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CLASS X · MATHEMATICS BASIC (241) · CBSE BOARD EXAMINATION 2027

CHAPTER 6 BASIC

Triangles

Answer Booklet · Full worked solutions with CBSE-style step marks

Every question of the Basic booklet | Step marks shown line by line | MCQ keys with working

INSIDE THIS BOOKLET

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HOW TO USE THE ANSWERS

1. Solve the question in your notebook **first**. Open this booklet only to check.
2. The orange number beside each line is the **step mark** an examiner gives for that line, as in the CBSE marking scheme.
3. Give yourself marks line by line. A right final answer without the working can lose step marks.
4. Check each similarity statement by matching the equal angles letter by letter before you write the ratio.
5. Copy every wrong answer to the My Mistakes page of your booklet.

READ THIS FIRST

Marking Guide

Full worked solutions to every question in the chapter booklet, set out the way a CBSE examiner marks them.

HOW MARKS ARE GIVEN IN TRIANGLES ANSWERS

1. **1-mark MCQ / assertion–reason:** only the correct option scores. The working here is for your understanding.
2. **Similarity in a figure (2 marks):** two pairs of equal angles with reasons 1 · criterion and the required ratio 1.
3. **BPT numerical (2 marks):** correct proportion 1 · value 1.
4. **Prove the BPT (3 marks):** given, to prove, construction and figure ½ + ½ · area ratios 1 · equal areas and conclusion 1.
5. **5-mark question:** usually the BPT proof (3) plus an application (2).
6. Lines with no number are working that earns no separate mark but must be shown.

A

PART A · SOLUTIONS

Guided Practice – Solutions

Worked solutions with step marks for every question in Part A.

Similar triangles and the BPT

A1. $\triangle ABC \sim \triangle PQR$. Complete the matching parts. [2]

$\angle A = \angle P,\ \angle B = \angle Q,\ \angle C = \angle R$ — 1

$\dfrac{AB}{PQ} = \dfrac{BC}{QR} = \dfrac{CA}{RP}$ — 1

A2. In $\triangle ABC$, $DE \parallel BC$, $AD = 2$ cm, $DB = 3$ cm and $AE = 3$ cm. Complete the steps to find EC. [2]

$\dfrac{AD}{DB} = \dfrac{AE}{EC} \rightarrow \dfrac{2}{3} = \dfrac{3}{EC}$ — 1

$EC = 4.5$ cm — 1

A3. $AD = 2$, $DB = 4$, $AE = 3$ and $EC = 6$ (cm) in $\triangle ABC$. Complete the steps to check whether $DE \parallel BC$. [2]

$\dfrac{AD}{DB} = \dfrac{1}{2}$ and $\dfrac{AE}{EC} = \dfrac{1}{2}$ — 1

Equal, so $DE \parallel BC$ (converse of the BPT) — 1

Criteria and ratios

A4. Complete the table. The first row is done for you. [2]

Row 2: $\dfrac{3}{6} = \dfrac{4}{8} = \dfrac{5}{10} \rightarrow$ yes, SSS — 1

Row 3: $\angle B = \angle Q$ and $\dfrac{2}{4} = \dfrac{3}{6} \rightarrow$ yes, SAS — 1

A5. $\triangle ABC \sim \triangle DEF$, $AB = 3$ cm, $DE = 4.5$ cm and the perimeter of $\triangle ABC$ is 15 cm. Complete the steps to find the perimeter of $\triangle DEF$. [2]

$\frac{\text{perimeter}(DEF)}{15} = \frac{4.5}{3}$ 1

Perimeter $= 22.5$ cm 1

Word problem

A6. A pole 2 m high casts a shadow 1.5 m long. At the same time a tree casts a shadow 12 m long. Complete the steps to find the height of the tree. [3]

Both are vertical and the sun's rays make equal angles: the triangles are similar (AA) 1

$\frac{h}{2} = \frac{12}{1.5}$ 1

$h = 16$ m 1

B PART B · SOLUTIONS
NCERT Practice – Solutions
Worked solutions with step marks for every question in Part B.

Similar figures

Q	Answer	Working / reason
B1	**(c)** two equilateral triangles	All angles of an equilateral triangle are 60°, and all its sides are equal, so any two are similar. The others can have different shapes.

B2. Give a counter-example for each statement: **(i)** Two quadrilaterals with equal corresponding angles need not be similar. **(ii)** Two quadrilaterals with proportional sides need not be similar. [2]

(i) A square of side 2 and a rectangle 2 × 4: all angles 90°, but $\frac{2}{2} \neq \frac{2}{4}$ 1

(ii) A square of side 3 and a rhombus of side 3 with angles 60° and 120°: sides in ratio 1 : 1, but angles differ 1

Basic Proportionality Theorem

B3. In $\triangle ABC$, $DE \parallel BC$ with D on AB and E on AC. Find: **(i)** EC, if $AD = 2$ cm, $DB = 3$ cm, $AE = 2.4$ cm **(ii)** AE, if $AD = 4$ cm, $AB = 10$ cm, $AC = 7.5$ cm [2]

(i) $\frac{AD}{DB} = \frac{AE}{EC} \rightarrow \frac{2}{3} = \frac{2.4}{EC} \rightarrow EC = 3.6$ cm 1

(ii) $\frac{AD}{AB} = \frac{AE}{AC} \rightarrow \frac{4}{10} = \frac{AE}{7.5} \rightarrow AE = 3$ cm 1

B4. E and F are points on sides PQ and PR of $\triangle PQR$. Is $EF \parallel QR$? **(i)** $PE = 4$, $EQ = 5$, $PF = 3.2$, $FR = 4$ (cm) **(ii)** $PE = 3$, $EQ = 4.5$, $PF = 2.4$, $FR = 3$ (cm) [2]

(i) $\frac{PE}{EQ} = \frac{4}{5} = 0.8$, $\frac{PF}{FR} = \frac{3.2}{4} = 0.8$: equal, so **yes**, $EF \parallel QR$ 1

(ii) $\frac{PE}{EQ} = \frac{3}{4.5} = \frac{2}{3}$, $\frac{PF}{FR} = \frac{2.4}{3} = 0.8$: not equal, so **no** 1

B5. In the figure, $LM \parallel CB$ and $LN \parallel CD$. Prove that $\frac{AM}{AB} = \frac{AN}{AD}$. **[3]**

In $\triangle ABC$, $LM \parallel CB$, so by the BPT $\frac{AM}{AB} = \frac{AL}{AC}$ — 1

In $\triangle ADC$, $LN \parallel CD$, so $\frac{AN}{AD} = \frac{AL}{AC}$ — 1

Hence $\frac{AM}{AB} = \frac{AN}{AD}$ — 1

B6. Using the BPT, prove that a line drawn through the midpoint of one side of a triangle, parallel to another side, bisects the third side. **[2]**

D is the midpoint of AB and $DE \parallel BC$. By the BPT $\frac{AE}{EC} = \frac{AD}{DB} = 1$ — 1

So $AE = EC$: E is the midpoint of AC — 1

Similarity criteria

B7. State which pairs of triangles are similar, and write the criterion: **(i)** $AB = 2$, $BC = 2.5$, $CA = 3$; $PQ = 4$, $QR = 5$, $RP = 6$ **(ii)** $\angle L = 50^\circ$, $\angle M = 70^\circ$; $\angle X = 50^\circ$, $\angle Z = 60^\circ$ **(iii)** $DE = 3$, $EF = 4$, $\angle E = 40^\circ$; $ST = 6$, $TU = 10$, $\angle T = 40^\circ$ **[3]**

(i) $\frac{2}{4} = \frac{2.5}{5} = \frac{3}{6} = \frac{1}{2}$: $\triangle ABC \sim \triangle PQR$ (SSS) — 1

(ii) $\angle Y = 180^\circ - 50^\circ - 60^\circ = 70^\circ$; $\angle L = \angle X$, $\angle M = \angle Y$: $\triangle LMN \sim \triangle XYZ$ (AA) — 1

(iii) $\angle E = \angle T$ but $\frac{3}{6} \neq \frac{4}{10}$: **not** similar — 1

B8. In the figure, $\triangle ODC \sim \triangle OBA$, $\angle BOC = 115^\circ$ and $\angle CDO = 75^\circ$. Find $\angle DOC$, $\angle DCO$ and $\angle OAB$. **[3]**

$\angle DOC = 180^\circ - 115^\circ = 65^\circ$ (linear pair) — 1

$\angle DCO = 180^\circ - 65^\circ - 75^\circ = 40^\circ$ — 1

$\angle OAB = \angle OCD = 40^\circ$ (similar triangles) — 1

B9. In $\triangle PQR$, $\angle Q = 90^\circ$ and $QS \perp PR$. Prove that $\triangle PSQ \sim \triangle PQR$ and $PQ^2 = PS \times PR$. **[3]**

In $\triangle PSQ$ and $\triangle PQR$: $\angle P$ is common and $\angle PSQ = \angle PQR = 90^\circ$ — 1

$\therefore \triangle PSQ \sim \triangle PQR$ (AA) — 1

$\frac{PS}{PQ} = \frac{PQ}{PR}$, so $PQ^2 = PS \times PR$ — 1

B10. A girl 1.5 m tall walks away from the foot of a lamp post at 1 m/s. The lamp is 4.5 m above the ground. How long is her shadow after 6 seconds? **[3]**

After 6 s she is 6 m from the post. Let the shadow be s m. The triangles are similar (AA) — 1

$\frac{1.5}{4.5} = \frac{s}{s+6} \rightarrow 3s = s + 6$ — 1

$s = 3$ m — 1

B11. A stick 2 m long, held upright, casts a shadow 1.6 m long. At the same time a building casts a shadow 24 m long. Find the height of the building. [2]

The triangles are similar (AA): $\frac{h}{2} = \frac{24}{1.6}$ — 1

$h = 30$ m — 1

Pythagoras (application)

B12. A ladder 13 m long reaches a window 12 m above the ground. How far is the foot of the ladder from the wall? [2]

$d^2 = 13^2 - 12^2 = 169 - 144 = 25$ — 1

$d = 5$ m — 1

PART C · SOLUTIONS

C Board Pattern Practice – Solutions

Worked solutions with step marks for every question in Part C.

Sides and perimeters of similar triangles

Q	Answer	Working / reason
C1	**(b)** 12 cm	$PQ = 9 \times \frac{48}{36} = 12$ cm.
C2	**(c)** 15 cm	$\frac{YZ}{QR} = \frac{XY}{PQ} = 3$, so $YZ = 15$ cm.
C3	**(a)** $\triangle$ABC $\sim$ $\triangle$EDF	SAS with $A \leftrightarrow E$, $B \leftrightarrow D$, $C \leftrightarrow F$.
C4	**(d)** RHS	RHS is a congruence rule.
C5	**(b)** similar but not congruent	AA gives similarity; the sides are not equal, so they are not congruent.
C6	**(a)**	$\frac{4}{6} = \frac{2}{3}$; R explains A.

BPT: lengths and parallel lines

Q	Answer	Working / reason
C7	**(d)** 6 cm	$\frac{3}{4} = \frac{4.5}{EC} \rightarrow EC = 6$ cm.
C8	**(b)** 4.5 cm	$\frac{AE}{AC} = \frac{3}{8}$, so $AE = 4.5$ cm.
C9	**(c)** 2	$\frac{4}{6} = \frac{3x}{9} \rightarrow x = 2$.
C10	**(a)**	$\frac{AD}{DB} = \frac{AE}{EC} = 1$; by the converse of the BPT, $DE \parallel BC$. R explains A.

C11. In $\triangle ABC$, $DE \parallel BC$ with $AD = x+2$, $DB = x-1$, $AE = x+5$ and $EC = x+1$ (cm). Find x. [2]

$\frac{x+2}{x-1} = \frac{x+5}{x+1} \rightarrow x^2+3x+2 = x^2+4x-5$ 1

$x = 7$ (check: $\frac{9}{6} = \frac{12}{8}$ ✓) 1

C12. D and E are points on AB and AC of $\triangle ABC$ with $AD = 1.5$, $DB = 3$, $AE = 1$ and $EC = 2$ (cm). Show that $DE \parallel BC$. [2]

$\frac{AD}{DB} = \frac{1.5}{3} = \frac{1}{2}$ and $\frac{AE}{EC} = \frac{1}{2}$ 1

The ratios are equal, so $DE \parallel BC$ (converse of the BPT) 1

Show two triangles similar

C13. In the figure, $AB \parallel CD$ and AD, BC meet at O. Show that $\triangle OAB \sim \triangle ODC$. If $OA = 3$ cm, $OD = 5$ cm and $AB = 4.2$ cm, find CD. [2]

$\angle AOB = \angle DOC$ (vertically opposite), $\angle OAB = \angle ODC$ (alternate): $\triangle OAB \sim \triangle ODC$ (AA) 1

$\frac{AB}{DC} = \frac{OA}{OD} \rightarrow \frac{4.2}{CD} = \frac{3}{5} \rightarrow CD = 7$ cm 1

C14. In the figure, $QA \perp AB$ and $PB \perp AB$. If $AO = 8$ cm, $BO = 6$ cm and $PB = 4.5$ cm, find AQ. [2]

$\angle A = \angle B = 90^\circ$, $\angle AOQ = \angle BOP$: $\triangle AOQ \sim \triangle BOP$ (AA) 1

$\frac{AQ}{BP} = \frac{AO}{BO} \rightarrow AQ = 4.5 \times \frac{8}{6} = 6$ cm 1

C15. In $\triangle ABC$, P and Q are on AB and AC with $PQ \parallel BC$, $AP = 3$ cm and $PB = 6$ cm. Show that $\triangle APQ \sim \triangle ABC$ and find PQ if $BC = 12$ cm. [2]

$\angle A$ common, $\angle APQ = \angle ABC$ (corresponding): $\triangle APQ \sim \triangle ABC$ (AA) 1

$\frac{PQ}{BC} = \frac{AP}{AB} = \frac{3}{9} \rightarrow PQ = 4$ cm 1

Theorem and proofs

C16. State and prove the Basic Proportionality Theorem. [5]

Statement: a line drawn parallel to one side of a triangle, meeting the other two sides in distinct points, divides them in the same ratio 1

Given $\triangle ABC$, $DE \parallel BC$; to prove $\frac{AD}{DB} = \frac{AE}{EC}$; construction: join BE, CD; draw $EN \perp AB$, $DM \perp AC$ (figure) 1

$\frac{\text{ar}(ADE)}{\text{ar}(BDE)} = \frac{AD}{DB}$ (same height EN) 1

$\frac{\text{ar}(ADE)}{\text{ar}(DEC)} = \frac{AE}{EC}$ (same height DM) 1

$\text{ar}(BDE) = \text{ar}(DEC)$ (same base DE, between the same parallels), so $\frac{AD}{DB} = \frac{AE}{EC}$ 1

C17. $ABCD$ is a trapezium with $AB \parallel DC$. E and F are points on AD and BC with $EF \parallel AB$. Show that $\dfrac{AE}{ED} = \dfrac{BF}{FC}$. **[3]**

Join AC, meeting EF at G. In $\triangle ADC$, $EG \parallel DC$: $\dfrac{AE}{ED} = \dfrac{AG}{GC}$ — 1

In $\triangle CAB$, $GF \parallel AB$: $\dfrac{CG}{GA} = \dfrac{CF}{FB}$, i.e. $\dfrac{AG}{GC} = \dfrac{BF}{FC}$ — 1

Hence $\dfrac{AE}{ED} = \dfrac{BF}{FC}$ — 1

Applications: shadows and ladders

Q	Answer	Working / reason
C18	**(c)** 8 m	$\sqrt{17^2 - 15^2} = \sqrt{64} = 8$ m.

C19. A vertical stick 1.8 m long casts a shadow 1.2 m long. At the same time a tree casts a shadow 9 m long. Find the height of the tree. **[2]**

Similar triangles (AA): $\dfrac{h}{1.8} = \dfrac{9}{1.2}$ — 1

$h = 13.5$ m — 1

C20. A lamp is 6 m above the ground. A boy 1.5 m tall stands 9 m from the foot of the lamp post. Find the length of his shadow. **[3]**

Shadow s m; the triangles are similar (AA) — 1

$\dfrac{1.5}{6} = \dfrac{s}{s+9} \rightarrow 4s = s + 9$ — 1

$s = 3$ m — 1

PART D · SOLUTIONS

D Case-Based Questions – Solutions

Worked solutions with step marks for every question in Part D.

D1. Case Study · Shadow and Height [4]

(i) Why are the triangles formed by the student and the flagpole with their shadows similar? **[1]**

Both stand vertically (90°) and the sun's rays meet the ground at the same angle: AA 1

(ii) Find the height of the flagpole. **[1]**

$\frac{h}{1.6} = \frac{15}{2} \rightarrow h = 12$ m 1

(iii) Later in the day the flagpole's shadow is 9 m long. How long is the student's shadow then? **[2]**

Flagpole 12 m (from the shadows at 10 a.m.); $\frac{1.6}{12} = \frac{s}{9}$ 1

$s = 1.2$ m 1

OR

(iii) A tree 8 m high stands near the flagpole. How long is its shadow at 10 a.m.? **[2]**

Shadow = height $\times \frac{2}{1.6}$ 1

$8 \times 1.25 = 10$ m 1

D2. Case Study · Roof Truss [4]

(i) Find the length EC. **[1]**

$\frac{1.5}{2.5} = \frac{1.8}{EC} \rightarrow EC = 3$ m 1

(ii) Find the length of the beam DE. **[1]**

$\frac{DE}{BC} = \frac{AD}{AB} = \frac{1.5}{4} \rightarrow DE = 2.25$ m 1

(iii) A second beam $FG \parallel BC$ is fixed with F on AB and $AF = 3$ m. Find FG and AG. **[2]**

$AB = 4$, $AC = 4.8$ (from the given lengths). $\frac{FG}{6} = \frac{3}{4} \rightarrow FG = 4.5$ m 1

$AG = 4.8 \times \frac{3}{4} = 3.6$ m 1

OR

(iii) A builder joins a point 2 m from A on AB to a point 2.4 m from A on AC. Is this beam parallel to BC? Justify. **[2]**

$AB = 4$ m, $AC = 4.8$ m; $\frac{2}{4} = \frac{1}{2}$ and $\frac{2.4}{4.8} = \frac{1}{2}$ 1

Equal ratios, so yes, it is parallel (converse of the BPT) 1

D3. Case Study · Pinhole Camera [4]

(i) Which criterion shows $\triangle OAB \sim \triangle OA'B'$? **[1]**

AA: $\angle AOB = \angle A'OB'$ (vertically opposite) and $\angle B = \angle B' = 90^\circ$ 1

(ii) Find the height of the object. **[1]**

$\frac{h}{3} = \frac{600}{10} \rightarrow h = 180 \text{ cm} = 1.8 \text{ m}$ 1

(iii) The object is moved to 9 m from the hole. Find the new height of the image. **[2]**

Object 180 cm (from the first set-up): $\frac{180}{x} = \frac{900}{10}$ 1

$x = 2 \text{ cm}$ 1

OR

(iii) The screen is moved to 15 cm behind the hole (object at 6 m). Find the height of the image. **[2]**

$\frac{x}{180} = \frac{15}{600}$ 1

$x = 4.5 \text{ cm}$ 1