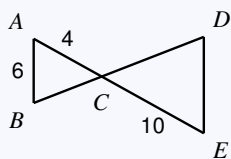
$BC = 10$

Your turn A2



DE is parallel to BC.
 $AD = 5$, $DB = 3$, $DE = 7.5$
 Find BC .

Worked example A3



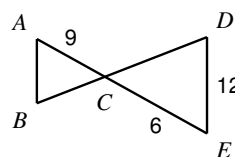
AB is parallel to DE.
 $AC = 4$, $CE = 10$, $AB = 6$
 Find DE .

Triangles ABC and EDC are similar: $CE \div AC = 2.5$

$$6 \times 2.5 = 15$$

$DE = 15$

Your turn A3



AB is parallel to DE.
 $AC = 9$, $CE = 6$, $DE = 12$
 Find AB .



HIGHER*Higher only: area and volume scale factors***Worked example A4: area scale factor = k^2**

Two similar triangles have lengths in the ratio 2 : 3. The small one has area 20 cm^2 . Find the area of the large one.

$k = 1.5$, so the area scale factor is $1.5^2 = 2.25$

$$20 \times 2.25 = 45$$

45 cm^2

Your turn A4

Two similar rectangles have widths 4 cm and 10 cm. The large one has area 150 cm^2 . Find the area of the small one.

Worked example A5: volume scale factor = k^3

Two similar cones have heights 5 cm and 15 cm. The small cone has volume 12 cm^3 . Find the volume of the large cone.

$k = 3$, so the volume scale factor is $3^3 = 27$

$$12 \times 27 = 324$$

324 cm^3

Your turn A5

Two similar solids have heights 10 cm and 14 cm. The small one has volume 250 cm^3 . Find the volume of the large one.

Worked example A6: from area to length to volume

Two similar solids have surface areas 50 cm^2 and 72 cm^2 . The small one has volume 125 cm^3 . Find the volume of the large one.

Area factor 1.44, so $k = \sqrt{1.44} = 1.2$ and the volume factor is $1.2^3 = 1.728$

$$125 \times 1.728 = 216$$

216 cm^3

Your turn A6

Two similar bottles have volumes 128 cm^3 and 250 cm^3 . The small one has surface area 96 cm^2 . Find the surface area of the large one.

Worked example A7: areas in nested triangles

DE is parallel to BC, and $AD : DB = 1 : 2$. Triangle ADE has area 5 cm^2 . Find the area of the trapezium DBCE.

$AB = 3 \times AD$, so area $ABC = 3^2 \times 5 = 45$

$$45 - 5 = 40$$

40 cm^2

Your turn A7

DE is parallel to BC, and $AD : DB = 3 : 1$. Triangle ABC has area 48 cm^2 . Find the area of triangle ADE.



B**Fluency**

Each question is a designed sequence. From one part to the next, ask yourself: what changed, and what did it do to the answer?

FOUNDATION

Everyone starts here

B1 Rectangle P is 4 cm by 10 cm. Each rectangle below is similar to P. Find the missing side.

- (a) width 8 cm (b) length 25 cm (c) width 6 cm (d) length 5 cm

[4 marks]

B2 Is each rectangle similar to a rectangle 2 cm by 3 cm? Write yes or no.

- (a) 4 cm by 6 cm (b) 3 cm by 4 cm (c) 5 cm by 7.5 cm (d) 9 cm by 6 cm

[4 marks]

B3 DE is parallel to BC. $AD = 4$ cm, $DB = 2$ cm, $DE = 5$ cm and $AC = 9$ cm.

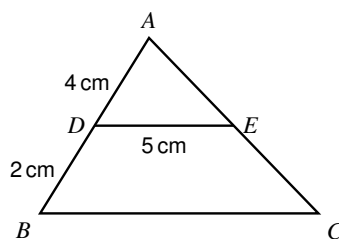


Diagram NOT accurately drawn

- (a) Find the scale factor from triangle ADE to triangle ABC. (b) Find BC
(c) Find AE (d) Find EC

[4 marks]

B4 AB is parallel to DE. The lines AE and BD cross at C. $AB = 6$ cm, $DE = 9$ cm, $AC = 4$ cm and $BC = 5$ cm.

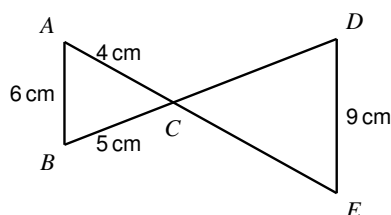


Diagram NOT accurately drawn

- (a) Find the scale factor from triangle ABC to triangle EDC. (b) Find CE
(c) Find CD (d) Find the length of AE

[4 marks]



FOUNDATION*continued: scale factors and perimeters*

B5 Write down the scale factor from the first length to the second.

(a) 4 cm to 10 cm

(b) 10 cm to 4 cm

(c) 7.5 cm to 12 cm

[3 marks]

B6 A triangle with sides 3 cm, 4 cm and 5 cm is enlarged by scale factor 2.5

(a) Find the longest side of the new triangle. (b) Find the perimeter of the new triangle.

(c) The first triangle has a right angle. What size is the matching angle in the new triangle?

(d) Write the ratio of the two perimeters in its simplest form.

[4 marks]

HIGHER*Higher tier only*

B7 Two shapes are similar. Find the missing area.

(a) lengths $\times 2$, small area 5 cm^2

(b) lengths $\times 3$, small area 5 cm^2

(c) lengths $\times \frac{1}{2}$, large area 60 cm^2

(d) lengths 4 cm and 6 cm, small area 12 cm^2

[4 marks]

B8 Two solids are similar. Find the missing volume.

(a) lengths $\times 2$, small volume 5 cm^3

(b) lengths $\times 3$, small volume 2 cm^3

(c) lengths $\times 0.5$, large volume 80 cm^3

(d) lengths 5 cm and 7.5 cm, small volume 24 cm^3

[4 marks]

B9 Write down

(a) the length factor when the area factor is 9

(b) the volume factor when the area factor is 9

(c) the area factor when the volume factor is 8

(d) the area factor when the volume factor is 1.728

[4 marks]

B10 (a) Lengths are in the ratio 2 : 5. Write down the ratio of the areas.

(b) Lengths are in the ratio 2 : 5. Write down the ratio of the volumes.

(c) Areas are in the ratio 9 : 16. Write down the ratio of the lengths.

(d) Areas are in the ratio 9 : 16. Write down the ratio of the volumes.

[4 marks]



C**Reasoning**

Show your working and explain your thinking. A correct answer without a reason does not score full marks.

FOUNDATION

Everyone starts here

- C1** Tom says, "A 3 cm by 5 cm rectangle is similar to a 5 cm by 7 cm rectangle, because I added 2 to each side."

Is Tom correct? Give a reason for your answer.

[2 marks]

- C2** (a) Explain why any two squares are similar.

(b) Explain why two rectangles are not always similar.

[2 marks]

- C3** DE is parallel to BC. $AD = 3$ cm, $DB = 6$ cm and $DE = 4$ cm.

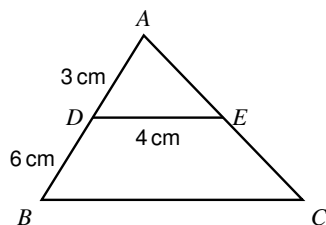


Diagram NOT accurately drawn

Kim writes $6 \div 3 = 2$, so $BC = 4 \times 2 = 8$ cm

- (a) Explain Kim's mistake. (b) Work out the correct length of BC

[3 marks]

- C4** Triangle P has sides 6 cm, 8 cm and 10 cm. Triangle Q has sides 9 cm, 12 cm and 15 cm.

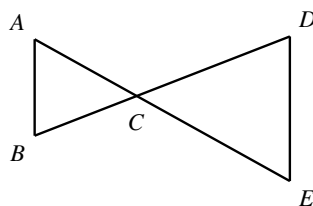
Show that the triangles are similar.

[3 marks]



HIGHER*Higher tier only*

- C5** Ali says, "If I double every length of a model, it needs twice as much paint and twice as much clay."
Explain why Ali is wrong, and write down how many times as much paint and clay the new model needs.
[3 marks]
- C6** A sheet of A4 paper has length l and width w . When it is folded in half across its length, each half is similar to the whole sheet.
Show that $l : w = \sqrt{2} : 1$
[3 marks]
- C7** AB is parallel to DE. The straight lines AE and BD cross at C.



Prove that triangle ABC is similar to triangle EDC. Give a reason for each step.

[3 marks]

- C8** ABC is a triangle with a right angle at B. D is the point on AC such that BD is perpendicular to AC.

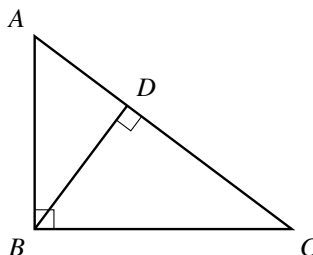


Diagram NOT accurately drawn

- (a) Prove that triangle ABD is similar to triangle ACB.
(b) Hence show that $AB^2 = AD \times AC$
(c) $AB = 6$ cm and $AC = 10$ cm. Find AD

[5 marks]



D**Problem solving**

You decide the method. Read the whole question first, and show every step.

FOUNDATION

Everyone starts here

- D1** Lena is 1.6 m tall. She stands 2 m from a mirror on flat ground and sees the top of a building in the mirror. The mirror is 30 m from the building, and the two triangles are similar.

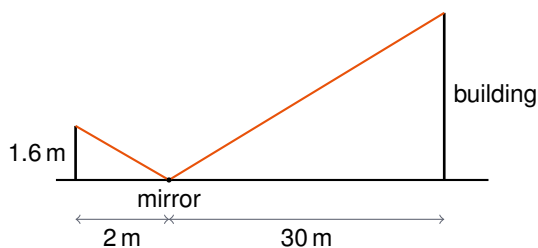


Diagram NOT accurately drawn

Work out the height of the building.

[3 marks]

- D2** A small triangular sail has sides 3 m, 4 m and 5 m.
A larger sail is similar to it and has a perimeter of 30 m. Work out the length of the longest side of the larger sail.

[3 marks]

- D3** A ramp rises in a straight line from the ground. A vertical post 0.5 m high supports the ramp at a point 2 m from its bottom end, measured along the ground. The top end of the ramp is 1.2 m above the ground.

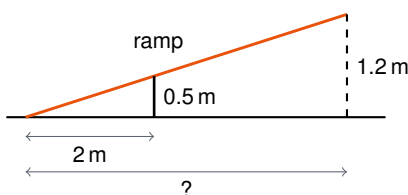


Diagram NOT accurately drawn

How far is the top end from the bottom end, measured along the ground?

[4 marks]

- D4** DE is parallel to BC. $AD = x$ cm, $DB = 6$ cm, $DE = 4$ cm and $BC = 10$ cm.

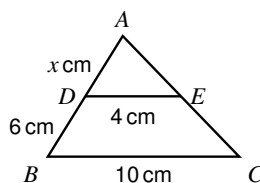


Diagram NOT accurately drawn

Find the value of x

[4 marks]



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HIGHER*Higher tier only*

- D5** A small statue needs 0.3 litres of paint to cover it and has a mass of 2 kg.
A similar statue is 3 times as tall, and is made of the same material. How much paint does it need, and what is its mass? **[4 marks]**
- D6** A solid cone has height 12 cm and volume 480 cm^3 . A cut parallel to its base removes the top 4 cm, which is a small similar cone.
Work out the volume of the piece that is left. Give your answer to 3 significant figures. **[4 marks]**
- D7** Two similar containers hold 250 ml and 2 litres. The small container is 8 cm tall and has a label of area 60 cm^2 .
The large container has a similar label. Work out the height of the large container and the area of its label. **[4 marks]**
- D8** A funnel is a cone with its point at the bottom. When it is full it holds 900 ml.
(a) The funnel is filled to half of its height. How much liquid is in it?
(b) To what percentage of its height must it be filled to hold half of its full volume? Give your answer to 1 decimal place. **[5 marks]**



E

Exam practice

Exam-style questions. Write your answers in the spaces. Aim for about one minute per mark.

FOUNDATION

Foundation and Higher crossover

E1 Rectangle A is 4 cm by 6 cm. Rectangle B is similar to A. The shorter side of B is 10 cm.

(a) Write down the scale factor from A to B.

.....
(1)

(b) Work out the length of the longer side of B.

..... cm
(2)

(Total for Question E1 is 3 marks)

E2 DE is parallel to BC. $AD = 4$ cm, $DB = 6$ cm, $DE = 5$ cm and $AC = 15$ cm.

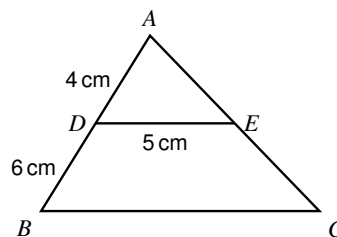


Diagram NOT accurately drawn

(a) Work out the length of BC

..... cm
(2)

(b) Work out the length of EC

..... cm
(2)

(Total for Question E2 is 4 marks)



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E3 Here are three triangles.

Triangle P: 3 cm, 4 cm, 5 cm

Triangle Q: 7.5 cm, 10 cm, 12.5 cm

Triangle R: 6 cm, 8 cm, 9 cm

Which two triangles are similar? You **must** show your working.

.....

(Total for Question E3 is 3 marks)

E4 AB is parallel to DE. The lines AE and BD cross at C. $AB = 8$ cm, $DE = 12$ cm and $AC = 6$ cm.

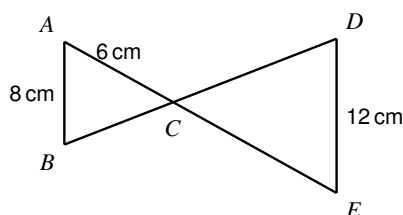


Diagram NOT accurately drawn

Work out the length of CE

..... cm

(Total for Question E4 is 3 marks)

E5 At the same time of day, a person 1.8 m tall casts a shadow 2.4 m long, and a tree casts a shadow 16 m long.

Work out the height of the tree.

..... m

(Total for Question E5 is 3 marks)

E6 Here are four rectangles.

A: 2 cm by 5 cm

B: 4 cm by 8 cm

C: 6 cm by 15 cm

D: 3 cm by 6 cm

Write down the two pairs of similar rectangles.

.....

(Total for Question E6 is 2 marks)



HIGHER*Higher tier only*

- E7** Two cylinders are similar. Their heights are 6 cm and 9 cm. The smaller cylinder has a volume of 160 cm^3 . Work out the volume of the larger cylinder.

..... cm^3 **(Total for Question E7 is 3 marks)**

- E8** Two bottles are similar. Their surface areas are 80 cm^2 and 180 cm^2 . The smaller bottle holds 400 ml. Work out how much the larger bottle holds.

..... ml

(Total for Question E8 is 4 marks)

- E9** DE is parallel to BC, and $AD : DB = 2 : 3$. The area of triangle ADE is 12 cm^2

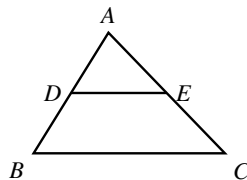


Diagram NOT accurately drawn

Work out the area of the trapezium DBCE.

..... cm^2 **(Total for Question E9 is 3 marks)****Join students already acing their exams.**Book your FREE lesson at www.eclassroom.org.uk

E10 Two vases are similar. Their heights are in the ratio 3 : 5

The difference between their volumes is 1960 cm^3 . The surface area of the smaller vase is 270 cm^2

Work out the volume and the surface area of the larger vase.

volume cm^3 surface area cm^2

(Total for Question E10 is 5 marks)

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