

M9

Scale Models

6.3

- Diagrams, plans, patterns, maps, and sketches are drawn to scale to correctly model reality.
- A scale is a ratio between the model and the reality.
- Examples of scales
 - 1 cm on a map : 10 km in reality (written in a legend as 1:1 000 000)
 - 1 cm on a floor plan : 3m in reality (written in a legend as 1cm : 3m OR 1 : 300)
 - 1 cm on a sketch : 10 cm in reality (written in a legend as 1cm : 10 cm OR 1 : 1000)
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- Scaling changes the size of the dimensions such as length, depth, height, width, radius, diameter, ...
- Scaling does not change angles and shape.

Scale Factor

- A number that expresses the ratio between the image and the original.

$$SF = \frac{\text{new dimension}}{\text{original dimension}} = \frac{\text{image}}{\text{original}} = \frac{\text{new}}{\text{old}}$$

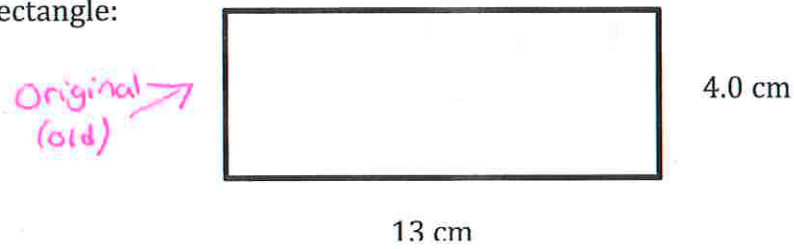
- $SF > 1$ means enlarging OR scaling up
- $0 < SF < 1$ means reducing OR scaling down
- There is no $SF = 1$ because multiplying dimensions by 1 will give an image that is exactly the same size and shape as the original.

Dimensions of the new shape = $SF \times$ dimensions of the original

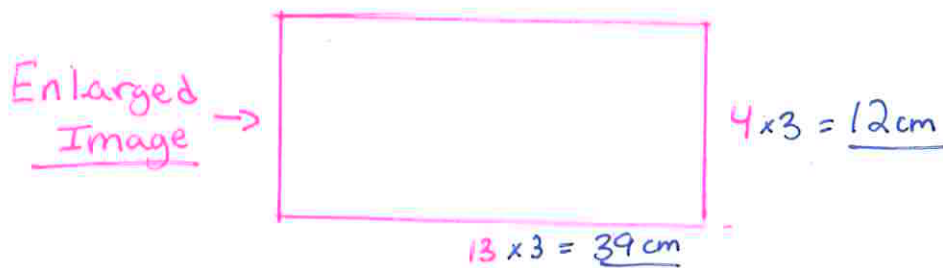
$$SF = \frac{n}{o}$$

Example 1: Sketch a labeled diagram of a scaled rectangle given the scale factor.

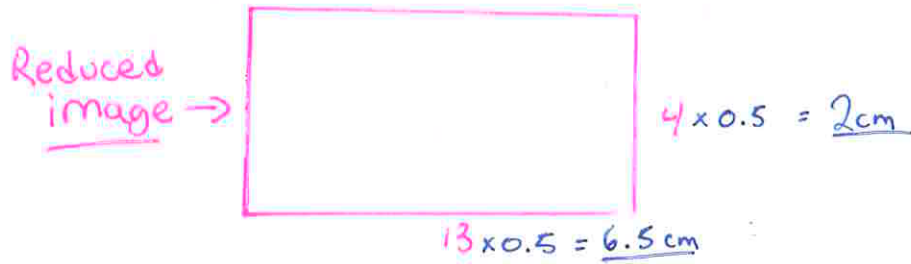
Original rectangle:



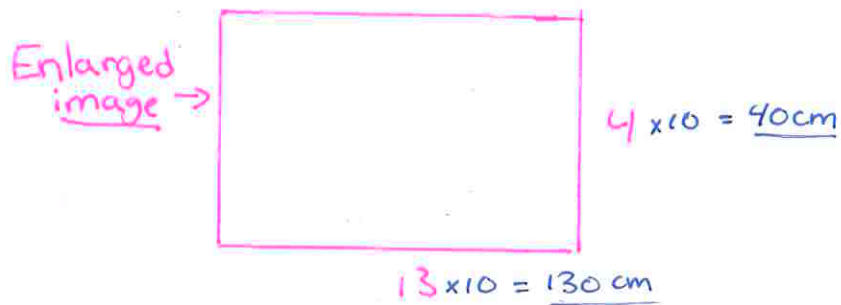
a) SF = 3



b) SF = 0.5



c) SF = 10



Example 2: What is the radius of the original circle if the enlarged circle has a radius of 14 cm and the scale factor used to create the scaled up image was 5? Include a labeled diagram in your solution.

Diagram showing a large circle with radius r and diameter, and a smaller circle with radius x . The scale factor is 5.

Equations:

$$SF = \frac{\text{New}}{\text{Old}}$$

$$x \cdot 5 = \frac{14}{x} \cdot \frac{x}{1}$$

$$\frac{5x}{5} = \frac{14}{5}$$

$$x = 2.8 \text{ cm}$$

The radius of the original circle is 2.8 cm.

Example 3: What is the length of a diagonal of a reduced square if the original square with a diagonal of 8.5 cm was scaled down by a factor of 0.2? Include a labeled diagram in your solution.

Diagram showing a large square with diagonal 8.5 cm and a smaller square with diagonal x . The scale factor is 0.2.

Equations:

$$SF = \frac{\text{New}}{\text{Old}}$$

$$0.2 = \frac{x}{8.5} \cdot \frac{8.5}{1}$$

$$(8.5)(0.2) = x$$

$$1.7 = x$$

\therefore The reduced square has a diagonal of 1.7 cm.

Example 4: What scale factor created the image below? What assumption do you make?



5 cm



12 cm

$$SF = \frac{\text{New}}{\text{Old}}$$

$$SF = \frac{12}{5}$$

$$SF = 2.4$$

\therefore SF of 2.4 created the image.

Scale factor doesn't have units!

