GCSE Maths – Ratio, Proportion and Rates of Change

Scale Factors and Scale Diagrams

Worksheet

WORKED SOLUTIONS

This worksheet will show you how to work out different types of scale factors and scale diagrams questions. Each section contains a worked example, a question with hints and then questions for you to work through on your own.

Section A

Worked Example

Each side of square *abcd* has a length of 7 cm. An enlargement of this square, *ABCD*, has sides of length 35 cm. Work out the scale factor for this enlargement.

Step 1: Identify corresponding sides of the smaller and larger shapes.

Since this shape is a square, all sides are the same length, so all sides are corresponding between the larger and smaller square.

Step 2: Work out $\frac{larger}{smaller}$ to find the scale factor. If trying to find the length of a side of a larger shape, multiply the smaller length by the scale factor.

$$Scale\ factor = \frac{35\ \text{cm}}{7\ \text{cm}} = 5$$

Therefore, the scale factor is 5, because the sides of the larger square are 5 times larger than the smaller square.

Guided Example

An equilateral triangle *ABC* has sides of length 2.5 cm. It is enlarged by scale factor 3. Calculate the lengths of the larger triangle.

Step 1: Identify corresponding sides of the smaller and larger shapes.

Smaller length = 2.5 cm

Step 2: Multiply the smaller length by the scale factor.

2.5 x 3 = 7.5

7.5 cm

Now it's your turn!
If you get stuck, look back at the worked and guided examples.

1. A rectangle, *A*, has a length of 8 cm and width of 5 cm. Calculate the length and width of the second rectangle, *B*, if *A* is enlarged by scale factor 4.

Smaller length$_a$ = 8 cm
enlarged length$_b$ = 8 × 4 = 32 cm

Smaller width$_a$ = 5 cm
enlarged width$_b$ = 5 × 4 = 20 cm

Length of B = 32 cm
Width of B = 20 cm

2. A square with sides of length 9 cm is enlarged by scale factor $\frac{1}{3}$. Calculate the length of the sides of the smaller square.

Square length : 9 cm
Enlarged length : $\frac{1}{3} \times 9 = 3$ cm

Length of smaller square: 3 cm

3. An equilateral triangle, *C*, with unknown side lengths is enlarged by scale factor 6 to produce a second triangle, *D*. Triangle *D* has side lengths of 27 cm. Calculate the lengths of the sides of triangle *C*.

Length $_D$ = 27
Length $_C$ = 27 ÷ 6 ← C is enlarged to D, so D to C = ÷
= $\frac{9}{2}$

Length of the sides of C = 4.5 cm

4. A square, *E*, with sides of length 10 cm are enlarged by a scale factor less than 1. The resulting shape, *F*, has sides of length 3 cm. Calculate the scale factor of enlargement.

Scale factor = $\frac{\text{smaller}}{\text{larger}}$ ← scale is less than 1

= $\frac{3}{10}$

Scale factor is 3/10

Section B

Worked Example

On a floor plan of a house, the kitchen is shown as being 4 cm in length and 6 cm in width. The scale factor of the plan is 1:100. Calculate the actual length and width of the kitchen.

Step 1: Convert all distances into the same units if possible.

As we only know the diagram distance, we cannot convert any others. If we needed to convert any others, we convert them to the smallest unit available (usually cm).

Step 1: Use the equation $Scale\ Factor = \frac{Real\ Life\ Distance}{Diagram\ Distance}$ to calculate the quantity required.

The scale factor is 100, meaning that 1 cm *on the plan is equal to* 100 cm *in real life.*

Substituting what we know into the equation gives:

$$100 = \frac{Real\ Life\ Distance}{4\ cm}$$ *for the length*

$$100 = \frac{Real\ Life\ Distance}{6\ cm}$$ *for the width*

Multiplying the scale factor by the diagram distance gives us the real-life measurements:

Length: 100×4 cm $= 400$ cm $(4$ m$)$
Width: 100×6 cm $= 600$ cm $(6$ m$)$

Guided Example

On a map, the distance between points A and B is 8 cm. In real life, the distance between points A and B is 8 km. Calculate the scale factor of this map.

Step 1: Convert all distances into the same units if possible.

Diagram : 8 cm

Real : 8 km = 800,000 cm (× 100,000)

Step 2: Use the equation $Scale\ Factor = \frac{Real\ Life\ Distance}{Diagram\ Distance}$ to calculate the quantity required.

$$Scale = \frac{800,000}{8} = 100,000$$

cm : 1 : 100,000
or : 1cm : 1km

Now it's your turn!
If you get stuck, look back at the worked and guided examples.

5. On a map, the distance between points *C* and *D* is 5 cm. The scale factor of this map is 1:10000. Calculate the real-life distance between points *C* and *D*.

Diagram : Real
1 : 10,000 (×5)
5 : 50,000 (×5)

Real life distance = 50,000 cm
= 500 m

6. The distance between Madrid and Barcelona is approximately 504 km. On a map of Spain, this distance is 4 cm. Calculate the scale factor for this map.

504 km = 50,400,000 cm (×100,000)

Scale = $\frac{50,400,000}{4}$ = 12,600,000

cm 1 : 12,600,000
or 1 cm : 126 km

7. A house has a kitchen with length 4.5 m and width 3 m. Calculate the length and width of this kitchen on a floor plan with scale factor 1:150.

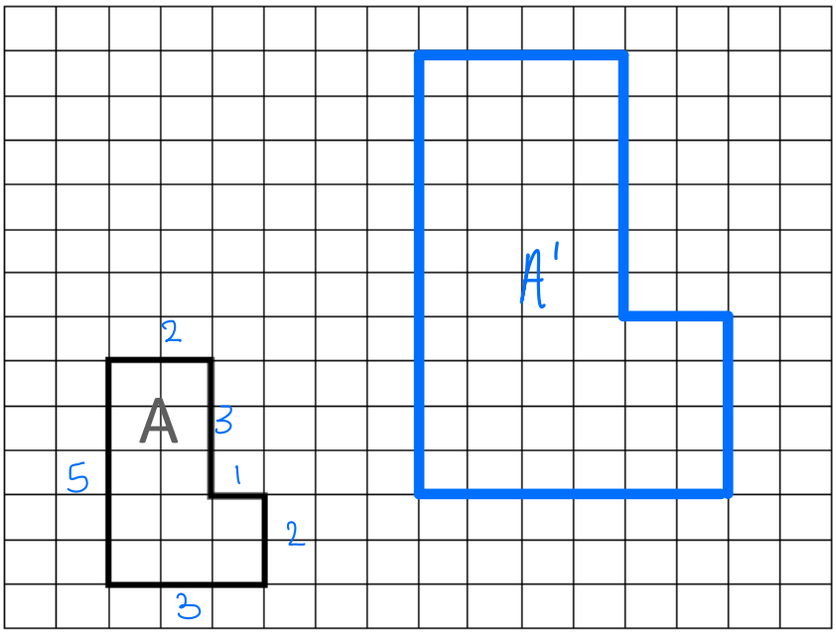
4.5 m = 450 cm (×100)
3 m = 300 cm (×100)

Length
Floor Plan : Real
1 : 150 (×3)
3 : 450 (÷3)

Width
Floor Plan : Real
1 : 150 (×2)
2 : 300 (÷2)

The floor plan of the kitchen will have 3cm length and 2cm width

8. The grid shows a shape called Shape A. It has an area of 12 cm². Work out the area of Shape A after an enlargement of scale factor 2.



Enlarging A

$3 \times 2 = 6$ $3 \times 2 = 6$
$5 \times 2 = 10$ $1 \times 2 = 2$
$2 \times 2 = 4$ $2 \times 2 = 4$

The area of the enlarged shape (counting the squares) is 48cm^2

Alt Method:

Linear Scale factor = 2

Area Scale factor = $2^2 = 4$

Area of enlarged shape is $12 \times 4 = 48\text{cm}^2$