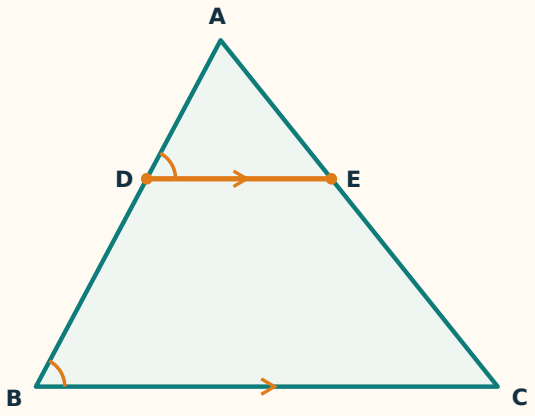
MATHS WITHOUT GUESSWORK

Triangles

Understand the Diagram.
Recognise the Theorem.
Prove with Confidence.

A guided problem-solving workbook

CBSE Class 10 Mathematics · Syllabus session 2026–27



Clue: DE ∥ BC
Theorem: Basic Proportionality Theorem
Step: AD/DB = AE/EC

SIGNATURE FEATURE

How do I know which theorem to use, and why is this proof step valid?

Every proof in this book is built from the same three links: the **clue** in the diagram, the **theorem** that matches it, and the **step** it lets you write. Learn the links and you can start a proof you have never seen before.

Core topics: similar figures · Basic Proportionality Theorem and its converse · AA, SSS and SAS similarity criteria

Original explanations, examples and questions. Not a substitute for the NCERT textbook or your teacher.

Liked this? The full Triangles workbook is ₹99 →

Contents

How to use: Tap any line to jump to that page. Page numbers match the numbers printed on each page.

A Orientation 2–4

Welcome 2
How to use this workbook 3
Roadmap and prerequisite check 4

B Foundation 5–10

Reading a triangle diagram 5
Angle facts: your bank of reasons 6
Similar figures: same shape, any size 7
Corresponding parts and vertex order 8
Ratio, proportion and scale factor 9
The chapter in one picture 10

C Core Theorems 11–20

Basic Proportionality Theorem: see it first 11
Proving the Basic Proportionality Theorem 12
Using BPT to find lengths 13
The converse of BPT: proving lines parallel 14
AA similarity: two angles are enough 15
AA in proofs: three shapes to recognise 16
SSS similarity: three proportional sides 17
SAS similarity: the angle must be included 18
Using similarity: sides, angles and heights 19
Same diagram, different question 20

D Doubt Bank 21–28

Doubts 1 and 2: what similar means 21
Doubts 3 and 4: matching the vertices 22
Doubts 5 and 6: choosing a criterion 23
Doubts 7 and 8: order and the right ratio 24
Doubts 9 and 10: understanding BPT 25
Doubts 11 and 12: converse, and starting a proof 26
Doubts 13 and 14: reasons and missing sides 27
Doubts 15 and 16: trusting diagrams, checking proofs 28

E Theorem Selection 29–32

Which theorem do I use? 29
Decision tree: from question to theorem 30
Look-alike questions, different reasoning 31
Choose the theorem first 32

F Mistake Clinic 33–36

Mistake clinic (1 of 3) 33
Mistake clinic (2 of 3) 34
Mistake clinic (3 of 3) 35
A model proof and the proof-writing guide 36

G Practice 37–42

Practice 1: reading diagrams and similar figures 37
Practice 2: corresponding vertices and sides 38
Practice 3: applying the theorems 39
Practice 4: multi-step proofs and missing values 40
Practice 5: mixed questions, choose the theorem 41
Chapter challenge: mini-test 42

H Answer Key 43–48

Answer key and full explanations 43–48

I Revision 49–50

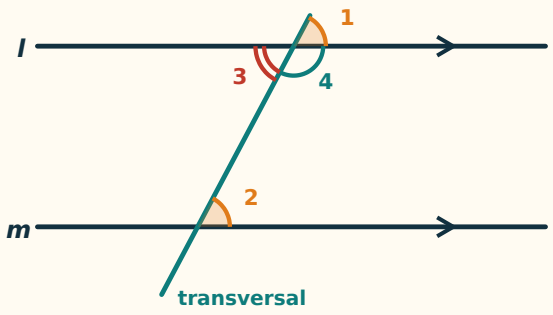
Revision map 49
My progress tracker 50

Angle facts: your bank of reasons

PREREQUISITE

Learning objective: Recall the angle facts that become the reasons in every similarity proof, and know the clue that allows each one.

Hold this question: *Where do the "equal angles" in a proof actually come from?*



l ∥ m. ∠1 and ∠2 are corresponding angles; ∠1 and ∠3 are vertically opposite.

◆ UNDERSTAND

When a **transversal** crosses two **parallel** lines:

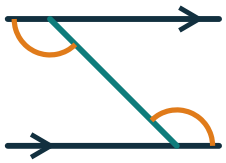
- **corresponding** angles are equal (∠1 = ∠2, same position at each crossing);
- **alternate** angles are equal (on opposite sides of the transversal, between the lines);
- **co-interior** angles add to 180°.

Without the parallel mark, none of these is guaranteed.

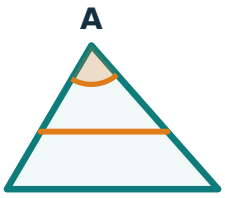
Fact	Clue that allows it	What you write in a proof
Corresponding angles are equal	*two lines marked ∥, cut by a line*	**∠ADE = ∠ABC (corresponding angles, DE ∥ BC)**
Alternate angles are equal	*∥ lines with a crossing line between them (Z-shape)*	**∠OAB = ∠OCD (alternate angles, AB ∥ CD)**
Vertically opposite angles are equal	*two straight lines crossing (X-shape)*	**∠AOB = ∠COD (vertically opposite angles)**
Common angle	*two triangles share a vertex and both arms*	**∠A = ∠A (common)**
Angle sum of a triangle is 180°	*two angles known*	**∠C = 180° − ∠A − ∠B**
Linear pair adds to 180°	*angles on a straight line*	**∠ADE + ∠BDE = 180°**



X-shape
vertically opposite angles



Z-shape between ∥ lines
alternate angles



Shared vertex
common angle ∠A in both triangles

? WHY THIS STEP?

Why learn these as "clue → reason" pairs? Every similarity proof in this chapter needs two pairs of equal angles, and almost all of them come from this table. If you can see the X-shape, the Z-shape or the shared vertex, you already have half the proof.

✔ CHECK YOURSELF

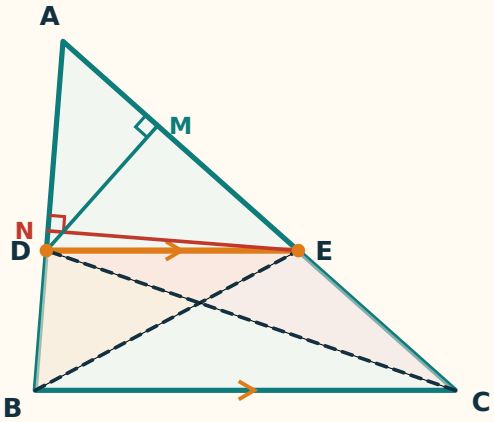
C2. In the figure above, suppose ∠1 = 62°. Find ∠2, ∠3 and ∠4, and name the fact you used for each.

Proving the Basic Proportionality Theorem

CORE

Learning objective: Write the prescribed proof of BPT, knowing the reason and the clue behind every line.

Hold this question: *How can areas of triangles prove something about lengths?*



GIVEN
In △ABC, DE ∥ BC; D on AB, E on AC.

TO PROVE
AD/DB = AE/EC

➤ CHOOSE THE METHOD

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

Idea. Triangles with the **same height** have areas in the ratio of their bases. Compare △ADE with △BDE (heights EN), and △ADE with △DEC (heights DM). The link: △BDE and △DEC have equal areas.

#	Statement	Reason	Clue that unlocked it
1	ar(ADE) = ½ × AD × EN; ar(BDE) = ½ × DB × EN	**area = ½ × base × height**	*EN ⊥ AB is a height for both*
2	ar(ADE)/ar(BDE) = AD/DB …(1)	**divide; ½ and EN cancel**	*same height EN*
3	ar(ADE) = ½ × AE × DM; ar(DEC) = ½ × EC × DM	**area = ½ × base × height**	*DM ⊥ AC is a height for both*
4	ar(ADE)/ar(DEC) = AE/EC …(2)	**divide; ½ and DM cancel**	*same height DM*
5	ar(BDE) = ar(DEC) …(3)	**triangles on the same base DE and between the same parallels DE and BC have equal areas**	*DE ∥ BC (given)*
6	ar(ADE)/ar(BDE) = ar(ADE)/ar(DEC)	**from (3): equal denominators**	—
7	Hence AD/DB = AE/EC. ∎	**from (1) and (2)**	*this is TO PROVE*

? WHY THIS STEP?

Where does "DE ∥ BC" get used? Only in line 5, and that is the whole point: two triangles on the same base DE with their third vertices B and C on a line parallel to DE have the same height, so equal areas. Without the parallel lines, line 5 fails and so does the theorem.

✓ EXAM TIP

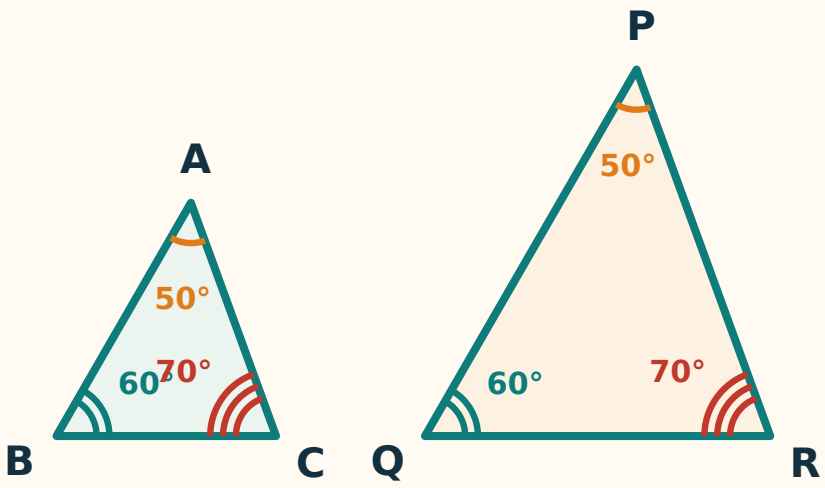
The syllabus asks you to **prove** this theorem, so learn the construction and the three area facts. Write the construction before the proof, number the results (1), (2), (3), and finish by stating the conclusion in the same words as TO PROVE.

AA similarity: two angles are enough

CORE

Learning objective: Use equal corresponding angles to prove two triangles similar, and know why two pairs suffice.

Hold this question: *Do I need all three pairs of angles, and is one pair ever enough?*



◆ UNDERSTAND

Theorem 6.3 (AAA criterion). If in two triangles the corresponding angles are equal, then their corresponding sides are in the same ratio, and the triangles are similar. **AA criterion:** if two angles of one triangle are equal to two angles of another, the triangles are similar, because the third angles must then be equal too (angle sum = 180°). (State and use; no proof required.)

◈ PROOF LINK

1 CLUE IN THE DIAGRAM	→	2 THEOREM THAT MATCHES	→	3 STEP IT LETS YOU WRITE
Two pairs of equal angles: from ∥ lines, an X-shape, a shared vertex, right angles, or given values		**AA similarity**: its condition is two pairs of equal corresponding angles		**△ABC ~ △PQR**, with vertices in matching order

Worked example: △ABC has ∠A = 50°, ∠B = 60°. △PQR has ∠P = 50°, ∠R = 70°. Are they similar?

#	Statement	Reason	Clue that unlocked it
1	∠C = 180° − 50° − 60° = 70°	**angle sum of a triangle**	*two angles of △ABC known*
2	∠Q = 180° − 50° − 70° = 60°	**angle sum of a triangle**	*two angles of △PQR known*
3	∠A = ∠P, ∠B = ∠Q (and ∠C = ∠R)	**values found**	*match equal angles*
4	△ABC ~ △PQR	**AA similarity criterion**	*two pairs of equal angles*

⚠ COMMON TRAP

One pair of equal angles is **not** enough. Two triangles can both contain a 50° angle and still have completely different shapes (Doubt 6). Find a **second** pair before writing "~".

✓ CHECK YOURSELF

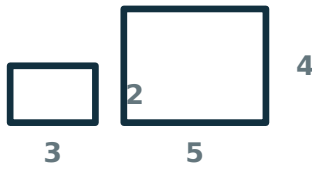
C8. In △ABC, ∠A = 35° and ∠B = 95°. In △PQR, ∠Q = 35° and ∠P = 50°. Show the triangles are similar and write the similarity statement in the correct vertex order.

Doubts 1 and 2: what similar means

DOUBT 1 *"These two rectangles look roughly the same shape. Doesn't that make them similar?"*

WHY IT HAPPENS	"Similar" in everyday English means "looks alike". In maths it is a precise condition.
SIMPLE EXPLANATION	Similar figures have equal corresponding angles **and** sides in one fixed ratio. You must check, not eyeball.
★ SPOT THE CLUE	Ask: is there **one** scale factor that turns every side into its partner?
WORKED EXAMPLE	Rectangles 3 × 2 and 5 × 4: 5/3 ≈ 1.67 but 4/2 = 2. No single scale factor, so **not similar**, even though all angles are 90°. *Why this step? Both conditions are needed for polygons.*
⚠ COMMON TRAP	Calling them similar because "both are rectangles". Equal angles alone are not enough for quadrilaterals.
✎ YOUR TURN DB1	Are a 4 × 6 rectangle and a 6 × 9 rectangle similar? Show the ratios.
✔ QUICK CHECK	Divide each side by its partner. All quotients equal → similar.

◉ VISUAL EXPLANATION

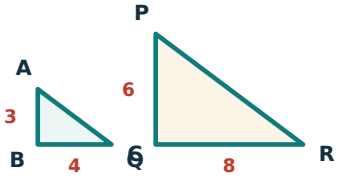


3 × 2 and 5 × 4: angles equal, ratios not.

DOUBT 2 *"If two triangles are similar, aren't they the same as congruent?"*

WHY IT HAPPENS	Both words describe "matching" triangles, and congruence was studied first (Class 9).
SIMPLE EXPLANATION	Congruent: same shape **and** same size (ratio 1). Similar: same shape, sizes in some ratio k. Congruent is the special case k = 1.
★ SPOT THE CLUE	Different lengths for matching sides → similar but not congruent.
WORKED EXAMPLE	Triangles with sides 3, 4, 5 and 6, 8, 10: ratios 6/3 = 8/4 = 10/5 = 2, so **similar, not congruent**. *Why this step? k ≠ 1.*
⚠ COMMON TRAP	Writing AB = PQ after proving △ABC ~ △PQR. Similarity gives AB/PQ = k, not equality.
✎ YOUR TURN DB2	True or false: (a) every pair of congruent triangles is similar; (b) every pair of similar triangles is congruent. Give a reason for each.
✔ QUICK CHECK	If the ratio is 1, they are congruent; otherwise only similar.

◉ VISUAL EXPLANATION



Sides 3, 4 → 6, 8: k = 2.

Decision tree: from question to theorem

Learning objective: Follow the branches to choose a theorem, and check its conditions before writing the step.

Mark the diagram. Then ask: what must I show or find?

↓

A length or ratio on the sides of a triangle with a ∥ line

↓

Is the line ∥ to a side and ending on the other two sides?

↓

Piece of a side → **BPT**

↓

The parallel side itself → **AA**, then DE/BC = AD/AB

↓

Not given ∥ → you cannot use BPT

Two lines are parallel

↓

Do you know lengths on two sides of a triangle?

↓

Equal ratios → **converse of BPT**

↓

Unequal ratios → **not parallel**

↓

Or: equal corresponding / alternate angles → parallel lines (Class 9 fact)

Triangles similar, or a ratio between two triangles

↓

What do you know about both triangles?

↓

Two pairs of angles → **AA**

↓

Three side ratios → **SSS** · angle + its two sides → **SAS**

↓

One angle only, or SSA → **not enough**

↓

Before you write the step: Are the theorem's conditions given or proved? Is the vertex order right? Does the ratio use corresponding sides? Does the last line say exactly what was asked?

? WHY THIS STEP?

Every branch starts from **what you must show**. That is the step most students skip, and it decides the theorem more reliably than any keyword. Questions often chain branches: prove similar (AA), then find a length (corresponding sides).

✎ YOUR TURN

Find the missing link. In △ABC, D is on AB and E on AC with AD/DB = AE/EC. To prove ∠ADE = ∠ABC, a student writes: (1) AD/DB = AE/EC (given); (2) _____ ; (3) ∠ADE = ∠ABC (corresponding angles). What must line (2) say, and which theorem justifies it? Hint: line (3) needs parallel lines. Answer in Section H, p. 46.

✓ CHECK YOURSELF

Try the tree: "In △PQR, S and T are on PQ and PR with PS/SQ = PT/TR. Prove ∠PST = ∠PQR." Which branches do you take, and in what order?

Mistake clinic (1 of 3)

MISTAKE 1 · Confusing similar with congruent	
✗ STUDENT'S WORK	*△ABC ~ △PQR and AB = 4 cm.* "So PQ = 4 cm."
⚠ WHERE IT FAILS	Similarity gives a **ratio**, not equal lengths. Only congruence (ratio 1) gives PQ = AB.
? WHY TEMPTING	Class 9 congruence proofs ended in "so AB = PQ", and the habit carries over.
✓ CORRECTED	PQ = k × AB, where k must be found from a known pair of corresponding sides.
➤ PREVENTION RULE	Similar ⇒ write a ratio. Congruent ⇒ write an equality.
✎ FIX IT E1	△ABC ~ △DEF, AB = 5, DE = 7.5 and BC = 6. A student writes EF = 6. Correct it.

MISTAKE 2 · Wrong vertex correspondence	
✗ STUDENT'S WORK	*∠A = 40°, ∠B = 70° in △ABC; ∠Q = 40°, ∠P = 70° in △PQR.* "△ABC ~ △PQR."
⚠ WHERE IT FAILS	That statement pairs A with P (40° with 70°). Equal angles say A ↔ Q and B ↔ P, so C ↔ R.
? WHY TEMPTING	Writing both triangles alphabetically looks tidy.
✓ CORRECTED	△**ABC** ~ △**QPR**. Then AB/QP = BC/PR = CA/RQ.
➤ PREVENTION RULE	Match the angle marks first, then write the letters in that order.
✎ FIX IT E2	∠X = 55°, ∠Y = 65° in △XYZ; ∠M = 65°, ∠N = 55° in △LMN. A student writes △XYZ ~ △LMN. Correct it.

MISTAKE 3 · Comparing non-corresponding sides	
✗ STUDENT'S WORK	*From △ABC ~ △PQR:* "AB/PQ = BC/PR."
⚠ WHERE IT FAILS	BC is positions 2–3, so its partner is QR, not PR.
? WHY TEMPTING	PR may look the right size or sit in the same place on the page.
✓ CORRECTED	AB/PQ = **BC/QR** = CA/RP.
➤ PREVENTION RULE	Partners use the same positions in the two names.
✎ FIX IT E3	From △DEF ~ △STU a student writes DE/ST = EF/SU. Find and correct the error.

Practice 1: reading diagrams and similar figures

Learning objective: Use notation, angle facts and the meaning of similarity correctly. (Level 1)

Level 1 | Level 2 | Level 3 | Level 4 | Level 5 *Answers: Section H.*

P1 In △PQR, name (a) the side opposite ∠Q, and (b) the angle included between sides QP and QR. In △ABC, name the angle included between AB and BC.

Purpose: read notation. easy ★☆☆

Working space (use separate paper if needed)

P2 True or false? (a) All congruent triangles are similar. (b) All similar triangles are congruent. (c) Any two equilateral triangles are similar. (d) Any two isosceles triangles are similar. (e) Any two squares are similar. (f) Any two rectangles are similar.

Purpose: use the definition and counter-examples. easy ★☆☆

Working space (use separate paper if needed)

P3 Give a counter-example: two quadrilaterals whose corresponding angles are equal but which are not similar. Draw them and state their sides.

Purpose: show that one condition is not enough. easy ★☆☆

Mark the diagram · Given · To prove

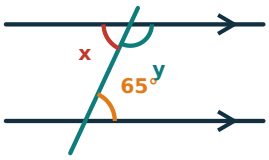
Working space (use separate paper if needed)

P4 The two horizontal lines are parallel. Find x and y, and give the reason for each.

Purpose: name angle facts as reasons. easy ★☆☆

Mark the diagram · Given · To prove

Working space (use separate paper if needed)



P5 A triangle has sides 3 cm, 4 cm and 6 cm. It is enlarged with scale factor 2.5. Find the sides of the new triangle. Are the two triangles congruent, similar, or both?

Purpose: use a scale factor. easy ★☆☆

Mark the diagram · Given · To prove

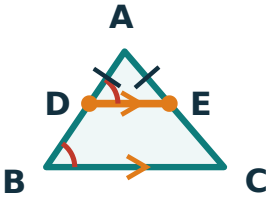
Working space (use separate paper if needed)

P6 From the marks on this diagram only, list (a) the pair of parallel lines, (b) the pair of equal angles, and (c) the pair of equal lengths. Which of these could you have *proved* if it were not marked?

Purpose: read marks as given information. moderate ★★☆

Mark the diagram · Given · To prove

Working space (use separate paper if needed)



Revision map

Learning objective: Recall every key fact, criterion and clue on one page.

◆ UNDERSTAND

Similar: same shape; corresponding angles equal **and** sides in one ratio k. **Congruent**: the case k = 1. All congruent figures are similar, not the other way round. For triangles, either condition alone is enough (that is what the criteria say).
△**ABC** ~ △**PQR** means A↔P, B↔Q, C↔R; AB/PQ = BC/QR = CA/RP.

BPT (prove)



DE ∥ BC ⇒ AD/DB = AE/EC; also AD/AB = AE/AC

Converse (state, use)



AD/DB = AE/EC ⇒ DE ∥ BC

AA



two pairs of equal angles

SSS



three side ratios equal (sort first)

SAS



equal angle + the two sides forming it, proportional

◈ PROOF LINK

1 CLUE IN THE DIAGRAM
∥ line in a triangle · X-shape · Z-shape · shared vertex · right angles · three sides · angle with its two sides

→

2 THEOREM THAT MATCHES
BPT · converse · AA · SSS · SAS (conditions checked)

→

3 STEP IT LETS YOU WRITE
a ratio, a ∥ line, or ~ with correct vertex order, each with its reason

When the question asks for…	Use
A piece of a side, with a ∥ line	BPT
The parallel side DE	AA, then DE/BC = AD/AB
"Show DE ∥ BC" with lengths	Converse of BPT
Prove ~ (angles)	AA
Prove ~ (sides)	SSS or SAS
A ratio like OA/OC = OB/OD	name the triangles from TO PROVE, then AA
Heights and shadows	AA, height ↔ height

⚠ COMMON TRAP

Final error checklist. ☐ Similar gives ratios, not equal sides (E1) ☐ Vertex order from the angles (E2) ☐ Partners by position (E3) ☐ Two pairs of angles, not one (E4) ☐ BPT vs converse named correctly (E5) ☐ Nothing assumed from appearance (E6) ☐ Criterion and its evidence written (E7) ☐ SAS angle included (E8) ☐ Ratios checked by substitution (E9)

MATHS WITHOUT GUESSWORK

Liked this? Get the full Triangles workbook for ₹99

You have just read 10 sample pages. The full workbook is 50 pages + cover.

What is in the full workbook

- **Diagnostic challenge.** A short warm-up to find what you already know before you start.
- **Foundation.** Concept explanations that build the ideas the chapter depends on.
- **Core theorems.** Worked examples with a reason for every step, and quick checks to try.
- **Doubt Bank.** 16 common doubts answered clearly, each followed by a question to try.
- **Theorem selection.** Clue tables, decision charts and look-alike questions that train you to choose the method.
- **Mistake Clinic.** 9 common mistakes: the wrong work, why it is tempting, and the fix.

Buy the full workbook — ₹99

or visit www.mathswithoutguesswork.com/ebooks/triangles

Instant PDF download after payment · Secure payment by Razorpay · If it doesn't reach you, we'll resend it.

Or get **all 14 concept ebooks for ₹999**: bought one by one they cost ₹1,386, so you save ₹387.