

MATHEMATICS • CLASS 10

CHAPTER 6

Triangles

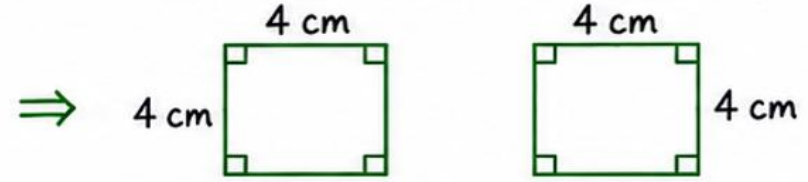
CHAPTER NOTES



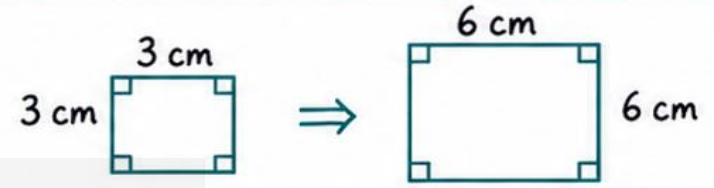
SIMILAR FIGURES & POLYGONS

- Similar figures have the same shape but not necessarily the same size.
- Congruent figures have the same shape and the same size.
- Every pair of congruent figures is similar, but similar figures need not be congruent.

Congruent figures
(same shape
and same size)



Similar but not congruent
(same shape,
different size)



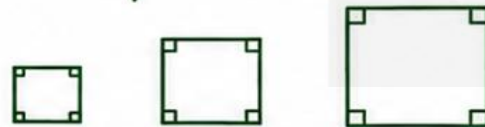
Not similar
(different shapes)



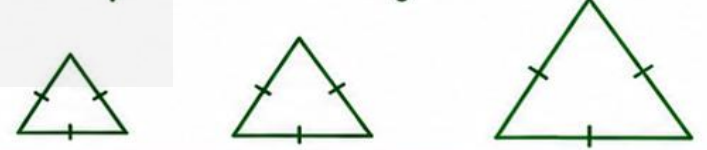
- All circles are similar.



- All squares are similar.



- All equilateral triangles are similar.



POLYGON SIMILARITY TEST

Two polygons with the same number of sides are similar if

- (1) corresponding angles are equal, and
- (2) corresponding sides are in the same ratio.

SCALE FACTOR

Scale factor = $\frac{\text{corresponding side in image / new figure}}{\text{corresponding side in original figure}}$

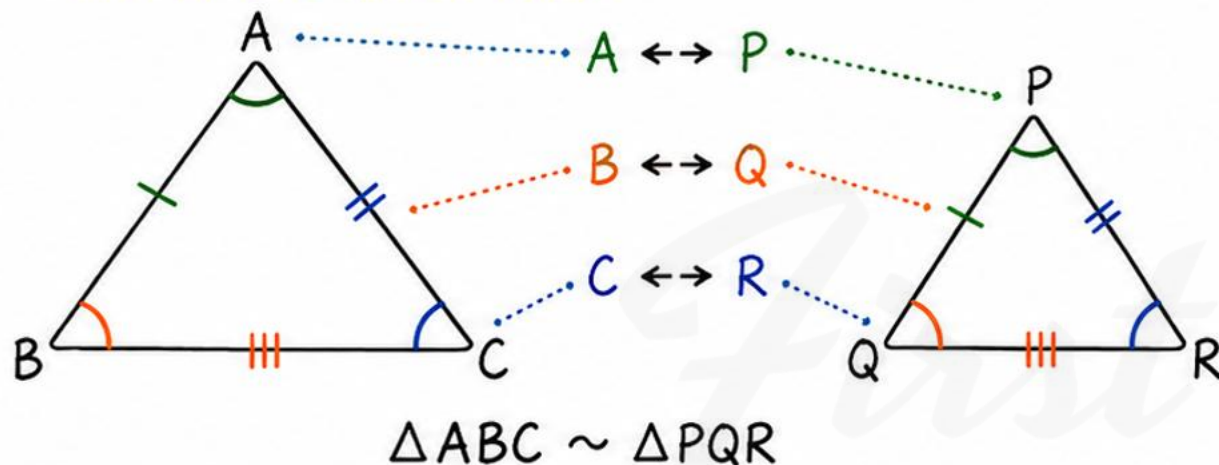


Scale factor = 2

$$\text{Scale factor} = \frac{6 \text{ cm}}{3 \text{ cm}} = 2$$

SIMILAR TRIANGLES: CORRESPONDENCE

- Two triangles are similar if their corresponding angles are equal and their corresponding sides are in the same ratio.



- The order of letters fixes the correspondence.

$$\angle A = \angle P, \quad \angle B = \angle Q, \quad \angle C = \angle R$$

- Corresponding sides are in the same ratio.

$$\frac{AB}{PQ} = \frac{BC}{QR} = \frac{CA}{RP} = k$$

where k is the scale factor ($k > 0$).

CONSEQUENCES

- Perimeters are in the same ratio k .

$$\frac{\text{Perimeter}(\triangle ABC)}{\text{Perimeter}(\triangle PQR)} = k$$

- Corresponding altitudes and medians are also in the ratio k .

- If $AD \perp BC$ and $PM \perp QR$, then $\frac{AD}{PM} = k$.
- If AM and PN are medians, then $\frac{AM}{PN} = k$.

WARNING: CHECK THE ORDER!

- Do not write $\triangle ABC \sim \triangle PRQ$ unless $A \leftrightarrow P$, $B \leftrightarrow R$, $C \leftrightarrow Q$ actually match.

- For example, in $\triangle PRQ$:

~~$\triangle ABC \sim \triangle PRQ$~~ would mean

$A \leftrightarrow P$ (✓)	} Does not match!
$B \leftrightarrow R$ (✗)	
$C \leftrightarrow Q$ (✗)	

Always fix the correspondence first, then write the similarity statement in that order.

Correct: $\triangle ABC \sim \triangle PQR$

Also correct (same correspondence): $\triangle CBA \sim \triangle RQP$

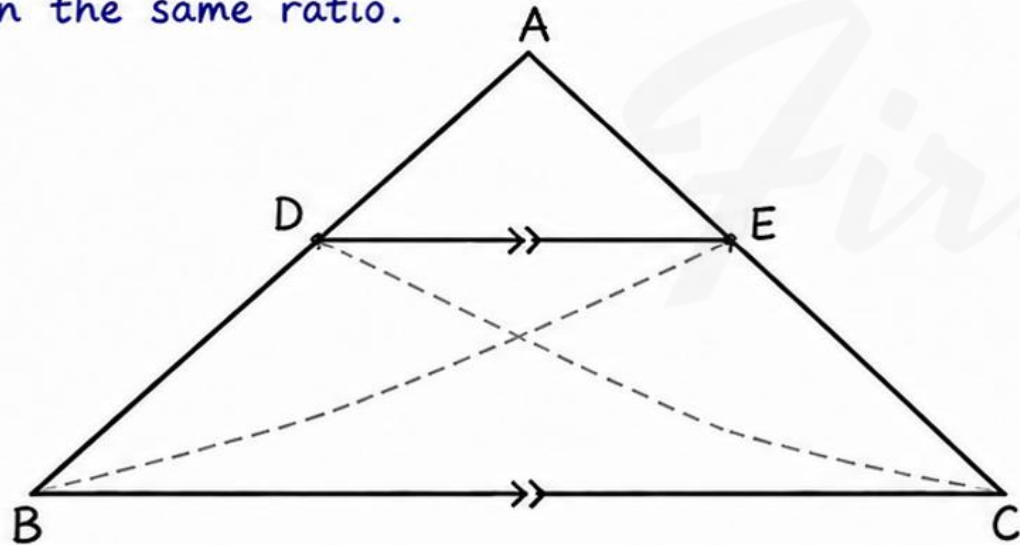
Incorrect: $\triangle ABC \sim \triangle PRQ$

BASIC PROPORTIONALITY THEOREM

THEOREM – Basic Proportionality Theorem (Thales)

STATEMENT:

If a line is drawn parallel to one side of a triangle and intersects the other two sides at distinct points, it divides those two sides in the same ratio.



RESULT:

$$\frac{AD}{DB} = \frac{AE}{EC}$$

GIVEN:

In $\triangle ABC$, D lies on AB, E lies on AC, and $DE \parallel BC$.

TO PROVE: $\frac{AD}{DB} = \frac{AE}{EC}$.

PROOF:

- In $\triangle ADE$ and $\triangle BDE$, the triangles have the same altitude from E to line AB.
 $\therefore \frac{\text{ar}(\triangle ADE)}{\text{ar}(\triangle BDE)} = \frac{AD}{DB}$ [Triangles on the same altitude from E to line AB]
- In $\triangle ADE$ and $\triangle CDE$, the triangles have the same altitude from D to line AC.
 $\therefore \frac{\text{ar}(\triangle ADE)}{\text{ar}(\triangle CDE)} = \frac{AE}{EC}$ [Triangles on the same altitude from D to line AC]
- In $\triangle BDE$ and $\triangle CDE$, the triangles are on the same base DE and between the same parallels DE and BC.
 $\therefore \text{ar}(\triangle BDE) = \text{ar}(\triangle CDE)$ [Triangles on the same base and between the same parallels]

From (1), (2) and (3),

$$\begin{aligned} \frac{AD}{DB} &= \frac{\text{ar}(\triangle ADE)}{\text{ar}(\triangle BDE)} = \frac{\text{ar}(\triangle ADE)}{\text{ar}(\triangle CDE)} = \frac{AE}{EC} \\ \therefore \frac{AD}{DB} &= \frac{AE}{EC} \end{aligned}$$

CONVERSE OF BPT

THEOREM – Converse of the Basic Proportionality Theorem

STATEMENT: If a line divides any two sides of a triangle in the same ratio, then it is parallel to the third side.

GIVEN: $\frac{AD}{DB} = \frac{AE}{EC}$.

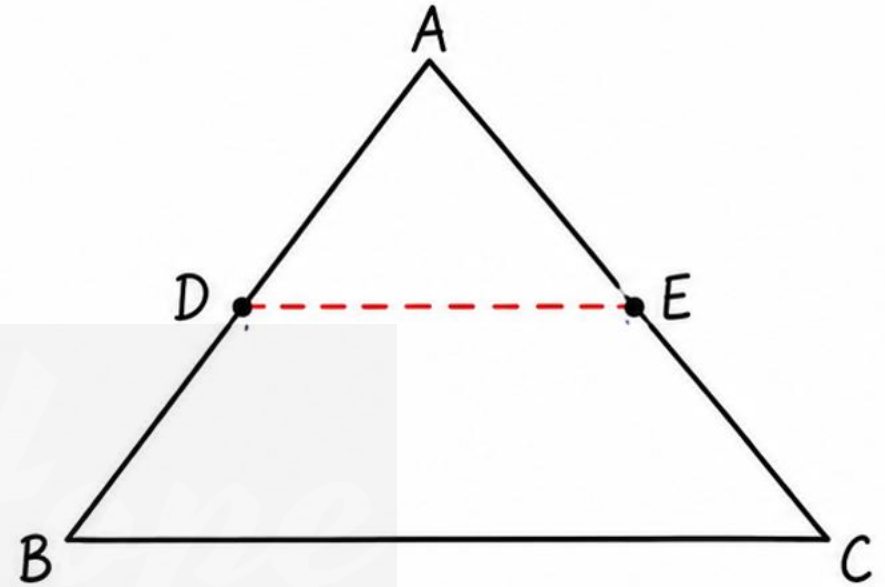
TO PROVE: $DE \parallel BC$.

CONSTRUCTION: Through D draw $DE' \parallel BC$, meeting AC at E' .

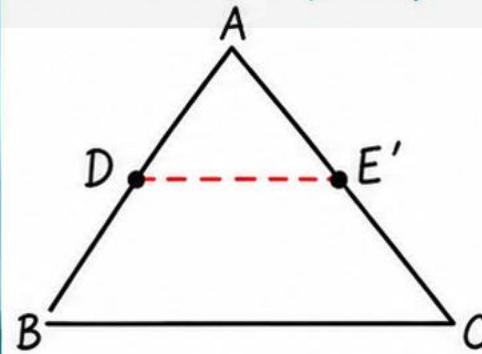
PROOF:

- By BPT, $\frac{AD}{DB} = \frac{AE'}{E'C}$.
- But $\frac{AD}{DB} = \frac{AE}{EC}$ (given).
- So $\frac{AE'}{E'C} = \frac{AE}{EC}$.
- A point dividing segment AC in a fixed internal ratio is unique; hence E' and E coincide.
- Therefore DE is the same line as DE' , so $DE \parallel BC$.

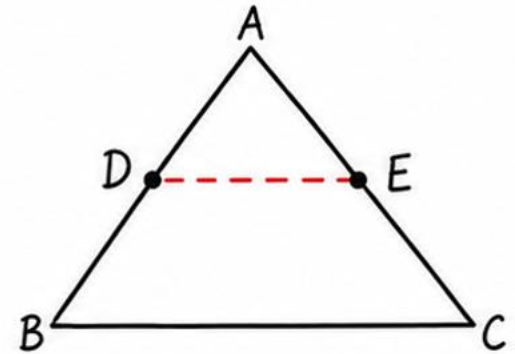
$\therefore DE \parallel BC$.



CONSTRUCTION (INSET):



Through D draw $DE' \parallel BC$ meeting AC at E' .



Since E' and E coincide, DE is the same line as DE' .

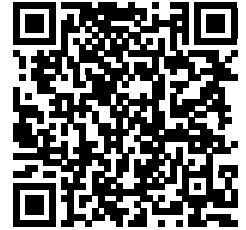


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