

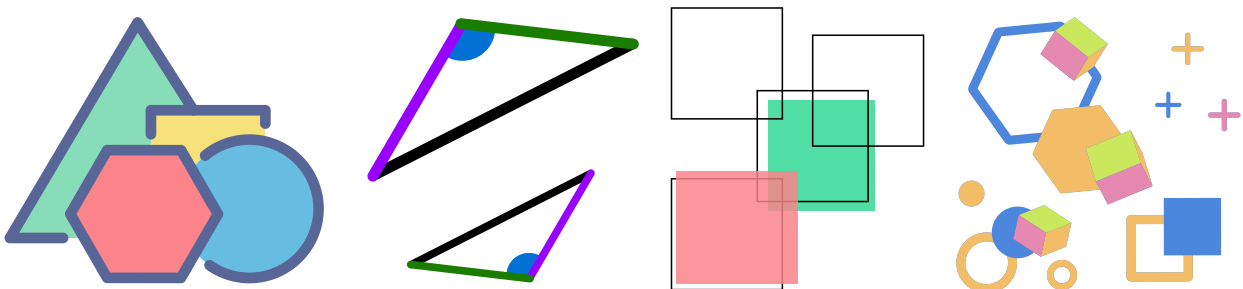
Similarity - GCSE Maths

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1. Introduction

- Similarity of shapes means that the shapes are same but they have different size, with equal corresponding angles and proportional sides.
- Concept of Similarity is applied in many places like linear algebra and data analysis to measure how much the two objects or datasets are similar.

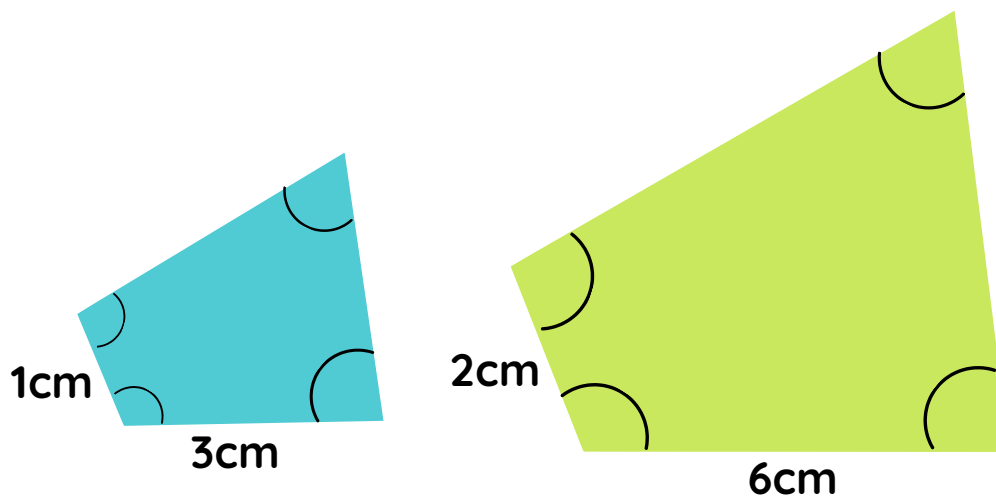


- Concept of Similarity -
- In Geometry - To determine properties of shapes and solve problems that involve proportions.
- In Computer Science - To detect patterns and compare objects.

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2. Similar Shapes

- **Similar Shapes** are those which are of same shape but have different size. The key characteristics of Similar Shapes are -
- **Same corresponding Angles**
- **Same Shape**
- **Different size**(proportional sides)



SCALE FACTOR

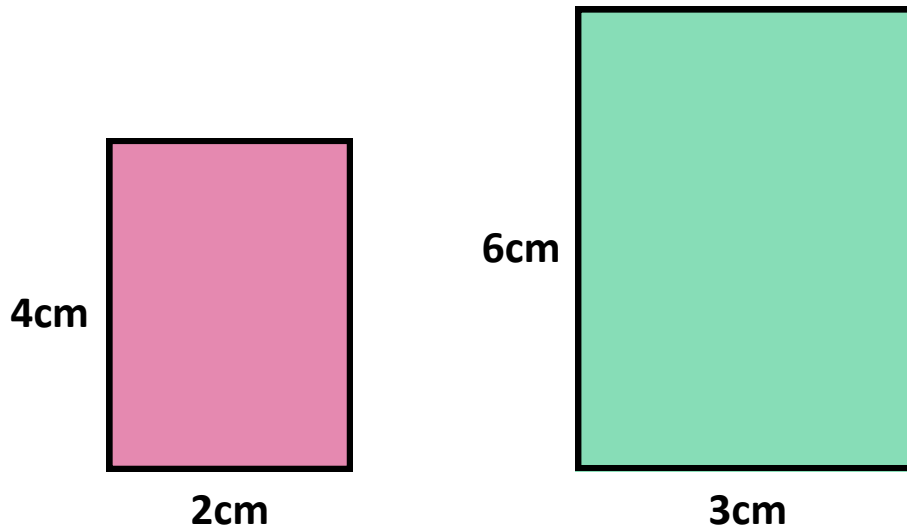
- The Scale Factor tells us how much bigger the larger shape is than the smaller one.

$$\text{SCALE FACTOR} = \frac{\text{The side length of larger shape}}{\text{The side length of smaller shape}}$$

- As the **scale factor from smaller to larger shape is positive** (greater than 1) we prefer using it to solve questions rather than from larger shape to smaller (lesser than 1 and create complexity).

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- The following rectangles are similar because they are of same shape and the equal corresponding angles with proportional sides.



$$\text{SCALE FACTOR} = \frac{\text{The side length of larger shape}}{\text{The side length of smaller shape}}$$

$$\text{SCALE FACTOR} = \frac{3}{2} = 1.5$$

- It is same for the other sides also-

$$\text{SCALE FACTOR} = \frac{6}{4} = 1.5$$

- The ratio of the corresponding sides is also same in both the shapes -

$$\frac{4}{2} = \frac{6}{3} = 2$$

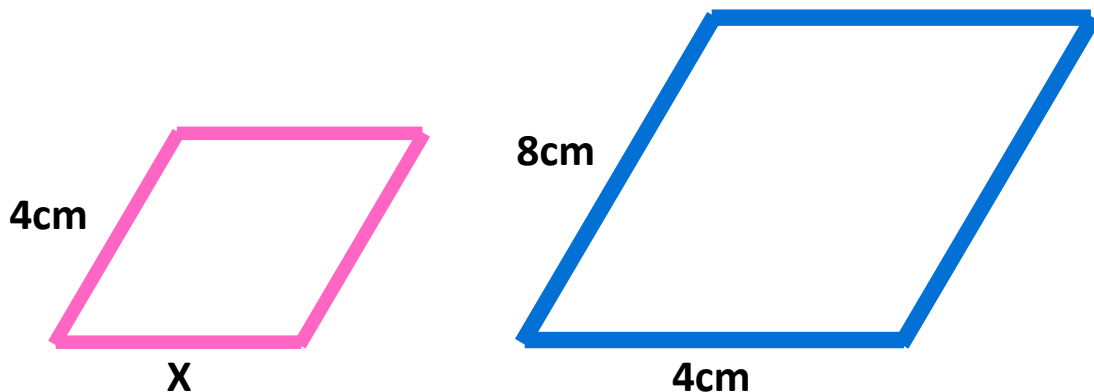
$$\frac{2}{4} = \frac{3}{6} = \frac{1}{2}$$

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3. Examples of Similar Shapes

(1) If the following pair of shapes are similar then find out the missing Sides/Angles?

(A)



Solution:

$$\text{SCALE FACTOR} = \frac{\text{The side length of larger shape}}{\text{The side length of smaller shape}}$$

$$\text{SCALE FACTOR} = \frac{8}{4} = 2$$

$$\text{We know that - } \frac{4}{X} = \text{SCALE FACTOR}$$

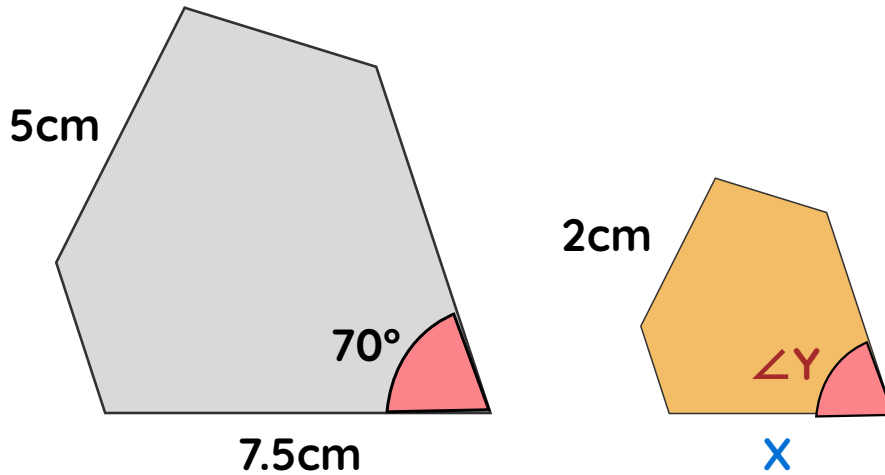
$$\frac{4}{X} = 2$$

$$\frac{1}{X} = \frac{2}{4} = \frac{1}{2}$$

Final Answer : $X = 2\text{cm}$

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(B) Find the value of Angle Y and side X -



Solution: We know that in similar shapes, the corresponding angles are always equal so -

$$\angle Y = 70^\circ$$

Also,

$$\text{SCALE FACTOR} = \frac{\text{The side length of larger shape}}{\text{The side length of smaller shape}}$$

$$\text{SCALE FACTOR} = \frac{5}{2} = 2.5$$

We know that - $\frac{7.5}{X} = \text{SCALE FACTOR}$

$$\frac{7.5}{X} = 2.5$$

$$\frac{1}{X} = \frac{2.5}{7.5}$$

$$X = \frac{7.5}{2.5}$$

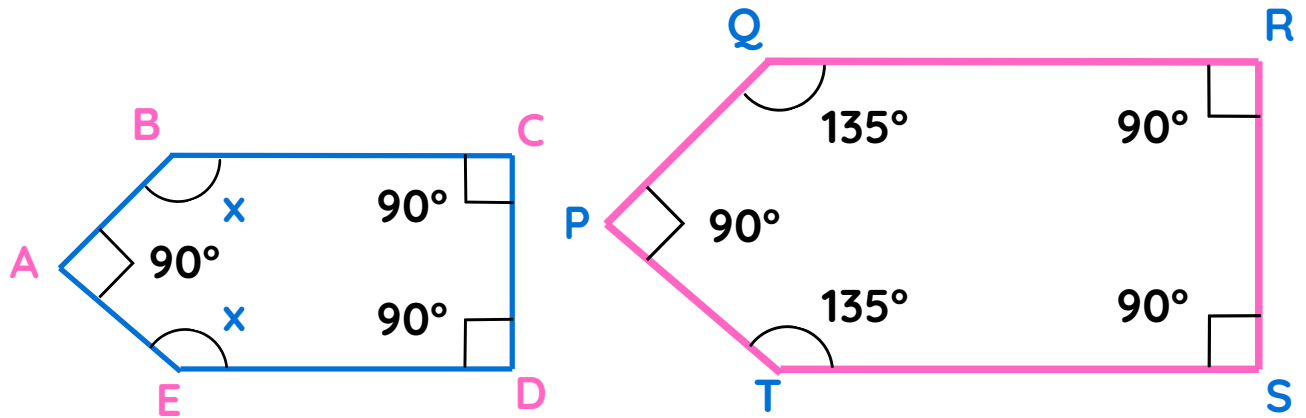
Final Answer :

$$X = 3\text{cm}$$

$$\angle Y = 70^\circ$$

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(D) Show that the polygon ABCDE is similar to PQRST -



Solution: The shape of polygon ABCDE is same as that of PQRST, but we need to check the corresponding angles are equal or not. For this we calculate the missing angles of the polygon ABCDE -

As The polygon is a pentagon the sum its angle is 540° . Thus,

$$\text{Sum of angles} = 540^\circ$$

$$90^\circ + 90^\circ + 90^\circ + \angle x + \angle x = 540^\circ$$

$$270^\circ + 2x = 540^\circ$$

$$2x = 270^\circ$$

$$x = \frac{270^\circ}{2}$$

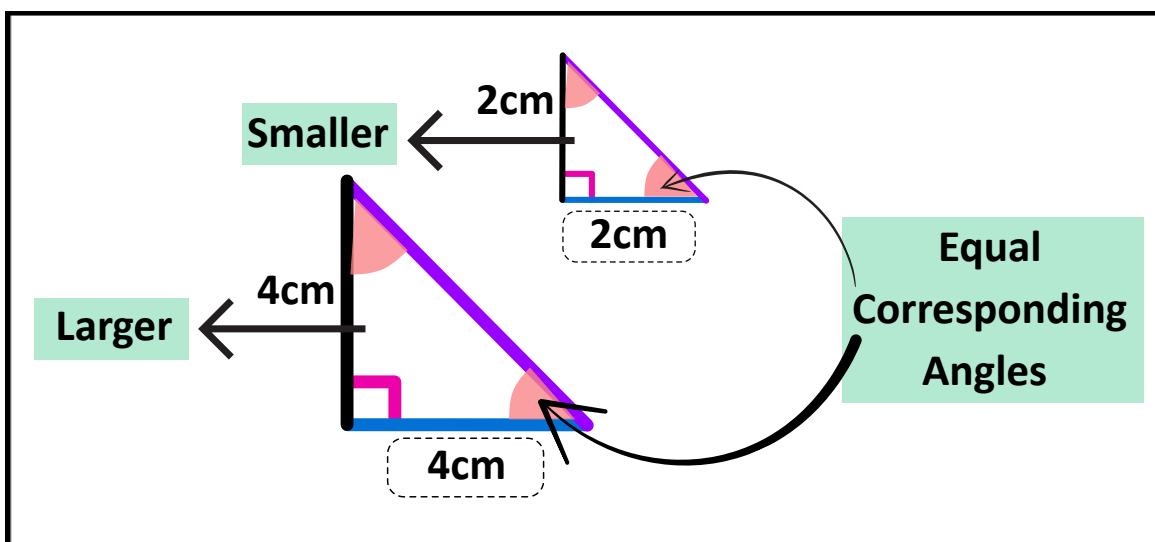
$$x = 135^\circ$$

As all the corresponding angles of the two polygons came out to be equal we can conclude that they are similar.

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4. Similar Triangles

- **Similar Triangles** are those which are of the **same shape but different size** along with **equal corresponding angles** and **proportional sides**.
- The Length scale factor formula is same in case of triangles as that of the other shapes.

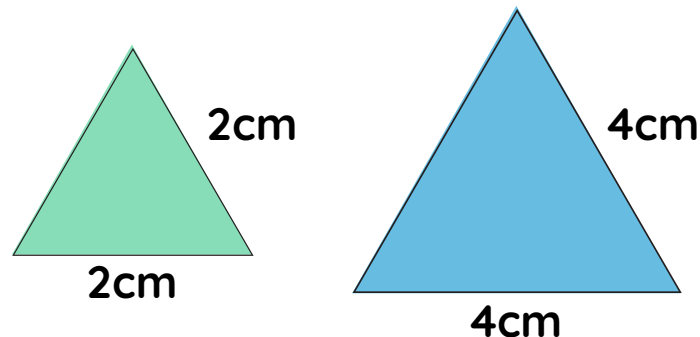


$$\text{SCALE FACTOR} = \frac{\text{The side length of larger shape}}{\text{The side length of smaller shape}}$$



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Example: Are the following triangles similar if yes find length scale factor?

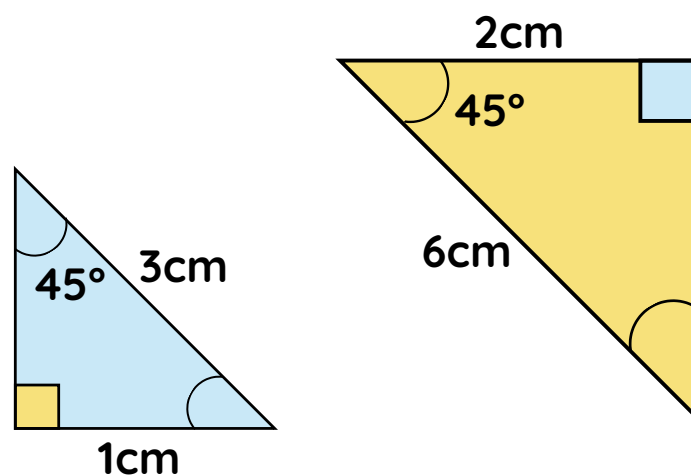


Solution: Yes, because the shape is same and sides are in proportion -

$$\text{SCALE FACTOR} = \frac{\text{The side length of larger shape}}{\text{The side length of smaller shape}}$$

$$\text{SCALE FACTOR} = \frac{4}{2} = 2\text{cm}$$

Example: Are the following triangles similar? Give reason.

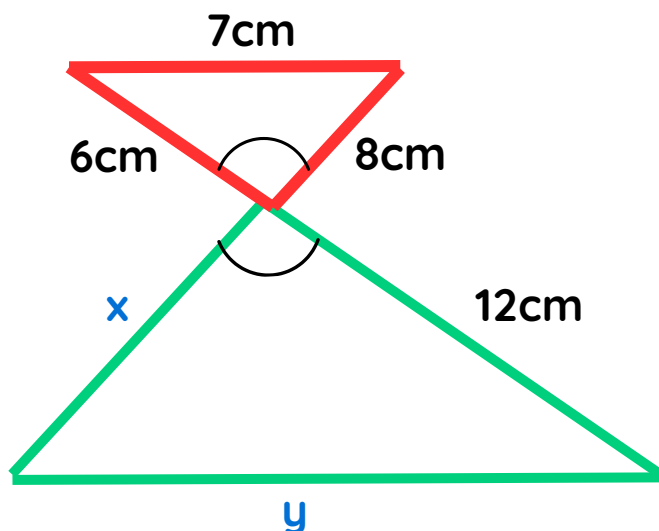


Solution: Yes, the triangles are similar as the corresponding angle equal and the shape is equal also the sides are in proportion -

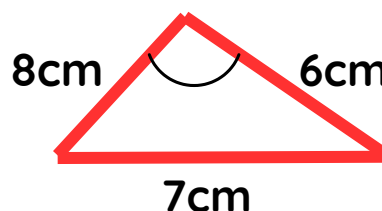
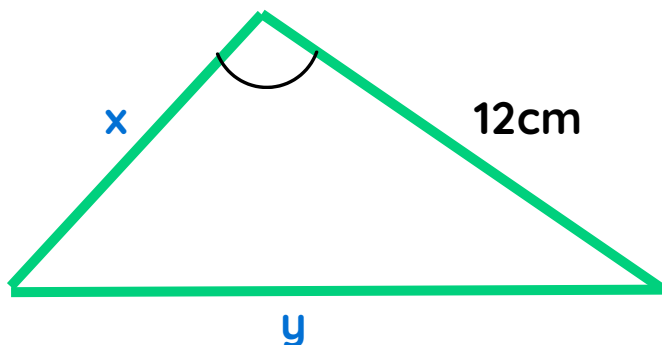
$$\frac{2}{1} = \frac{6}{3} = 2$$

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Example: Find out the missing sides of the triangle shown in diagram -



Solution: The Triangles shown in above diagram are similar, because -



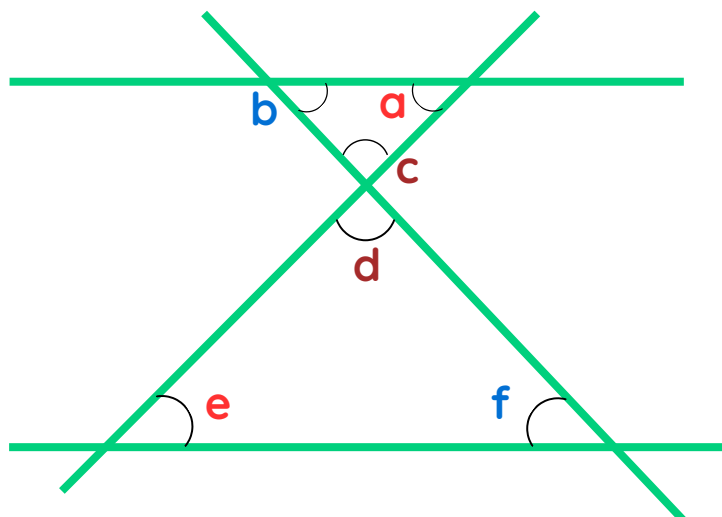
According to the interior angle property of parallel lines -

$$a = e$$

$$b = f$$

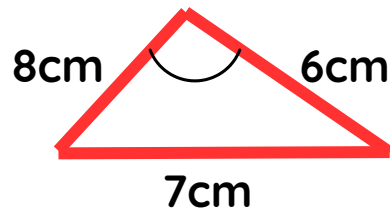
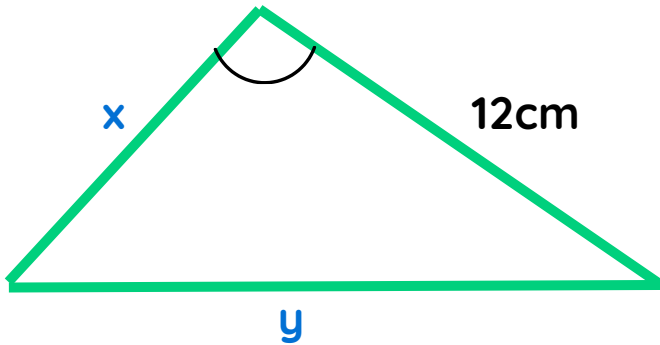
Vertically Opposite Angles -

$$c = d$$



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Since the triangles are similar their sides should be in proportion means that -



$$\text{Scale Factor} = \frac{12}{6} = 2$$

Thus,

$$\frac{x}{8} = 2$$

$$x = 2 \times 8$$

$$x = 16\text{cm}$$

$$\frac{y}{7} = 2$$

$$y = 2 \times 7$$

$$y = 14\text{cm}$$