Class 10 Maths Chapter 6 Triangles Notes With Free PDF Download

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What Are Similar Figures?

Two figures are called similar if they have the same shape but not necessarily the same size.

- All circles are similar to each other
- All squares are similar to each other
- Equilateral triangles are always similar to each other

Similar vs Congruent

Feature	**Similar Figures**	**Congruent Figures**
Shape	Same	Same

Size	May differ	Must be equal
Angles	Equal	Equal
Sides	Proportional	Equal
Symbol	~	≅

Example:

Two triangles ABC and DEF where:

Congruent: AB = DE, BC = EF, AC = DF (sides equal)

Similar: AB/DE = BC/EF = AC/DF (sides proportional)

Key Property of Similar Figures

When two figures are similar:

1. Corresponding angles are equal
2. Corresponding sides are proportional (in the same ratio)

If △ABC ~ △DEF (Triangle ABC similar to Triangle DEF)

Then:

∠A = ∠D

∠B = ∠E

∠C = ∠F

And:

AB/DE = BC/EF = AC/DF = k (constant ratio)

k is called the scale factor

Similar Triangles

Two triangles are similar if:

- Their corresponding angles are equal

- Their corresponding sides are in the same ratio

Notation:

△ABC ~ △DEF means "Triangle ABC is similar to Triangle DEF"

Important: The order of letters matters! When writing ABC ~ DEF:

A corresponds to D

B corresponds to E

C corresponds to F

Understanding Scale Factor

The scale factor tells you how many times bigger or smaller one triangle is compared to the other.

If AB/DE = BC/EF = AC/DF = 2

This means Triangle ABC is 2 times bigger than Triangle DEF

Example:

△ABC ~ △PQR

AB = 6 cm, PQ = 3 cm

BC = 8 cm, QR = 4 cm

AC = 10 cm, PR = 5 cm

Ratio = 6/3 = 8/4 = 10/5 = 2

Scale factor = 2

Properties of Similar Triangles

Property 1: If △ABC ~ △DEF, then all three ratios are equal

AB/DE = BC/EF = CA/FD

Property 2: Similarity is reflexive

Every triangle is similar to itself

△ABC ~ △ABC

Property 3: Similarity is symmetric

If △ABC ~ △DEF, then △DEF ~ △ABC

Property 4: Similarity is transitive

If △ABC ~ △DEF and △DEF ~ △PQR

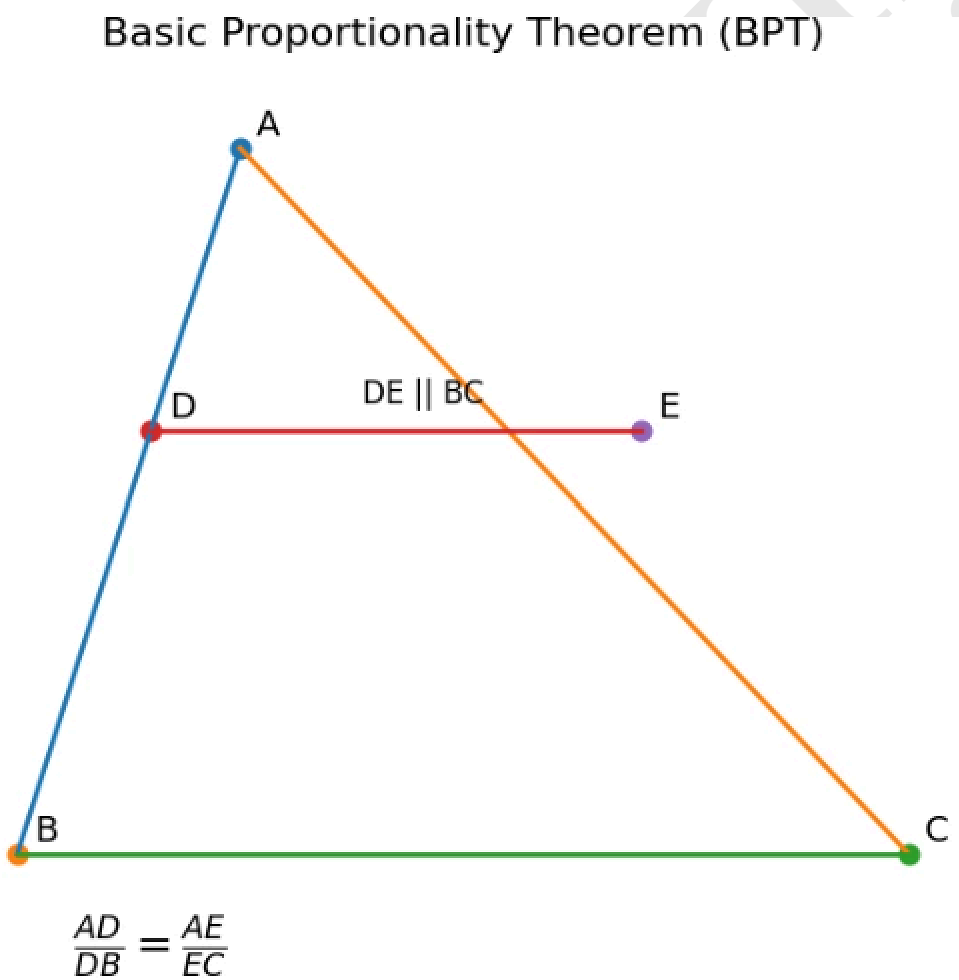
Then △ABC ~ △PQR

Basic Proportionality Theorem (BPT)

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

If in △ABC, DE || BC where D is on AB and E is on AC:

AD/DB = AE/EC



DE || BC

Therefore: AD/DB = AE/EC

Proof of BPT

Given:

- △ABC with DE || BC
- D on AB, E on AC

To prove: AD/DB = AE/EC

Construction: Draw DM ⊥ AC and EN ⊥ AB. Join BE and CD.

Proof:

Area of △ADE = (1/2) × AD × EN ...(1)

Area of △BDE = (1/2) × DB × EN ...(2)

Dividing (1) by (2):

Area(△ADE)/Area(△BDE) = AD/DB ...(3)

Similarly:

Area of △ADE = (1/2) × AE × DM ...(4)

Area of △CDE = (1/2) × EC × DM ...(5)

Area(△ADE)/Area(△CDE) = AE/EC ...(6)

Since △BDE and △CDE are on the same base DE

and between the same parallels DE and BC:

Area(△BDE) = Area(△CDE) ...(7)

From (3), (6), and (7):

AD/DB = AE/EC (Proved!)

Converse of BPT

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

Mathematical form:

If in △ABC:

AD/DB = AE/EC

Then DE || BC

Important Results from BPT

When DE || BC in △ABC:

Result 1: AD/DB = AE/EC

Result 2: AB/AD = AC/AE

(taking the whole side in numerator)

Result 3: DB/AB = EC/AC

Result 4: AD/AB = AE/AC

Solved Example on BPT

Example: In △ABC, DE || BC. AD = 4 cm, DB = 6 cm, AE = 3 cm. Find EC.

Solution:

By BPT:

AD/DB = AE/EC

4/6 = 3/EC

EC = (3 × 6)/4

EC = 18/4

EC = 4.5 cm

Answer: EC = 4.5 cm

Criteria for Similarity of Triangles

There are three important criteria to prove two triangles are similar. You don't need to check all six parts (3 sides + 3 angles). These shortcuts save time!

1. AA Similarity Criterion (Angle-Angle)

Theorem: If two angles of one triangle are equal to two angles of another triangle, then the two triangles are similar.

Condition:

If ∠A = ∠D and ∠B = ∠E

Then △ABC ~ △DEF

Why only two angles?

Because if two angles match, the third automatically matches too. (All angles of a triangle sum to 180°)

Example:

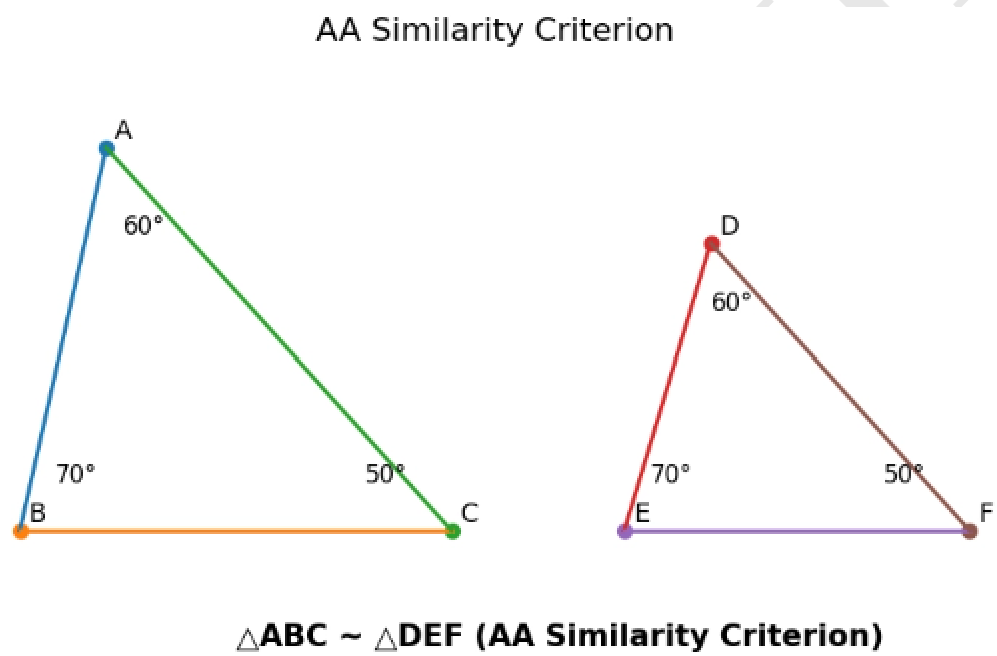
In △ABC and △DEF:

∠A = ∠D = 60°

∠B = ∠E = 70°

Therefore: ∠C = ∠F = 50° (automatically)

So △ABC ~ △DEF (by AA)



70° 50° 70° 50°

△ABC ~ △DEF

2. SSS Similarity Criterion (Side-Side-Side)

Theorem: If the corresponding sides of two triangles are in the same ratio, then the triangles are similar.

Condition:

If AB/DE = BC/EF = CA/FD

Then △ABC ~ △DEF

Example:

In △ABC: AB = 4, BC = 6, CA = 8

In △DEF: DE = 2, EF = 3, FD = 4

Check:

AB/DE = 4/2 = 2

BC/EF = 6/3 = 2

CA/FD = 8/4 = 2

All ratios equal → △ABC ~ △DEF (by SSS)

3. SAS Similarity Criterion (Side-Angle-Side)

Theorem: If one angle of a triangle equals one angle of another triangle and the sides including these angles are in the same ratio, then the triangles are similar.

Condition:

If AB/DE = AC/DF and ∠A = ∠D

Then △ABC ~ △DEF

Important: The equal angle must be the angle BETWEEN the proportional sides!

Example:

In △ABC and △DEF:

AB = 4, DE = 2 (ratio = 2)

AC = 6, DF = 3 (ratio = 2)

∠A = ∠D = 50°

The angle is between the proportional sides

→ △ABC ~ △DEF (by SAS)

Comparison of Criteria

Criterion	What to Check	Result
AA	2 pairs of equal angles	Similar
SSS	All 3 sides proportional	Similar
SAS	2 sides proportional + included angle equal	Similar

Areas of Similar Triangles

The ratio of areas of two similar triangles equals the square of the ratio of their corresponding sides.

Mathematical form:

If $\triangle ABC \sim \triangle DEF$:

$\text{Area}(\triangle ABC)/\text{Area}(\triangle DEF) = (AB/DE)^2 = (BC/EF)^2 = (CA/FD)^2$

If sides are in ratio 2:1, then areas are in ratio 4:1 (square of 2:1)

If sides are in ratio 3:2, then areas are in ratio 9:4

Proof of the Theorem

Given: $\triangle ABC \sim \triangle DEF$

To prove: $\text{Area}(\triangle ABC)/\text{Area}(\triangle DEF) = (BC/EF)^2$

Construction: Draw $AM \perp BC$ and $DN \perp EF$

Proof:

$\text{Area}(\triangle ABC) = (1/2) \times BC \times AM$ ...(1)

$\text{Area}(\triangle DEF) = (1/2) \times EF \times DN$ ...(2)

Dividing:

$\text{Area}(\triangle ABC)/\text{Area}(\triangle DEF) = (BC \times AM)/(EF \times DN)$ ...(3)

Since $\triangle ABC \sim \triangle DEF$:

∠B = ∠E

In △ABM and △DEN:

∠AMB = ∠DNE = 90° (construction)

∠B = ∠E (given)

So △ABM ~ △DEN (AA)

Therefore: AM/DN = AB/DE = BC/EF ...(4)

Substituting (4) in (3):

Area(△ABC)/Area(△DEF) = (BC/EF) × (BC/EF) = $(BC/EF)^2$

Results:

If △ABC ~ △DEF and AB/DE = k

Then:

Area(△ABC)/Area(△DEF) = k^2

Perimeter(△ABC)/Perimeter(△DEF) = k

(Perimeters are in the same ratio as sides, not squared!)

Example on Areas

Example: △ABC ~ △DEF. If AB = 6 cm and DE = 4 cm, find the ratio of their areas.

Solution:

AB/DE = 6/4 = 3/2

Area ratio = $(AB/DE)^2 = (3/2)^2 = 9/4$

Area(△ABC) : Area(△DEF) = 9 : 4

Answer: Areas are in ratio 9:4

Pythagoras Theorem

In a right-angled triangle, the square of the hypotenuse equals the sum of squares of the other two sides.

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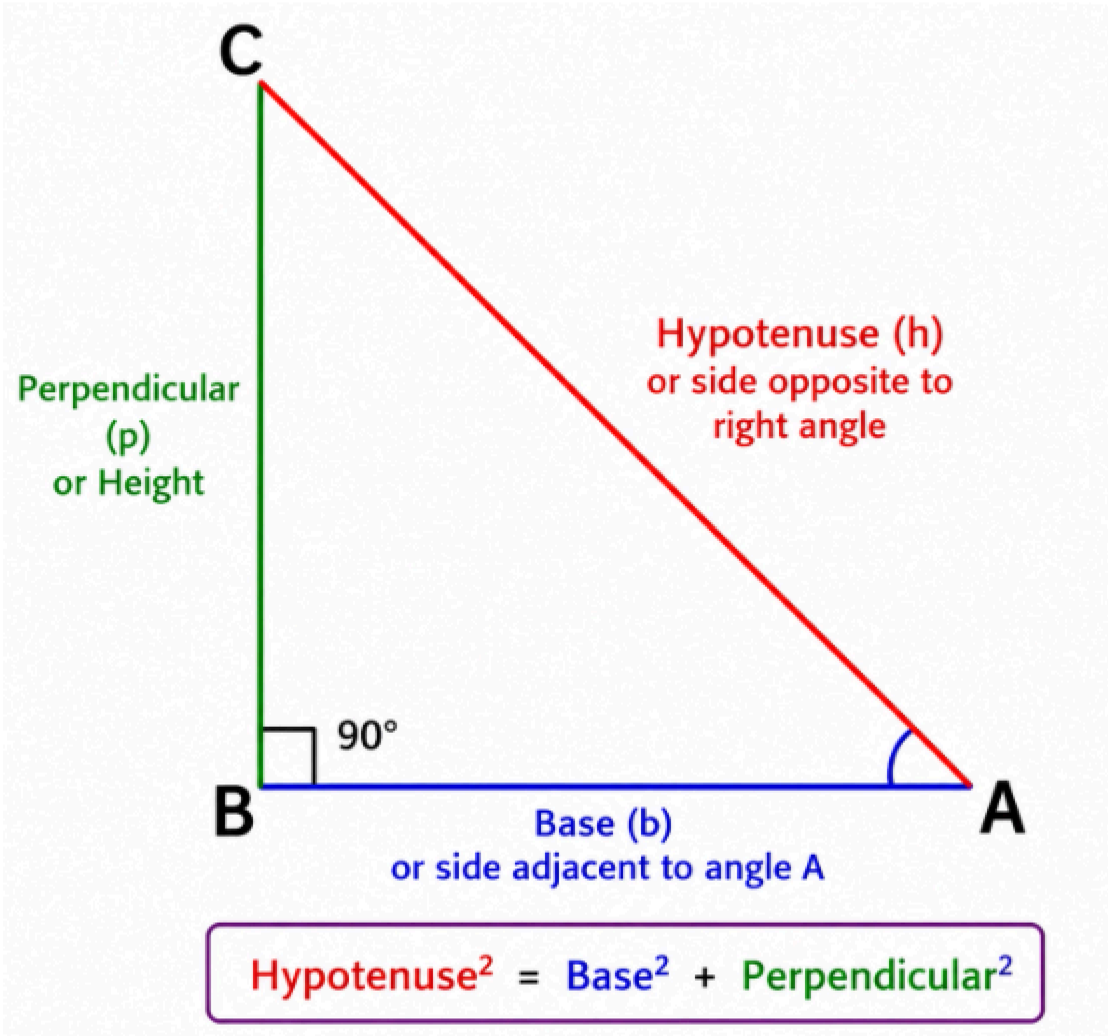


If ∠B = 90° in △ABC:

$AC^2 = AB^2 + BC^2$

$(\text{Hypotenuse})^2 = (\text{Base})^2 + (\text{Height})^2$

$AC^2 = AB^2 + BC^2$

Proof of Pythagoras Theorem

Given: △ABC, right-angled at B (∠B = 90°)

To prove: $AC^2 = AB^2 + BC^2$

Construction: Draw BD ⊥ AC

Proof:

In $\triangle ADB$ and $\triangle ABC$:

$\angle ADB = \angle ABC = 90°$

$\angle A = \angle A$ (common)

By AA: $\triangle ADB \sim \triangle ABC$

Therefore: $AD/AB = AB/AC$

$AB^2 = AD \times AC$ ...(1)

In $\triangle BDC$ and $\triangle ABC$:

$\angle BDC = \angle ABC = 90°$

$\angle C = \angle C$ (common)

By AA: $\triangle BDC \sim \triangle ABC$

Therefore: $DC/BC = BC/AC$

$BC^2 = DC \times AC$ ...(2)

Adding (1) and (2):

$AB^2 + BC^2 = AD \times AC + DC \times AC$

$AB^2 + BC^2 = AC(AD + DC)$

$AB^2 + BC^2 = AC \times AC$

$AB^2 + BC^2 = AC^2$

(Proved!)

Converse of Pythagoras Theorem

Theorem: If in a triangle, the square of one side equals the sum of squares of the other two sides, then the angle opposite to the first side is a right angle.

Mathematical form:

If $AC^2 = AB^2 + BC^2$

Then $\angle B = 90°$

Pythagorean Triplets

These are sets of three numbers that satisfy Pythagoras theorem.

Set	**Verification**
(3, 4, 5)	$3^2 + 4^2 = 9 + 16 = 25 = 5^2$
(5, 12, 13)	$5^2 + 12^2 = 25 + 144 = 169 = 13^2$
(8, 15, 17)	$8^2 + 15^2 = 64 + 225 = 289 = 17^2$
(7, 24, 25)	$7^2 + 24^2 = 49 + 576 = 625 = 25^2$
(6, 8, 10)	$6^2 + 8^2 = 36 + 64 = 100 = 10^2$

Generating Pythagorean triplets:

For any number $m > 1$:

Triplet: $(2m, m^2 - 1, m^2 + 1)$

Example: $m = 3$

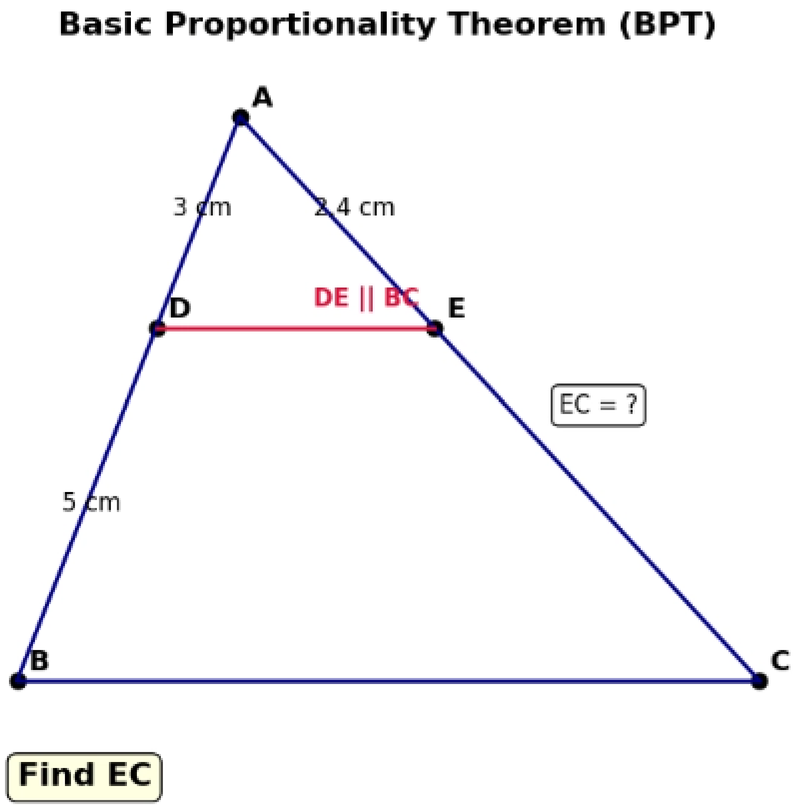
$2m = 6$, $m^2 - 1 = 8$, $m^2 + 1 = 10$

Check: $6^2 + 8^2 = 36 + 64 = 100 = 10^2$

Solved Examples on Class 10 Maths Chapter 6 Triangles Notes

Example 1: BPT Application

Question: In the figure, DE || BC. AD = 3 cm, DB = 5 cm, AE = 2.4 cm. Find EC.



Solution:

By BPT:

AD/DB = AE/EC

3/5 = 2.4/EC

EC = (2.4 × 5)/3

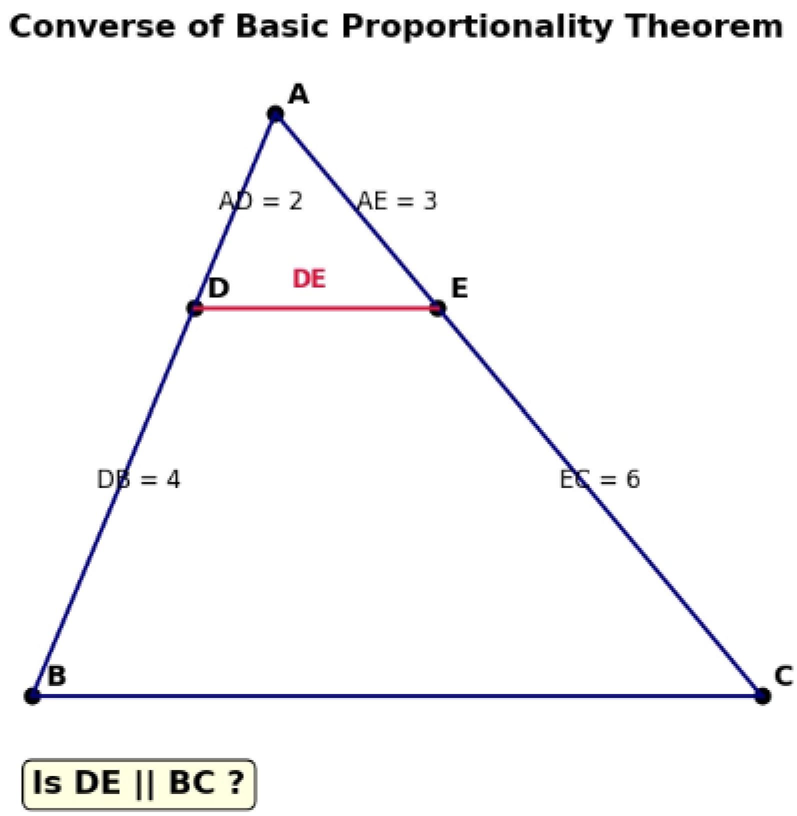
EC = 12/3

EC = 4 cm

Answer: EC = 4 cm

Example 2: Check for Parallel Lines

Question: In △ABC, D and E are points on AB and AC. AD = 2, DB = 4, AE = 3, EC = 6. Is DE || BC?



Solution:

AD/DB = 2/4 = 1/2

AE/EC = 3/6 = 1/2

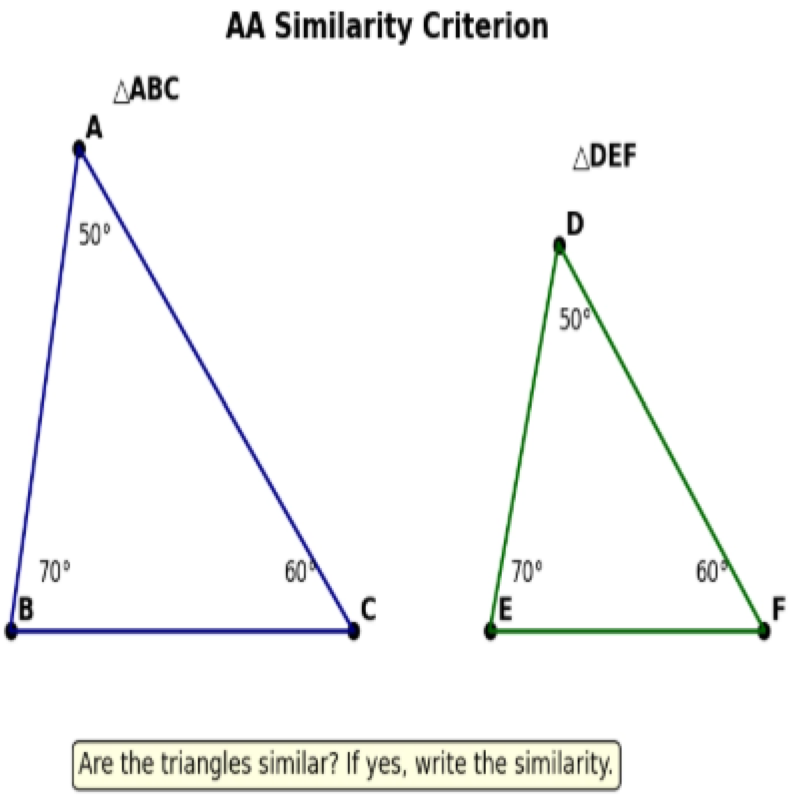
Since AD/DB = AE/EC = 1/2

By Converse of BPT: DE || BC

Answer: Yes, DE || BC

Example 3: AA Similarity

Question: In △ABC and △DEF, ∠A = 50°, ∠B = 70°, ∠D = 50°, ∠E = 70°. Are the triangles similar? If yes, write the similarity.



Solution:

In △ABC:

∠A = 50°, ∠B = 70°

∠C = 180° - 50° - 70° = 60°

In △DEF:

∠D = 50°, ∠E = 70°

∠F = 180° - 50° - 70° = 60°

∠A = ∠D = 50°

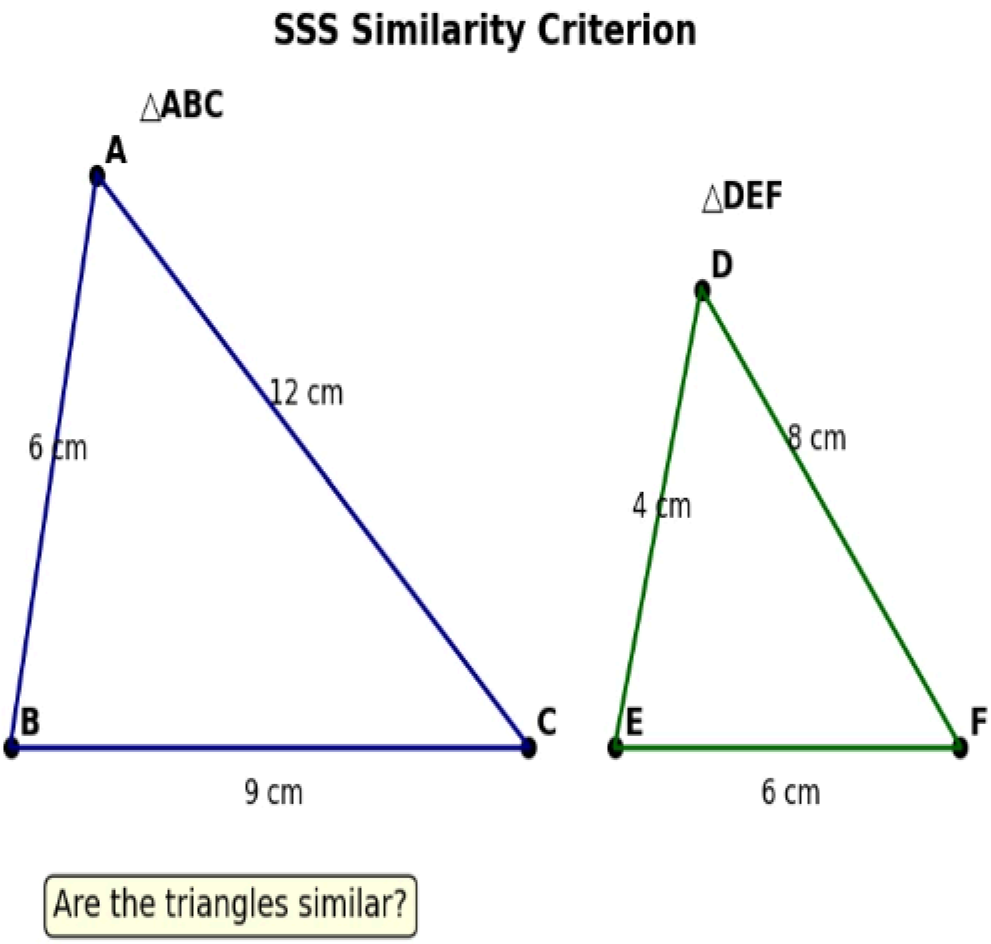
∠B = ∠E = 70°

By AA Criterion: △ABC ~ △DEF

Answer: Yes, △ABC ~ △DEF (by AA)

Example 4: SSS Similarity

Question: In △ABC, AB = 6 cm, BC = 9 cm, CA = 12 cm. In △DEF, DE = 4 cm, EF = 6 cm, FD = 8 cm. Are the triangles similar?



Solution:

AB/DE = 6/4 = 3/2

BC/EF = 9/6 = 3/2

CA/FD = 12/8 = 3/2

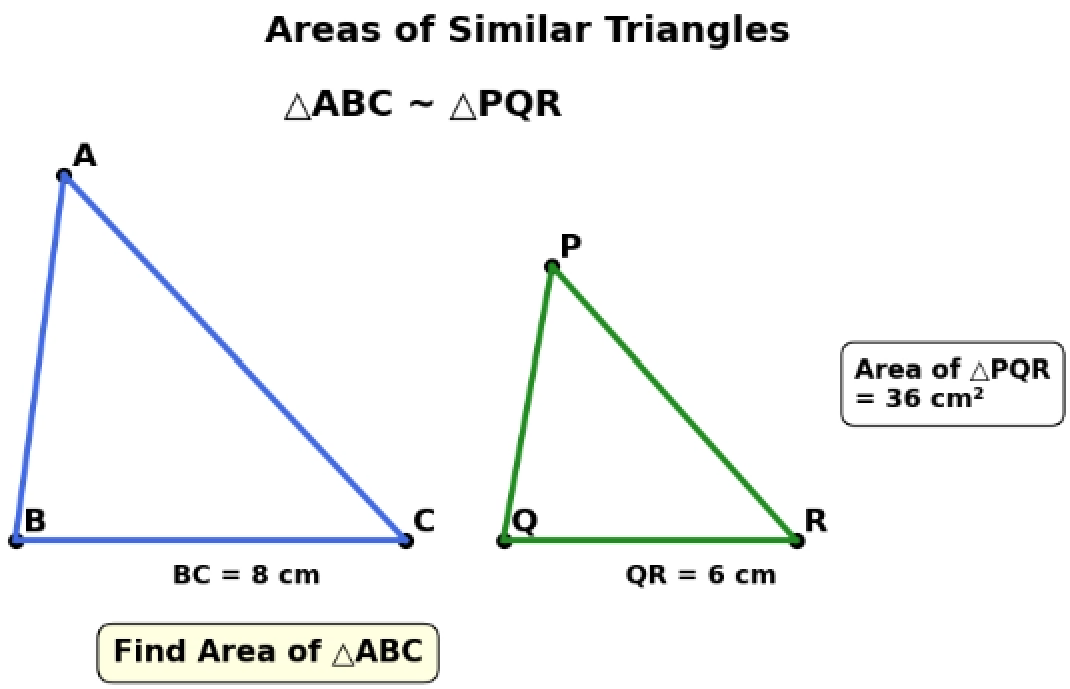
AB/DE = BC/EF = CA/FD = 3/2

By SSS Criterion: △ABC ~ △DEF

Answer: Yes, △ABC ~ △DEF (by SSS, ratio = 3/2)

Example 5: Area of Similar Triangles

Question: △ABC ~ △PQR. BC = 8 cm and QR = 6 cm. If area of △PQR = 36 cm², find area of △ABC.



Solution:

Area(△ABC)/Area(△PQR) = $(BC/QR)^2$

Area(△ABC)/36 = $(8/6)^2$

Area(△ABC)/36 = 64/36

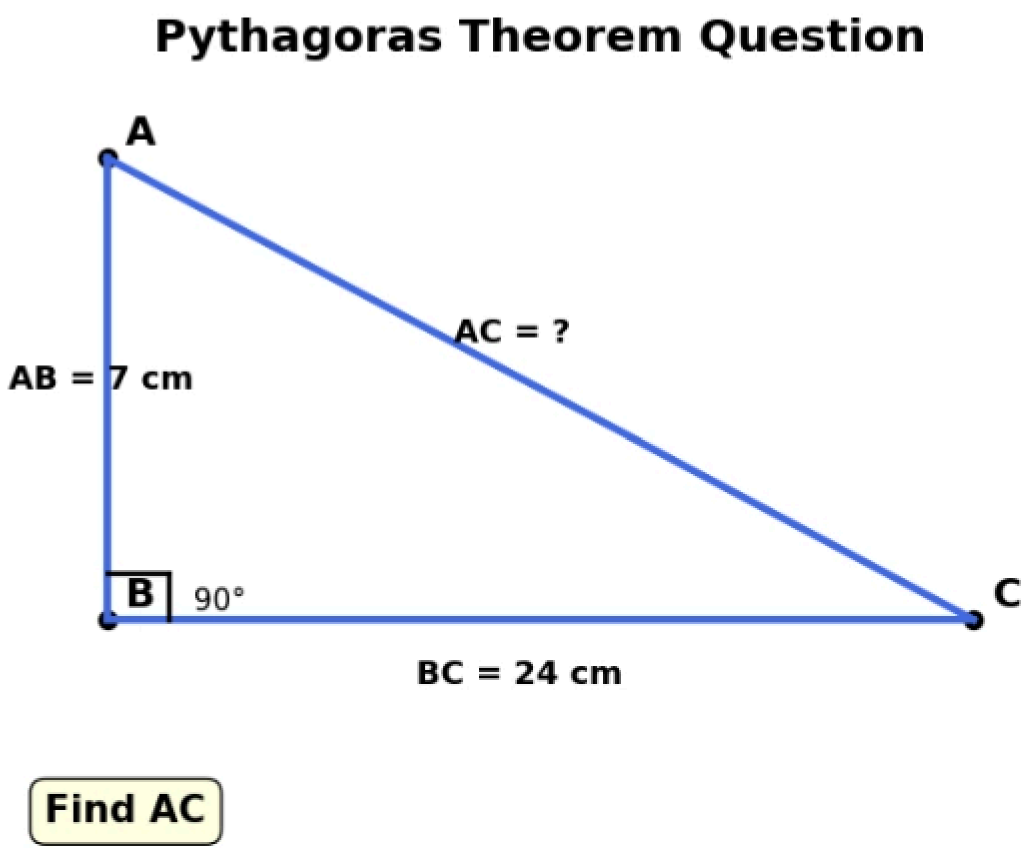
Area(△ABC) = 36 × 64/36

Area(△ABC) = 64 cm²

Answer: Area of △ABC = 64 cm²

Example 6: Pythagoras Theorem

Question: In △ABC, ∠B = 90°. AB = 7 cm, BC = 24 cm. Find AC.



Solution:

By Pythagoras Theorem:

$AC^2 = AB^2 + BC^2$

$AC^2 = 7^2 + 24^2$

$AC^2 = 49 + 576$

$AC^2 = 625$

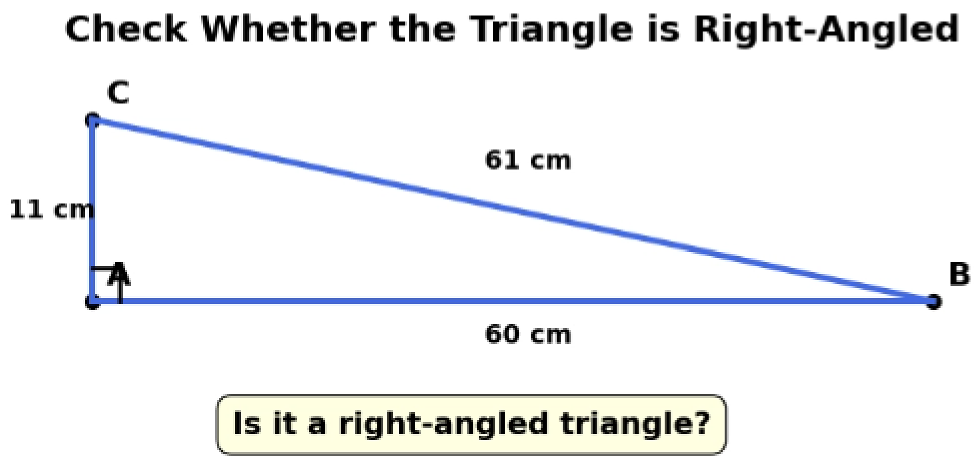
$AC = \sqrt{625}$

AC = 25 cm

Answer: AC = 25 cm

Example 7: Converse of Pythagoras

Question: A triangle has sides 11 cm, 60 cm, and 61 cm. Is it a right-angled triangle?



Solution:

Check: (Smallest sides)^2 + (Second side)^2

$= 11^2 + 60^2$

$= 121 + 3600$

$= 3721$

(Largest side)^2 = $61^2 = 3721$

Since $11^2 + 60^2 = 61^2$

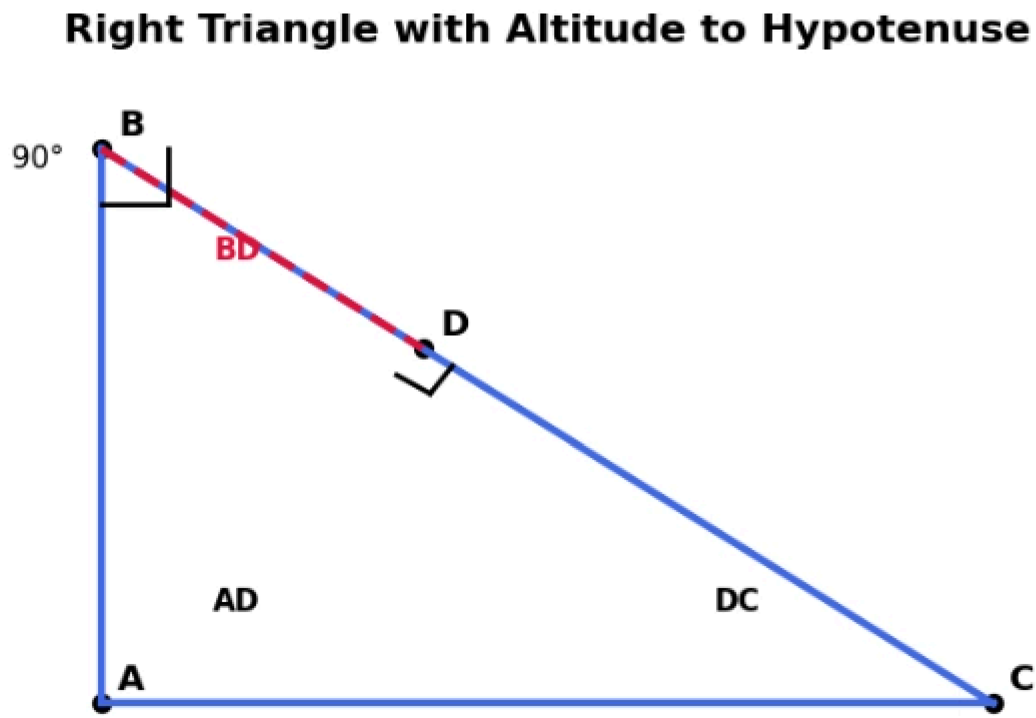
By Converse of Pythagoras:

This is a right angled triangle!

Answer: Yes, it's a right angled triangle (right angle opposite to side 61 cm)

Example 8: Combined Application

Question: In $\triangle ABC$, $\angle ABC = 90°$ and $BD \perp AC$. Prove that $BD^2 = AD \times DC$.



Prove that BD² = AD × DC

Solution:

In △ABD and △BCD:

∠ADB = ∠BDC = 90° (BD ⊥ AC)

In △ABD and △ABC:

∠ADB = ∠ABC = 90°

∠A is common

△ABD ~ △ABC (by AA)

Therefore: AD/BD = BD/BC ... (not what we need)

Better approach:

In △BDA and △CDB:

∠BDA = ∠CDB = 90°

∠ABD + ∠DBC = 90° (since ∠ABC = 90°)

$\angle ABD + \angle A = 90°$ (since $\angle ADB = 90°$)

Therefore $\angle DBC = \angle A$

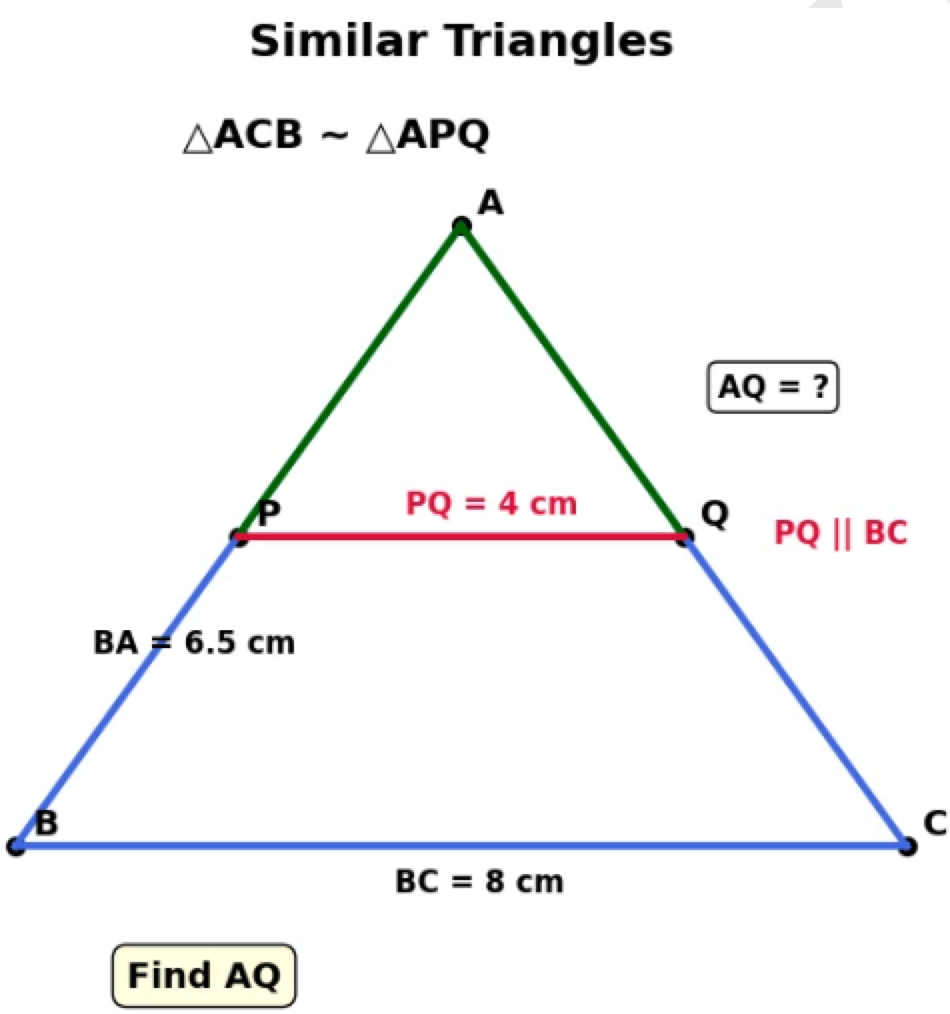
So $\triangle BDA \sim \triangle CDB$ (by AA)

Therefore: $BD/CD = AD/BD$

$BD^2 = AD \times DC$ (Proved!)

Example 9: Finding Missing Side Using Similarity

Question: In the given figure, $\triangle ACB \sim \triangle APQ$. If BC = 8 cm, PQ = 4 cm, BA = 6.5 cm. Find AQ.



Solution:

△ACB ~ △APQ

Corresponding sides:

AC ↔ AP

CB ↔ PQ

BA ↔ QA

BC/PQ = BA/AQ

8/4 = 6.5/AQ

2 = 6.5/AQ

AQ = 6.5/2

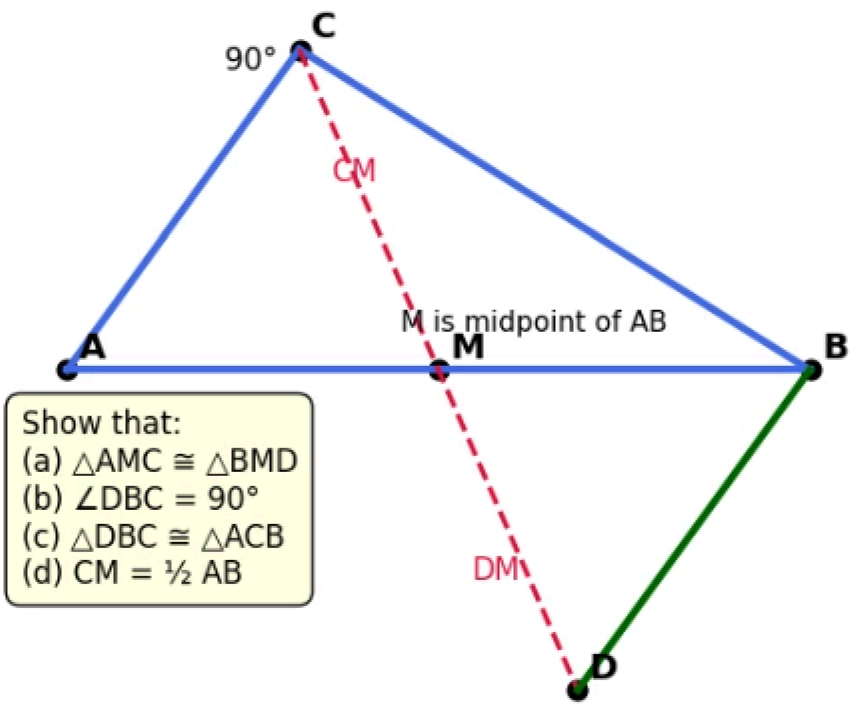
AQ = 3.25 cm

Answer: AQ = 3.25 cm

Example 10: Three Stage Problem

Question: In right triangle ABC, right angled at C, M is the mid-point of hypotenuse AB. C is joined to M and produced to D such that DM = CM. Point D is joined to point B. Show that: a) △AMC ≅ △BMD b) ∠DBC is a right angle c) △DBC ≅ △ACB d) CM = (1/2)AB

Midpoint of Hypotenuse Theorem



Solution:

Part a) △AMC ≅ △BMD:

In △AMC and △BMD:

AM = BM (M is mid-point of AB)

CM = DM (given)

∠AMC = ∠BMD (vertically opposite angles)

By SAS: △AMC ≅ △BMD

Part b) ∠DBC is right angle:

From part a): △AMC ≅ △BMD

Therefore: ∠ACM = ∠BDM (CPCT)

These are alternate angles for DB and AC with BC as transversal

Therefore: DB || AC

∠DBC + ∠ACB = 180° (co-interior angles)

∠DBC + 90° = 180°

∠DBC = 90°

Part c) △DBC ≅ △ACB:

BC = BC (common)

DB = AC (from part a, CPCT)

∠DBC = ∠ACB = 90°

By SAS: △DBC ≅ △ACB

Part d) CM = (1/2)AB:

From part c): DC = AB (CPCT)

But CM = DM = (1/2)DC = (1/2)AB

Therefore: CM = (1/2)AB (Proved)

Practice Questions on Class 10 Maths Chapter 6 Triangles Notes

Section 1: Basic Concepts

Question 1: State the Basic Proportionality Theorem.

Question 2: In △ABC, D and E are points on AB and AC. If AD/DB = AE/EC, what can you conclude?

Question 3: Two triangles are similar with sides in ratio 3:5. What is the ratio of their areas?

Question 4: State the AA similarity criterion.

Question 5: Find the Pythagorean triplet where one member is 20.

Section 2: BPT Problems

Question 6: In △ABC, DE || BC. If AD = 2.4 cm, DB = 3.6 cm and AC = 5 cm, find AE and EC.

Question 7: In △PQR, ST || QR. If PS = 3, SQ = 5, PT = 4.5 cm, find TR.

Question 8: In $\triangle ABC$, DE || BC. If $AD/AB = 2/5$, find DE/BC.

Question 9: E and F are points on sides AB and AC of $\triangle ABC$. EF || BC. If AE = 3.6 cm, EB = 2.4 cm, AC = 9 cm, find AF.

Question 10: In $\triangle ABC$, DE || BC. BD = 9 cm, AD = 6 cm, AE = 8 cm. Find the length of EC.

Section 3: Similarity

Question 11: Prove that if a line divides two sides of a triangle proportionally, it is parallel to the third side.

Question 12: In $\triangle ABC$ and $\triangle DEF$, $AB/DE = BC/EF = CA/FD = 4/3$. Are triangles similar? State the criterion.

Question 13: In right $\triangle ABC$, $\angle B = 90°$. $BD \perp AC$. If AD = 9 and DC = 4, find BD.

Question 14: $\triangle ABC \sim \triangle DEF$. If AB = 12 cm, DE = 9 cm, find the ratio of their perimeters.

Question 15: The areas of two similar triangles are 64 cm^2 and 100 cm^2. If a side of the smaller triangle is 8 cm, find the corresponding side of the larger triangle.

Section 4: Pythagoras Theorem

Question 16: In $\triangle ABC$, $\angle C = 90°$. AC = 5 cm, BC = 12 cm. Find AB.

Question 17: Check if triangle with sides 6, 8, 10 is right angled.

Question 18: A ladder 13 m long leans against a wall. If the foot of the ladder is 5 m from the wall, how high up the wall does it reach?

Question 19: In an equilateral triangle with side 2a, find the length of each altitude.

Question 20: In $\triangle ABC$, AB = 9 cm, BC = 12 cm, AC = 15 cm. Is $\angle B = 90°$? Find the area.

Important Table of Formulas:

Similarity Criteria:

Criterion	**Condition**

AA	Two pairs of equal angles
SSS	All three sides proportional
SAS	Two sides proportional + included angle equal

Important Ratios:

BPT: AD/DB = AE/EC (when DE || BC)

Area ratio: $(side_1/side_2)^2$

Perimeter ratio: $side_1/side_2$

Scale factor: k = any corresponding side ratio

Pythagoras Theorem:

In right △ABC (∠B = 90°):

$AC^2 = AB^2 + BC^2$

$Hypotenuse^2 = Base^2 + Height^2$

Previous Years Important Questions on Class 10 Maths Chapter 6 Triangles Notes

1 Mark Questions:

- State Basic Proportionality Theorem
- Write the converse of Pythagoras theorem
- If △ABC ~ △DEF and AB/DE = 3/4, find area ratio

2 Mark Questions:

- In △ABC, DE || BC. Find missing sides using BPT
- Check if given triangle is right-angled using converse of Pythagoras
- Find the third side of right triangle using Pythagoras theorem

3 Mark Questions:

- Prove BPT

- Two similar triangles find sides or areas
- Applications of Pythagoras theorem in real problems

4 Mark Questions:

- Prove Pythagoras theorem using similarity
- Complex problems combining BPT and similarity
- Multi-step problems involving all concepts of chapter