CHAPTER 7

TRIANGLES

REVISION OF KEY CONCEPTS AND FORMULAE

1. Two figures having the same shape but not necessarily the same size are called similar figures.
2. All congruent figures are similar but the converse is not true.
3. Two polygons having the same number of sides are similar, if
   (i) their corresponding angles are equal and
   (ii) their corresponding sides are proportional (i.e., in the same ratio).
4. If a line is drawn parallel to one side of a triangle to intersect the other two sides in distinct points, then the other two sides are divided in the same ratio.
5. If a line divides any two sides of a triangle in the same ratio, then the line is parallel to the third side of the triangle.
6. The internal bisector of an angle of a triangle divides the opposite side internally in the ratio of the sides containing the angle.
7. If a line through one vertex of a triangle divides the opposite side in the ratio of other two sides, then the line bisects the angle at the vertex.
8. The external bisector of an angle of a triangle divides the opposite side externally in the ratio of the sides containing the angle.
9. The line drawn from the mid-point of one side of a triangle is parallel of another side bisects the third side.
10. The line joining the mid-points of two sides of a triangle is parallel to the third side.
11. The diagonals of a trapezium divide each other proportionally.
12. If the diagonals of a quadrilateral divide each other proportionally, then it is a trapezium.
13. Any line parallel to the parallel sides of a trapezium divides the non-parallel sides proportionally.
14. If three or more parallel lines are intersected by two transversals, then the intercepts made by them on the transversals are proportional.
15. *AAA Similarity criterion:* If in two triangles, corresponding angles are equal, then the triangles are similar.
16. *AA Similarity criterion:* If in two triangles, two angles of one triangle are respectively equal to the two angles of the other triangle, then the two triangles are similar.
17. *SSS Similarity criterion:* If in two triangles, corresponding sides are in the same ratio, then the two triangles are similar.
18. *SAS Similarity criterion:* If one angle of a triangle is equal to one angle of another triangle and the sides including these angles are in the same ratio, then the triangles are similar.
19. *RHS Similarity criterion:* If in two triangles, hypotenuse and one side of one triangle are proportional to the hypotenuse and one side of the other triangle, then the two triangles are similar.
20. If two triangles are equiangular, then
    (i) the ratio of the corresponding sides is same as the ratio of corresponding medians.
    (ii) the ratio of the corresponding sides is same as the ratio of the corresponding angle bisector segments.
    (iii) the ratio of the corresponding sides is same as the ratio of the corresponding altitudes.
21. If one angle of a triangle is equal to one angle of another triangle and the bisectors of these equal angles divide the opposite side in the same ratio, then the triangles are similar.

22. If two sides and a median bisecting one of these sides of a triangle are respectively proportional to the two sides and the corresponding median of another triangle, then the triangles are similar.
23. If two sides and a median bisecting the third side of a triangle are respectively proportional to the two sides and the corresponding median of another triangle, then the triangles are similar.
24. $\Delta ABC \sim \Delta DEF$, then

$$\frac{AB}{DE}=\frac{BC}{EF}=\frac{AC}{DF}=\frac{\text{Perimeter of } \Delta ABC}{\text{Perimeter of } \Delta DEF}$$

25. If a perpendicular is drawn from the vertex of the right angle of a right triangle to the hypotenuse, then the triangles on both sides of the perpendicular are similar to the whole triangle and also to each other.
26. *Pythagoras Theorem:* In a right triangle, the square of the hypotenuse is equal to the sum of the squares of the other two sides.
27. *Converse of Pythagoras Theorem:* If in a triangle, square of one side is equal to the sum of the squares of the other two sides, then the angle opposite to first side is a right angle.
28. In any triangle, the sum of the squares of any two sides is equal to twice the square of half of the third side together with the twice of the square of the median which bisects the third side.
29. Three times the sum of the squares of the sides of a triangle is equal to four times the sum of the squares of the medians of the triangle.
30. Three times the square of any side of an equilateral triangle is equal to four times the square of the altitude.
31. In a triangle perpendicular drawn from the vertex of right angle to the hypotenuse divides the triangle into two similar triangle i.e. $\Delta ADB \sim \Delta CDA$.
Also, $AD^2 = BD \times CD$ i.e. the square of the perpendicular is equal to the product of projections of other two sides on the hypotenuse (Fig. 7.1).

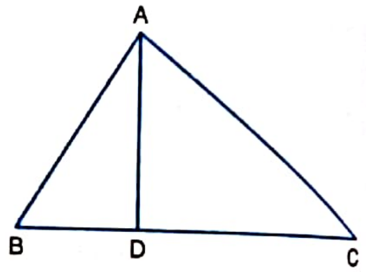

Fig. 7.1

SOLVED EXAMPLES

MULTIPLE CHOICE QUESTIONS (MCQs)

EXAMPLE 1 *In Fig. 7.2, $DE \parallel BC$. If $AD = 3$ cm, $AB = 7$ cm and $EC = 3$ cm, then the length of AE is*

(a) 2 *cm* (b) 2.25 *cm* (c) 3.5 *cm* (d) 4 *cm*

Ans. (b) [CBSE 2023]

SOLUTION Given that $DE \parallel BC$

$$\therefore \quad \frac{AD}{DB}=\frac{AE}{EC} \Rightarrow \frac{3}{4}=\frac{AE}{3} \Rightarrow AE=\frac{9}{4}\text{ cm}=2.25\text{ cm}$$

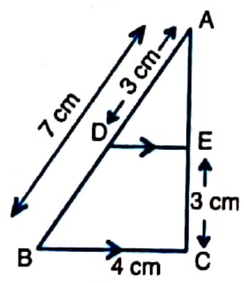

Fig. 7.2

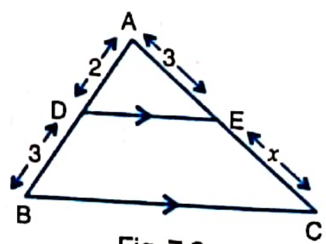

Fig. 7.3

EXAMPLE 2 *In Fig. 7.3, $DE \parallel BC$. If $AD = 2$ units, $DB = AE = 3$ units and $EC = x$ units, then the value of x is*

(a) 2 (b) 3 (c) 5 (d) 9/2

Ans. (d) [CBSE 2023]

SOLUTION Given that $DE \parallel BC$

$$\therefore \quad \frac{AD}{DB} = \frac{AE}{EC} \Rightarrow \frac{2}{3} = \frac{3}{x} \Rightarrow x = \frac{9}{2}$$

EXAMPLE 3 *In Fig. 7.4, $\Delta ABC \sim \Delta QPR$. If $AC = 6$ cm, $BC = 5$ cm, $QR = 3$ cm and $PR = x$ cm, then the value of x is*

(a) 2.6 *cm* (b) 2.5 *cm* (c) 10 *cm* (d) 3.2 *cm*

Ans. (b) [CBSE 2023]

SOLUTION $\Delta ABC \sim \Delta QPR$

$$\Rightarrow \quad \frac{AB}{QP} = \frac{BC}{PR} = \frac{AC}{QR}$$

$$\Rightarrow \quad \frac{BC}{PR} = \frac{AC}{QR} \Rightarrow \frac{5}{x} = \frac{6}{3} \Rightarrow x = \frac{5}{2}\text{ cm} = 2.5\text{ cm}$$

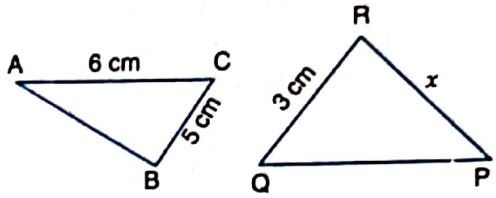

Fig. 7.4

EXAMPLE 4 *In ΔABC, $PQ \parallel BC$. If $PB = 6$ cm, $AP = 4$ cm, $AQ = 8$ cm, then the length of AC is*

(a) 12 *cm* (b) 20 *cm* (c) 6 *cm* (d) 14 *cm*

Ans. (b) [CBSE 2023]

SOLUTION $PQ \parallel BC$

$$\Rightarrow \quad \frac{AP}{PB} = \frac{AQ}{QC}$$

$$\Rightarrow \quad \frac{4}{6} = \frac{8}{QC} \Rightarrow QC = 12\text{ cm}$$

$$\therefore \quad AC = AQ + QC = (8+12)\text{ cm} = 20\text{ cm}$$

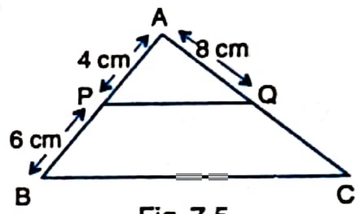

Fig. 7.5

EXAMPLE 5 *In Fig. 7.6, if $DE \parallel BC$, then the value of x is*

(a) 6 (b) 12.5 (c) 8 (d) 10

Ans. (a) [CBSE 2023]

SOLUTION Given that $DE \parallel BC$

$$\therefore \quad \frac{AD}{DB} = \frac{DE}{BC}$$

$$\Rightarrow \quad \frac{2}{3} = \frac{4}{x} \Rightarrow 2x = 12 \Rightarrow x = 6$$

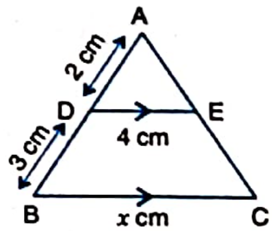

Fig. 7.6

EXAMPLE 6 *If $\Delta ABC \sim \Delta PQR$ with $\angle A = 32°$ and $\angle R = 65°$, then the measure of $\angle B$ is*

(a) 32° (b) 65° (c) 83° (d) 97°

Ans. (c) [CBSE 2023]

SOLUTION $\Delta ABC \sim \Delta PQR$

$$\Rightarrow \quad \angle A = \angle P, \angle B = \angle Q \text{ and } \angle C = \angle R \Rightarrow \angle A = 32° \text{ and } \angle C = 65°$$

Using angle sum property in ΔABC, we obtain

$$\angle A + \angle B + \angle C = 180° \Rightarrow 32° + \angle B + 65° = 180° \Rightarrow \angle B = 83°$$

EXAMPLE 7 *It is given that $\Delta ABC \sim \Delta DFE$, $\angle A = 30°$, $\angle C = 50°$, $AB = 5$ cm, $AC = 8$ cm and $DF = 7.5$ cm. Then, which of the following is true?*

(a) $DE = 12$ cm, $\angle F = 50°$ (b) $DE = 12$ cm, $\angle F = 100°$

(c) $EF = 12$ cm, $\angle D = 100°$ (d) $EF = 12$ cm, $\angle D = 30°$

[NCERT EXEMPLAR]

Ans. (b)

SOLUTION It is given that $\Delta ABC \sim \Delta DFE$.

$\therefore \quad \angle A = \angle D, \angle B = \angle F, \angle C = \angle E$ and $\dfrac{AB}{DF} = \dfrac{BC}{EF} = \dfrac{AC}{DE}$

$\Rightarrow \quad \angle D = 30°, \angle F = 100°, \angle E = 50°$ and $\dfrac{5}{7.5} = \dfrac{BC}{EF} = \dfrac{8}{DE}$ $\quad [\because \angle A = 30°, \angle C = 50° \therefore \angle B = 100°]$

$\Rightarrow \quad \angle F = 100°$ and $DE = 12$ cm.

EXAMPLE 8 *In triangles ABC and DEF, $\angle B = \angle E, \angle F = \angle C$ and $AB = 3$ DE. Then, the two triangles are*

(a) *congruent but not similar*
(b) *similar but not congruent*
(c) *neither congruent nor similar*
(d) *congruent as well as similar* [NCERT EXEMPLAR]

Ans. (b)

SOLUTION In triangles ACB and DEF, it is given that $\angle B = \angle E, \angle F = \angle C$. So by AA-criterion of similarity $\Delta ABC \sim \Delta DEF$. It is also given that $AB = 3DE$. So, ΔABC is not congruent to ΔDEF as $AB \neq DE$. Thus $\Delta ABC \sim \Delta DEF$ but ΔABC is not congruent to ΔDEF.

EXAMPLE 9 *If $\Delta PQR \sim \Delta ABC$; $PQ = 6$ cm, $AB = 8$ cm and the perimeter of ΔABC is 36 cm, then perimeter of ΔPQR is*

(a) 20.25 *cm* (b) 27 *cm* (c) 48 *cm* (d) 64 *cm*

Ans. (b) [CBSE 2023]

SOLUTION $\Delta PQR \sim \Delta ABC$

$$\Rightarrow \frac{PQ}{AB} = \frac{\text{Perimeter of } \Delta PQR}{\text{Perimeter of } \Delta ABC} \Rightarrow \frac{6}{8} = \frac{\text{Perimeter of } \Delta PQR}{36} \Rightarrow \text{Perimeter of } \Delta PQR = \frac{36 \times 6}{8} \text{ cm} = 27 \text{ cm}$$

EXAMPLE 10 *If in two triangles ABC and PQR, $\dfrac{AB}{QR} = \dfrac{BC}{PR} = \dfrac{CA}{PQ}$, then*

(a) $\Delta PQR \sim \Delta CAB$ (b) $\Delta PQR \sim \Delta ABC$ (c) $\Delta CBA \sim \Delta PQR$ (d) $\Delta BCA \sim \Delta PQR$

Ans. (a)

SOLUTION It is given that

$$\frac{AB}{QR} = \frac{BC}{RP} = \frac{CA}{PQ} \Rightarrow A \leftrightarrow Q, B \leftrightarrow R, C \leftrightarrow P \Rightarrow \Delta PQR \sim CAB$$

EXAMPLE 11 *In ΔABC and ΔPQR, we have $AB = 4.5$ cm $BC = 5$ cm, $CA = 6\sqrt{2}$ cm, $PQ = 10$ cm, $QR = 9$ cm, $PR = 12\sqrt{2}$ cm. If $\angle A = 75°$ and $\angle B = 55°$, then $\angle P =$*

(a) 75° (b) 55° (c) 50° (d) 130°

Ans. (c)

SOLUTION In ΔABC and ΔPQR, we find that

$$\frac{AB}{QR} = \frac{BC}{QP} = \frac{CA}{PR} \Rightarrow \Delta ABC \sim \Delta RQP \Rightarrow \angle A = \angle R, \angle B = \angle Q \text{ and } \angle C = \angle P \Rightarrow \angle R = 75°, \angle Q = 55°$$

Using angle sum property in ΔPQR,, we obtain

$$\angle P + \angle Q + \angle R = 180° \Rightarrow \angle P + 55° + 75° = 180° \Rightarrow \angle P = 50°$$

EXAMPLE 12 *ΔABC is such that $AB = 3$ cm, $BC = 2$ cm, $CA = 2.5$ cm. If $\Delta ABC \sim \Delta DEF$ and $EF = 4$ cm, then perimeter of ΔDEF is*

(a) 7.5 cm (b) 15 cm (c) 22.5 cm (d) 30 cm

Ans. (b)

SOLUTION It is given that

$\Delta ABC \sim \Delta DEF$

$\Rightarrow \quad \dfrac{AB}{DE}=\dfrac{BC}{EF}=\dfrac{AC}{DF}=\dfrac{AB+BC+CA}{DE+EF+DF}$

$\Rightarrow \quad \dfrac{BC}{FE}=\dfrac{3+2+2.5}{\text{Perimeter of } \Delta DEF} \Rightarrow \dfrac{4}{2}=\dfrac{7.5}{\text{Perimeter of } \Delta DEF} \Rightarrow$ Perimeter of ΔDEF = 15 cm.

EXAMPLE 13 *If in ΔABC and ΔDEF, $\dfrac{AB}{DE}=\dfrac{BC}{FD}$, then they will be similar, when*

(a) $\angle B=\angle E$ (b) $\angle A=\angle D$ (c) $\angle B=\angle D$ (d) $\angle A=\angle F$

Ans. (c) [NCERT EXEMPLAR]

SOLUTION We have,

$$\frac{AB}{DE}=\frac{BC}{FD} \Rightarrow \frac{AB}{ED}=\frac{BC}{DF} \Rightarrow A \leftrightarrow E, B \leftrightarrow D \text{ and } C \leftrightarrow F$$

Thus, $\Delta ABC \sim \Delta EDF$ and hence $\angle A=\angle E$, $\angle B=\angle D$ and $\angle C=\angle F$.

EXAMPLE 14 *In Fig. 7.7, $\angle ACB=\angle CDA$, AC= 8 cm, AD = 3 cm, then BD =*

(a) $\dfrac{22}{3}$ cm (b) $\dfrac{26}{3}$ cm (c) $\dfrac{55}{3}$ cm (d) $\dfrac{64}{3}$ cm

Ans. (c)

SOLUTION In triangles ACB and CDA, we find that

$\angle ACB=\angle CDA$ [Given]

and $\angle CAB=\angle CAD$

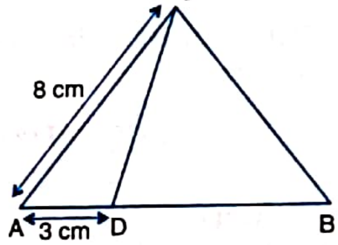

Fig. 7.7

So, by using AA-criterion of similarity, we obtain

$$\Delta ACB \sim \Delta ADC \Rightarrow \frac{AC}{AD}=\frac{AB}{AC} \Rightarrow \frac{8}{3}=\frac{AD+DB}{8} \Rightarrow \frac{64}{3}=3+DB \Rightarrow DB=\frac{55}{3}\text{ cm}$$

EXAMPLE 15 *If ΔABC and ΔDEF, $\dfrac{AB}{DE}=\dfrac{BC}{FD}$. Which of the following makes the two triangles similar?*

(a) $\angle A=\angle D$ (b) $\angle B=\angle D$ (c) $\angle B=\angle E$ (d) $\angle A=\angle F$

[CBSE 2023]

Ans. (b)

SOLUTION We have,

$$\frac{AB}{DE}=\frac{BC}{FD} \Rightarrow \frac{AB}{BC}=\frac{ED}{DF} \therefore \Delta ABC \sim \Delta EDF \text{ if } \angle B=\angle D$$

EXAMPLE 16 *In ΔABC, $DE \parallel AB$. If AB = a, DE = x, BE = b and EC = c. Then, x =*

(a) $\dfrac{ac}{b}$ (b) $\dfrac{ac}{b+c}$ (c) $\dfrac{ab}{c}$ (d) $\dfrac{ab}{b+c}$

[CBSE Sample Paper 2024]

Ans. (b)

SOLUTION Given that $DE \parallel AB$

$\therefore \quad \dfrac{AB}{DE}=\dfrac{BC}{EC}$

$\Rightarrow \quad \dfrac{a}{x}=\dfrac{b+c}{c} \Rightarrow x=\dfrac{ac}{b+c}$

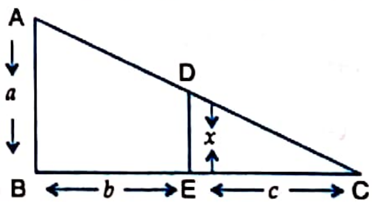

Fig. 7.8

EXAMPLE 17 *If in Fig. 7.9, $\angle BAC=90°$ and $AD \perp BC$, then*

(a) $BD \times CD=BC^2$ (b) $AB \times AC=BC^2$ (c) $BD \times CD=AD^2$ (d) $AB \times AC=AD^2$

[NCERT EXEMPLAR]

Ans. (c)

SOLUTION In triangles ABD and ABC, we find that

$\angle ADB = \angle BAC$ [Each equal to 90°]

and, $\angle ABD = \angle ABC$ [Common]

So, by using AA-criterion of similarity, we obtain

$\Delta BDA \sim \Delta BAC$ ...(i)

Similarly, $\Delta ADC \sim \Delta BAC$ ...(ii)

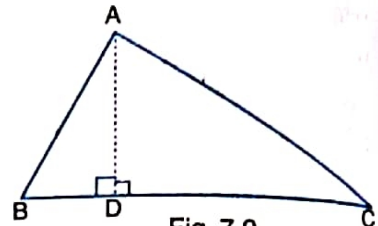

Fig. 7.9

From (i) and (ii), we obtain

$$\Delta BDA \sim \Delta ADC \Rightarrow \frac{BD}{AD} = \frac{DA}{DC} = \frac{BA}{AC} \Rightarrow BD \times DC = AD^2$$

ALITER In a right triangle perpendicular drawn from the vertex of right angle to the hypotenuse, divides the triangle into two similar triangles.

$$\therefore \quad \Delta ADB \sim \Delta CDA \Rightarrow \frac{AD}{CD} = \frac{DB}{DA} \Rightarrow AD^2 = BD \times CD.$$

EXAMPLE 18 *In ΔABC, $\angle B = 90°$, $BD \perp AC$. If $AC = 9$ cm and $AD = 3$ cm, then BD is equal to*

(a) $2\sqrt{2}$ cm (b) $3\sqrt{2}$ cm (c) $2\sqrt{3}$ cm (d) $3\sqrt{3}$ cm

Ans. (b)

SOLUTION By using the result given in the above example, we obtain

$$BD^2 = AD \times CD = 3 \times 6 = 18 \Rightarrow BD = 3\sqrt{2}\text{cm}.$$

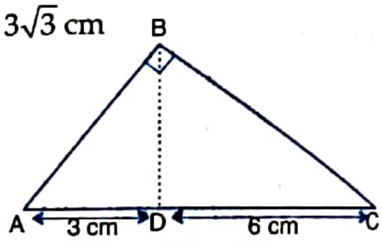

Fig. 7.10

EXAMPLE 19 *Sides AB and BE of a right triangle, right angled at B are of lengths 16 cm and 8 cm respectively. The length of the side of largest square FDGB that can be inscribed in the triangle ABE is*

(a) $\frac{32}{3}$ cm (b) $\frac{16}{3}$ cm (c) $\frac{8}{3}$ cm (d) $\frac{4}{3}$ cm

Ans. (b)

SOLUTION Let the length of a side of the square be x cm. In triangles AFD and DGE, we find that

$\angle AFD = \angle EGD$ [Each equal to 90°]

and, $\angle ADF = \angle DEG$

So, by using AA-similarity criterion, we obtain

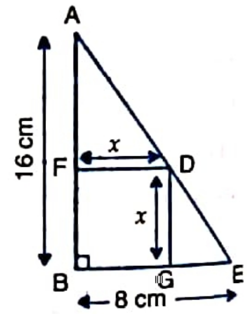

Fig. 7.11

$$\Rightarrow \quad \Delta AFD \sim \Delta DGE \Rightarrow \frac{AF}{DG} = \frac{FD}{GE} \Rightarrow \frac{16-x}{x} = \frac{x}{8-x} \Rightarrow 128 - 24x + x^2 = x^2 \Rightarrow x = \frac{16}{3}\text{cm}$$

EXAMPLE 20 *If in two triangles DEF and PQR, $\angle D = \angle Q$ and $\angle R = \angle E$, then which of the following is not true?*

(a) $\frac{EF}{PR} = \frac{DF}{PQ}$ (b) $\frac{DE}{PQ} = \frac{EF}{RP}$ (c) $\frac{DE}{QR} = \frac{DF}{PQ}$ (d) $\frac{EF}{RP} = \frac{DE}{QR}$

Ans. (b) [NCERT EXEMPLAR]

SOLUTION It is given that $\angle D = \angle Q$ and $\angle R = \angle E$. So, by using AA-criterion of similarity, we obtain

$$\Delta DEF \sim \Delta QRP \Rightarrow \frac{DE}{QR} = \frac{EF}{PR} = \frac{DF}{PQ} \Rightarrow \frac{EF}{PR} = \frac{DF}{PQ}, \frac{DE}{QR} = \frac{EF}{PR}, \frac{DE}{QR} = \frac{DF}{PQ}$$

Hence, option (a), (c) and (d) are true but option (b) is not true.

EXAMPLE 21 *If $\Delta ABC \sim \Delta EDF$ and ΔABC is not similar to ΔDEF, then which of the following is not true?*

(a) $BC \times EF = AC \times FD$ (b) $AB \times EF = AC \times DE$ (c) $BC \times DE = AB \times EF$ (d) $BC \times DE = AB \times FD$

Ans. (c) [NCERT EXEMPLAR]

SOLUTION Given that $\Delta ABC \sim \Delta EDF$ and ΔABC is not similar to ΔDEF.

$$\therefore \quad \frac{AB}{ED} = \frac{BC}{DF} = \frac{AC}{EF} \text{ and either } \frac{AB}{DE} \neq \frac{BC}{EF} \text{ or, } \frac{BC}{EF} \neq \frac{AC}{DF} \text{ or, } \frac{AB}{DE} \neq \frac{AC}{DF}$$

$$\Rightarrow \quad \frac{AB}{ED} = \frac{BC}{DF}, \frac{AB}{ED} = \frac{AC}{EF} \text{ and } \frac{BC}{DF} = \frac{AC}{EF}$$

$$\Rightarrow \quad AB \times DF = BC \times ED, AB \times EF = AC \times ED, BC \times EF = AC \times DF$$

$\Rightarrow$ Options (d), (b) and (a) are true.

EXAMPLE 22 *In Fig. 7.12, two line segments AC and BD intersect each other at the point P such that $PA = 6$ cm, $PB = 3$ cm, $PC = 2.5$ cm, $PD = 5$ cm, $\angle APB = 50°$ and $\angle CDP = 30°$. Then $\angle PBA$ is equal to*

(a) 50° (b) 30° (c) 60° (d) 100°

Ans. (d) [NCERT EXEMPLAR]

SOLUTION In triangles *PAB* and *PDC*, we have

$$\frac{PA}{PD} = \frac{PB}{PC} \text{ and } \angle APB = \angle CPD \qquad \text{[Vertically opposite angles]}$$

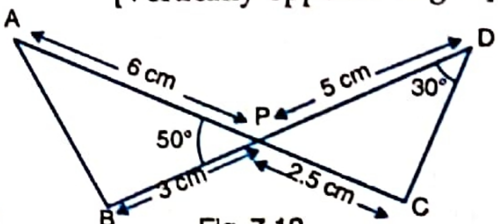

Fig. 7.12

So, by using *SAS*-criterion of similarity, we obtain

$$\Delta PBA \sim \Delta PDC \Rightarrow \angle D = \angle A \Rightarrow \angle A = 30°$$

Applying angle sum property in ΔPAB, we obtain

$$\angle P + \angle A + \angle B = 180° \Rightarrow 50° + 30° + \angle B = 180° \Rightarrow \angle B = 100°$$

EXAMPLE 23 *ΔABC is such that $AB = 3$ cm, $BC = 2$ cm, $CA = 2.5$ cm. If $\Delta ABC \sim \Delta DEF$ and $EF = 4$ cm, then perimeter of ΔDEF is*

(a) 7.5 cm (b) 15 cm (c) 22.5 cm (d) 30 cm

Ans. (b)

SOLUTION Given that $\Delta ABC \sim \Delta DEF$.

$$\therefore \quad \frac{AB}{DE} = \frac{BC}{EF} = \frac{AC}{DF} = \frac{AB+BC+CA}{DE+EF+DF} \Rightarrow \frac{2}{4} = \frac{3+2+2.5}{\text{Perimeter of } \Delta DEF} \Rightarrow \text{Perimeter of } \Delta DEF = 15 \text{ cm}$$

EXAMPLE 24 *In Fig. 7.13, if $DE \parallel BC$, $AD = 3$ cm, $BD = 4$ cm and $BC = 14$ cm, then DE equals*

(a) 7 cm (b) 6 cm (c) 4 cm (d) 3 cm

Ans. (b)

SOLUTION It is given that $DE \parallel BC$. Therefore,

$$\Delta ADE \sim \Delta ABC \Rightarrow \frac{AD}{AB} = \frac{DE}{BC} \Rightarrow \frac{3}{3+4} = \frac{DE}{14} \Rightarrow DE = 6 \text{ cm}$$

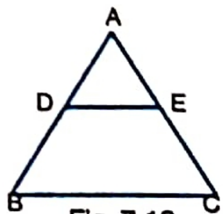

Fig. 7.13

EXAMPLE 25 *In Fig. 7.14, $DE \parallel BC$. Which of the following is true?*

(a) $x = \frac{a+b}{ay}$ (b) $y = \frac{ax}{a+b}$ (c) $x = \frac{ay}{a+b}$ (d) $\frac{x}{y} = \frac{a}{b}$

Ans. (c)

SOLUTION It is given that $DE \parallel BC$. Therefore,

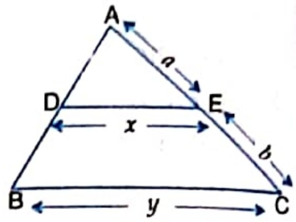

Fig. 7.14

$$\Delta ADE \sim \Delta ABC \Rightarrow \frac{AE}{AC} = \frac{DF}{BC} \Rightarrow \frac{a}{a+b} = \frac{x}{y}$$

$$\Rightarrow \qquad x = \frac{ay}{a+b} \text{ and } y = \frac{(a+b)x}{a}$$

EXAMPLE 26 *If AM and PN are altitudes of* ΔABC *and* ΔPQR *respectively. If* $\Delta ABC \sim \Delta PQR$ *and* $AB^2 : PQ^2 = 4:9$, *then* $AM : PN =$

(a) 16 : 81 (b) 4 : 9 (c) 3 : 2 (d) 2 : 3

Ans. (d)

SOLUTION Given that $\Delta ABC \sim \Delta PQR \Rightarrow \frac{AB}{PQ} = \frac{AM}{PN} \Rightarrow \frac{AM}{PN} = \frac{2}{3}$

EXAMPLE 27 *In Fig. 7.15, AB* $\parallel$ *PQ. If AB = 6 cm, PQ = 2 cm and OB = 3 cm, then the length of OP is*

(a) 9 cm (b) 3 cm (c) 4 cm (d) 1 cm

Ans. (d) [CBSE 2023]

SOLUTION In ΔOAB and OQP, we have

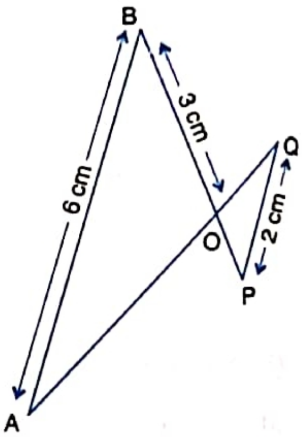

Fig. 7.15

$$\angle AOB = \angle QOP, \angle OAB = \angle OQP \text{ and } \angle OBA = \angle OPQ$$

So, by AAA criterion of similarity, we obtain

$$\Rightarrow \qquad \Delta OAB \sim \Delta OQP$$

$$\Rightarrow \qquad \frac{AB}{QP} = \frac{OB}{OP} \Rightarrow \frac{6}{2} = \frac{3}{OP} \Rightarrow OP = 1\text{cm}$$

CASE STUDY BASED EXAMPLES

EXAMPLE 28 *Vijay is trying to find the average height of a tower near his house. He is using the properties of similar triangles. The height of Vijay's house is 20 meter. Wen Vijay's house casts a shadow 10 m long on the ground at the same time, the tower casts a shadows 50 m long on the ground and the house of Ajay casts 20 m shadow on the ground. Based on the above information answer the following questions.*

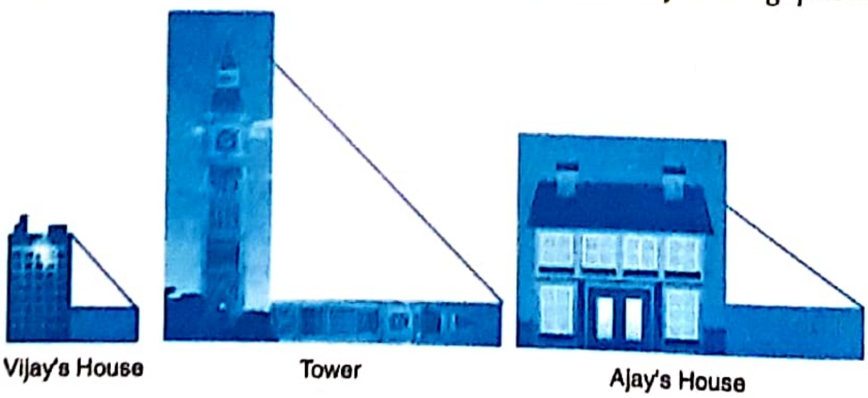

Fig. 7.16

(i) *The height of the tower is*

(a) 20 m (b) 50 m (c) 100 m (d) 200 m

(ii) *When Vijay's house casts a shadow of 12 m, the length of the shadow of the tower is*
(a) 75 m (b) 50 m (c) 45 m (d) 60 m

(iii) *The height of Ajay's house is*
(a) 30 m (b) 40 m (c) 50 m (d) 20 m

(iv) *When the tower casts a shadow of 40 m, the length of the shadow of Ajay's house is*
(a) 16 m (b) 32 m (c) 20 m (d) 8 m

(v) *When the tower casts a shadow of 40 m, the length of the shadow of Vijay's house is*
(a) 15 m (b) 32 m (c) 16 m (d) 8 m

SOLUTION Three triangles formed by Vijay's house, tower and Ajay's house are shown in Fig. 7.17 these are similar triangles.

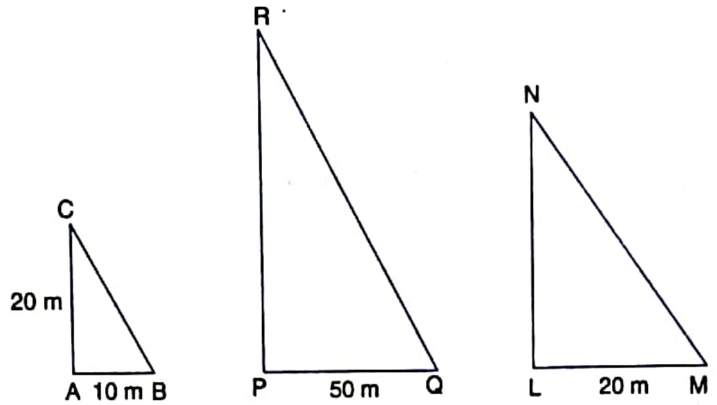

Fig. 7.17

$$\therefore \quad \frac{AC}{AB} = \frac{PR}{PQ} = \frac{LN}{LM} \quad \text{... (i)}$$

$$\Rightarrow \quad \frac{20}{10} = \frac{PR}{50} = \frac{LN}{20} \Rightarrow 2 = \frac{PR}{50} \text{ and } 2 = \frac{LN}{20} \Rightarrow PR = 100 \text{ and } LN = 40 \quad \text{...(ii)}$$

(i) **Ans.** (c): From (ii), we obtain PR = Height of tower = 100 m.

(ii) **Ans.** (c): From (i), we obtain

$$\frac{AC}{AB} = \frac{PR}{PQ}$$

$$\Rightarrow \quad \frac{20}{12} = \frac{100}{PQ} \quad \left[\text{From (i), we obtain } PR = 100, AC = 20 \text{ and } AB = 12 \text{ (given)}\right]$$

$$\Rightarrow \quad PQ = 60 \text{ cm}$$

(iii) **Ans.** (b): From (ii), we obtain $LN = 40$ cm.

(iv) **Ans.** (c): From (i), we obtain $\frac{PR}{PQ} = \frac{LN}{LM}$. When $PQ = 40, LN = 40$ and $PR = 100$, we obtain

$$\frac{100}{40} = \frac{40}{LM} \Rightarrow LM = 16$$

(v) From (i), we obtain: $\frac{AC}{AB} = \frac{PR}{PQ}$. When $PQ = 40$ m, $PR = 100$ m and $AC = 20$ m, we obtain

$$\frac{20}{AB} = \frac{100}{40} \Rightarrow AB = 8$$

ASSERTION-REASON BASED MCQs

Each of the following examples contains STATEMENT-1 (Assertion) and STATEMENT-2 (Reason) and has following four choices (a), (b), (c) and (d), only one of which is the correct answer. Mark the correct choice.

(a) Statement-1 and Statement-2 are True; Statement-2 is a correct explanation for Statement-1.

(b) Statement-1 and Statement-2 are True; Statement-2 is not a correct explanation for Statement-1.

(c) Statement-1 is True, Statement-2 is False.

(d) Statement-1 is False, Statement-2 is True.

EXAMPLE 29 *Statement-1 (A): Let ΔPQR be a right triangle right angled at Q such that the perpendicular drawn from Q on hypotenuse PR meets PR at S. If PS = 4 cm and RS = 9 cm, then QS = 6 cm.*

Statement-2 (R): In a right triangle, the square of the perpendicular drawn from the vertex forming right angle to the hypotenuse is equal to the product of projections of two sides on the hypotenuse.

Ans. (a)

SOLUTION Let ABC be a right triangle right angled at A and AD be perpendicular drawn from A on hypotenuse BC.

In Δ's ADB and CDA, we have

$$\angle ADB = \angle CDA \qquad \text{[Each equal to 90°]}$$

and, $$\angle DAB = \angle DCA$$

So, by using AA-criterion of similarity, we obtain

$$\Delta ADB \sim \Delta CDA \Rightarrow \frac{AD}{CD} = \frac{DB}{DA} \Rightarrow AD^2 = BC \times CD$$

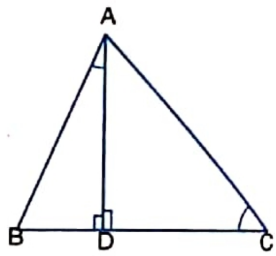

Fig. 7.18

Thus, statement-2 is true. Using statement-2, we find that in ΔPQR.

$$QS^2 = PS \times RS \Rightarrow QS^2 = 4 \times 9 = 36 \Rightarrow QS = 6 \text{ cm}$$

So, statement-1 is also true and statement-2 is a correct explanation for statement-1.
Hence, option (a) is correct.

EXAMPLE 30 *Statement-1 (A): In ΔABC, if $AB = 24$ cm, $BC = 10$ cm and $AC = 26$ cm, then ΔABC is a right angled triangle.*

Statement-2 (R): If corresponding sides of two triangles are equal, then the triangles are similar.

Ans. (b)

SOLUTION We find that in ΔABC, $AC^2 = AB^2 + BC^2$ holds good.

Thus, by using the converse of Pythagoras theorem, ΔABC is a right angled triangle. So, statement-1 is true.

Let ABC and PQR be two triangles such that their corresponding sides are equal i.e. $AB = PQ$, $BC = QR$ and $AC = PR$. Then,

$$\frac{AB}{PQ} = \frac{BC}{QR} = \frac{AC}{PR} \Rightarrow \Delta ABC \sim \Delta PQR$$

So, statement-2 is true. But, it is not a correct explanation for statement-1.
Hence, option (b) is correct.

EXAMPLE 31 *Statement-1 (A): Let ΔABC and ΔDEF be right triangles right angled at B and E respectively. If AC = 5 cm, BC = 4 cm, DF = 15 cm and EF = 12 cm, then $\angle A = \angle D$ and $\angle C = \angle F$.*

Statement-2 (R): If in two right triangles, hypotenuse and one side of one triangle are proportional to the hypotenuse and one side of the other triangle, then the triangles are similar.

Ans. (a)

SOLUTION Statement-2 is the *RHS*-similarity criterion, so it is true.

In right triangles *ABC* and *DEF*, we find that *AC* and *DF* are hypotenuse such that $\frac{AC}{DF} = \frac{BC}{EF} = \frac{1}{3}$.

Therefore, by using statement-2, we obtain

$$\Delta ABC \sim \Delta DEF \Rightarrow \angle A = \angle D \text{ and } \angle C = \angle F$$

So, statement-1 is also true and statement-2 is a correct explanation for statement-1.
Hence, option (a) is correct.

EXAMPLE 32 *Statement-1 (A): If in ΔABC, D and E are points on sides AB and AC respectively such that DE ∥ BC, then* $\frac{AD}{AB} = \frac{AE}{AC}$.

Statement-2 (R): If a line is drawn parallel to one side of a triangle intersecting the other two sides, then it divides the two sides in the same ratio.

Ans. (a)

SOLUTION We find that statement-2, being well known BP T, is true. Using statement-2, we obtain

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

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

$$\Rightarrow \frac{DB}{AD} + 1 = \frac{EC}{AE} + 1$$

$$\Rightarrow \frac{DB + AD}{AD} = \frac{EC + AE}{AE} \Rightarrow \frac{AB}{AD} = \frac{AC}{AE} \Rightarrow \frac{AD}{AB} = \frac{AE}{AC}$$

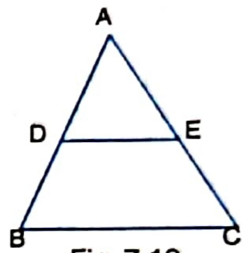

Fig. 7.19

So, statement-2 is true. Also, statement-2 is a correct explanation for statement-1.
Hence, option (a) is correct.

PRACTICE EXERCISES

MULTIPLE CHOICE QUESTIONS (MCQs)

Mark the correct alternative in each of the following:

1. If Δ *ABC* and Δ *DEF* are similar such that 2 *AB* = *DE* and *BC* = 8 cm, then *EF* =
   (a) 16 cm (b) 12 cm (c) 8 cm (d) 4 cm.
2. *XY* is drawn parallel to the base *BC* of a Δ *ABC* cutting *AB* at *X* and *AC* at *Y*. If *AB* = 4 *BX* and *YC* = 2 cm, then *AY* =
   (a) 2 cm (b) 4 cm (c) 6 cm (d) 8 cm.
3. Two poles of height 6 m and 11 m stand vertically upright on a plane ground. If the distance between their foot is 12 m, the distance between their tops is
   (a) 12 m (b) 14 m (c) 13 m. (d) 11 m
4. In Δ *ABC*, *D* and *E* are points on side *AB* and *AC* respectively such that *DE* ∥ *BC* and *AD* : *DB* = 3 : 1. If *EA* = 3.3 cm, then *AC* =
   (a) 1.1 cm (b) 4 cm (c) 4.4 cm (d) 5.5 cm
5. In triangles *ABC* and *DEF*, ∠ *A* = ∠ *E* = 40°, *AB* : *ED* = *AC* : *EF* and ∠ *F* = 65°, then ∠ *B* =
   (a) 35° (b) 65° (c) 75° (d) 85°
6. If *ABC* and *DEF* are similar triangles such that ∠ *A* = 47° and ∠ *E* = 83°, then ∠ C =
   (a) 50° (b) 60° (c) 70° (d) 80°
7. In a Δ *ABC*, *AD* is the bisector of ∠ *BAC*. If *AB* = 6 cm, *AC* = 5 cm and *BD* = 3 cm, then *DC* =
   (a) 11.3 cm (b) 2.5 cm (c) 3 : 5 cm (d) none of these
8. In a Δ *ABC*, *AD* is the bisector of ∠ *BAC*. If *AB* = 8 cm, *BD* = 6 cm and *DC* = 3 cm, then *AC*
   (a) 4 cm (b) 6 cm (c) 3 cm (d) 8 cm

9. $ABCD$ is a trapezium such that $BC \parallel AD$ and $AB = 4$ cm. If the diagonals AC and BD intersect at O such that $\frac{AO}{OC} = \frac{DO}{OB} = \frac{1}{2}$, then $BC =$

(a) 7 cm (b) 8 cm (c) 9 cm (d) 6 cm

10. If in ΔABC and ΔDEF, $\frac{AB}{DE} = \frac{BC}{FD}$, then $\Delta ABC \sim \Delta EDF$ when

(a) $\angle A = \angle F$ (b) $\angle A = \angle D$ (c) $\angle B = \angle D$ (d) $\angle B = \angle E$

11. If in two triangles ABC and DEF, $\frac{AB}{DE} = \frac{BC}{FE} = \frac{CA}{FD}$, then

(a) $\Delta FDE \sim \Delta CAB$ (b) $\Delta FDE \sim \Delta ABC$ (c) $\Delta CBA \sim \Delta FDE$ (d) $\Delta BCA \sim \Delta FDE$

12. If in two triangles ABC and DEF, $\angle A = \angle E, \angle B = \angle F$, then which of the following is not true?

(a) $\frac{BC}{DF} = \frac{AC}{DE}$ (b) $\frac{AB}{DE} = \frac{BC}{DF}$ (c) $\frac{AB}{EF} = \frac{AC}{DE}$ (d) $\frac{BC}{DF} = \frac{AB}{EF}$

13. In Fig. 7.20 the measures of $\angle D$ and $\angle F$ are respectively

(a) 50°, 40° (b) 20°, 30° (c) 40°, 50° (d) 30°, 20°

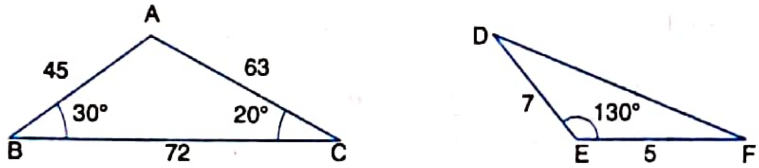

Fig. 7.20

14. In Fig. 7.21, the value of x for which $DE \parallel BC$ is

(a) 4 (b) 1 (c) 3 (d) 2

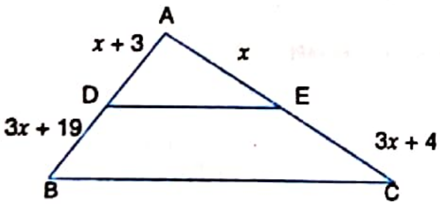

Fig. 7.21

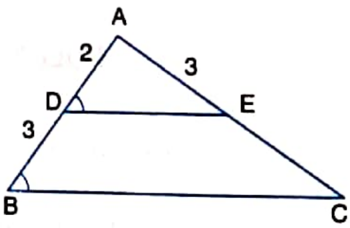

Fig. 7.22

15. In Fig. 7.22, if $\angle ADE = \angle ABC$, then $CE =$

(a) 2 (b) 5 (c) 9/2 (d) 3

16. In Fig. 7.23, $RS \parallel DB \parallel PQ$. If $CP = PD = 11$ cm and $DR = RA = 3$ cm. Then the values of x and y are respectively

(a) 12, 10 (b) 14, 6 (c) 10, 7 (d) 16, 8

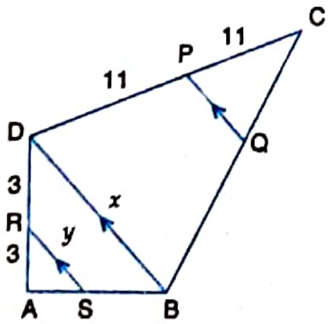

Fig. 7.23

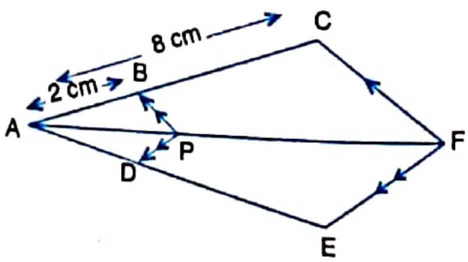

Fig. 7.24

17. In Fig. 7.24, if $PB \parallel CF$ and $DP \parallel EF$, then $\frac{AD}{DE} =$

(a) $\frac{3}{4}$ (b) $\frac{1}{3}$ (c) $\frac{1}{4}$ (d) $\frac{2}{3}$

18. ΔABC is such that $AB = 3$ cm, $BC = 2$ cm and $CA = 2.5$ cm. If $\Delta DEF \sim \Delta ABC$ and $EF = 4$ cm, then perimeter of ΔDEF is
(a) 7.5 cm (b) 15 cm (c) 22.5 cm (d) 30 cm.

19. In ΔABC, a line XY parallel to BC cuts AB at X and AC at Y. If BY bisects $\angle XYC$, then
(a) $BC = CY$ (b) $BC = BY$ (c) $BC \neq CY$ (d) $BC \neq BY$

20. In a ΔABC, perpendicular AD from A on BC meets BC at D. If $BD = 8$ cm, $DC = 2$ cm and $AD = 4$ cm, then
(a) ΔABC is isosceles (b) ΔABC is equilateral
(c) $AC = 2AB$ (d) ΔABC is right-angled at A.

21. If $\Delta ABC \sim \Delta DEF$ such that $DE = 3$ cm, $EF = 2$ cm, $DF = 2.5$ cm, $BC = 4$ cm, then perimeter of ΔABC is
(a) 18 cm (b) 20 cm (c) 12 cm (d) 15 cm

22. If $\Delta ABC \sim \Delta DEF$ such that $AB = 9.1$ cm and $DE = 6.5$ cm. If the perimeter of ΔDEF is 25 cm, then the perimeter of ΔABC is
(a) 36 cm (b) 30 cm (c) 34 cm (d) 35 cm

23. In an isosceles triangle ABC, if $AB = AC = 25$ cm and $BC = 14$ cm, then the measure of altitude from A on BC is
(a) 20 cm (b) 22 cm (c) 18 cm (d) 24 cm

24. In ΔPQR, $\angle Q = 90°$, $PQ = 5$ cm, $QR = 12$ cm. If $QS \perp PR$, then QS is equal to
(a) $\frac{80}{13}$ cm (b) $\frac{13}{5}$ cm (c) $\frac{60}{13}$ cm (d) $\frac{12}{5}$ cm

25. In Fig. 7.25, $PQRS$ is a parallelogram, if $AT = AQ = 6$ cm, $AS = 3$ cm and $TS = 4$ cm, then
(a) $x = 4, y = 5$ (b) $x = 2, y = 3$ (c) $x = 1, y = 2$ (d) $x = 3, y = 4$

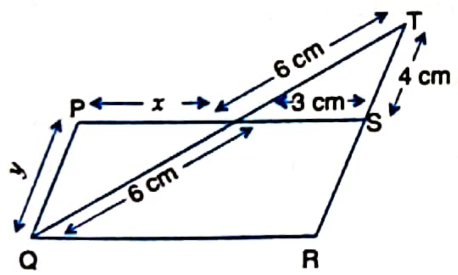

Fig. 7.25

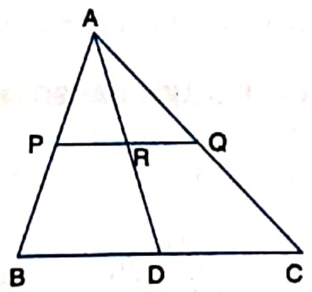

Fig. 7.26

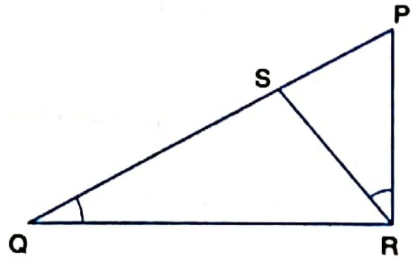

Fig. 7.27

26. In Fig. 7.26, if $AP = 3$ cm, $AR = 4.5$ cm, $AQ = 6$ cm, $AB = 5$ cm and $AC = 10$ cm, then AD is equal to
(a) 5.7 cm (b) 7.6 cm (c) 5.5 cm (d) 7.5 cm

27. In Fig. 7.27, $\angle PQR = \angle PRS$. If $PR = 8$ cm, $PS = 4$ cm, then $PQ =$
(a) 12 cm (b) 16 cm (c) 32 cm (d) 24 cm

28. If $\Delta PQR \sim \Delta XYZ$ and $XY = 4$ cm, $YZ = 4.5$ cm, $ZX = 6.5$ cm and $PQ = 8$ cm, then perimeter of ΔPQR is
(a) 25 cm (b) 23 cm (c) 15 cm (d) 30 cm

29. Consider the following three statements about a triangle ABC with side lengths m, n and r.
S-1 ABC is a right triangle provided $n^2 - m^2 = r^2$.
S-2 Triangle with side lengths $m+2$, $n+2$ and $r+2$ is a right angle triangle.
S-3 Triangle with sides $2m$, $2n$ and $2r$ is a right-angle triangle.

Which of the following is correct?

(a) Statement S-1 would be correct if $n > m$, $n > r$ and statement S-2 would be correct if ΔABC is a right triangle.

(b) Statement S-1 would be correct if $r > m$, $r > n$ and statement S-2 would be correct if ΔABC is a right triangle.

(c) Statement S-1 would be correct if $n > m$, $n > r$ and statement S-3 would be correct if ΔABC is a right triangle.

(d) Statement S-1 would be correct if $r > m$, $r > n$ and statement S-3 would be correct if ΔABC is a right triangle.

30. Which of the following statements is correct about the triangles in the following figure?

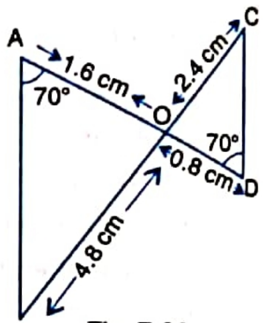

Fig. 7.28

(a) $\Delta AOB \sim \Delta DOC$ because $\frac{AO}{DO} = \frac{BO}{CO}$.

(b) $\Delta AOB \sim \Delta DOC$ because $\angle AOB = \angle DOC$.

(c) $\Delta AOB \sim \Delta DOC$ because $\frac{AO}{DO} = \frac{BO}{CO}$ and $\angle BAO = \angle CDO$.

(d) $\Delta AOB \sim \Delta DOC$ because $\frac{AO}{DO} = \frac{BO}{CO}$ and $\angle AOB = \angle DOC$.

31. Which of the following statements help in proving that ΔABO is similar to ΔDOC?

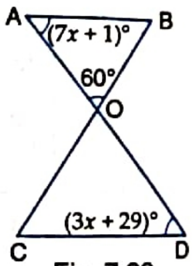

Fig. 7.29

Statement-1: $\angle B = 70°$, Statement-2: $\angle C = 70°$

(a) S-1 alone is sufficient, but S-2 alone is not sufficient.

(b) S-2 alone is sufficient, but S-1 alone is not sufficient.

(c) Each statement alone is sufficient.

(d) S-1 and S-2 together are sufficient but neither alone is sufficient.

CASE STUDY BASED MCQs

32. A scale drawing of an object is the same shape as the object but a different size. The scale of a drawing is a comparison of the length used on a drawing to the length it represents. The scale is written as a ratio.

$$\text{Scale factor} = \frac{\text{Length in image}}{\text{Corresponding length in object}}$$

If one shape can become another using resizing then the shapes are similar. The ratio of two corresponding sides in similar figures is called the scale factor.

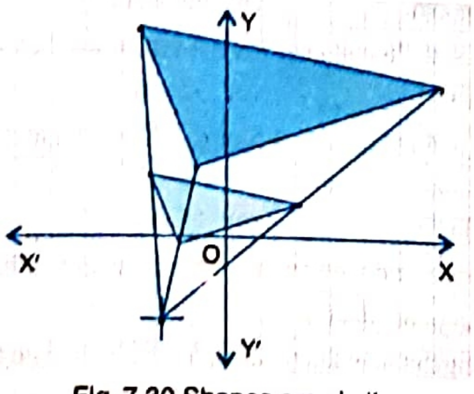

Fig. 7.30 Shapes are similar

Hence, two shapes are similar when one can become the other after a resize, flip, slide or turn.

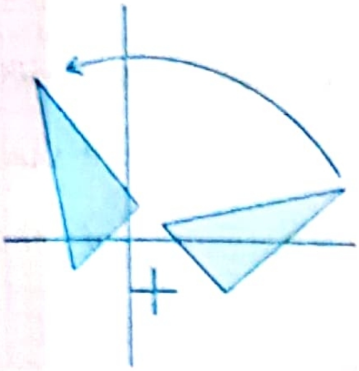

Fig. 7.31 Rotation or Turn

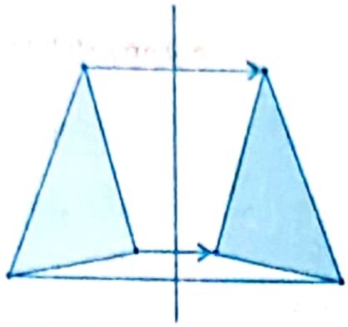

Fig. 7.32 Reflection or Flip

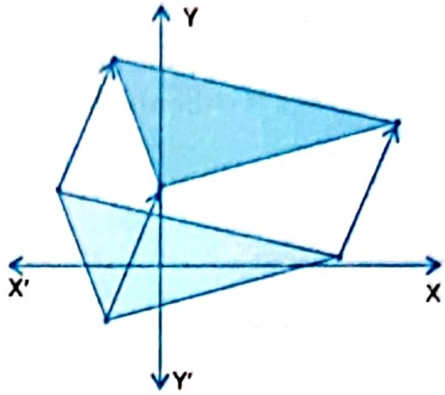

Fig. 7.33 Translation or Slide

(i) A model of a boat is made on the scale of 1 : 4. The model is 120 cm long. The full size of the boat has a width of 60 cm. What is the width of the scale model?

Fig. 7.34

(a) 20 cm (b) 25 cm (c) 15 cm (d) 240 cm

(ii) What will effect the similarity of any two polygons?
(a) They are flipped horizontally
(b) They are dilated by a scale factor
(c) They are translated down
(d) They are not the mirror image of one another

(iii) If two similar triangles have a scale factor of $a : b$. Which statement regarding the two triangles is true?
(a) The ratio of their perimeters is $3a : b$ (b) Their altitudes have a ratio $a : b$

(c) Their medians have a ratio $\frac{a}{2} : b$ (d) Their angle bisectors have a ratio $a^2 : b^2$

(iv) The shadow of a stick 5 m long is 2 m. At the same time the shadow of a tree 12.5 m high is
(a) 3 m (b) 3.5 m (c) 4.5 m (d) 5 m

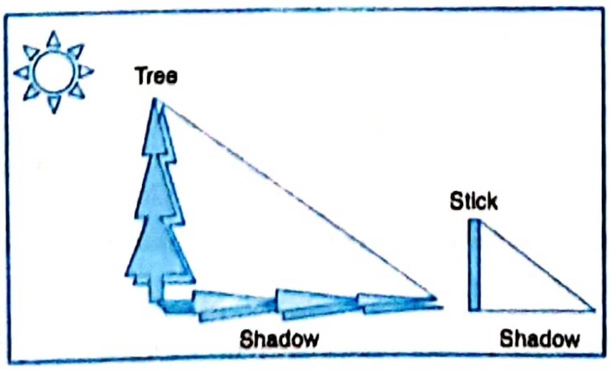

Fig. 7.35

(v) Below you see a student's mathematical model of a farmhouse roof with measurements. The attic floor, $ABCD$ in the model, is a square. The beams that support the roof are the edges of a rectangular prism, $EFGHKLMN$. E is the middle of AT, F is the middle of BT, G is the middle of CT, and H is the middle of DT. All the edges of the pyramid in the model have length of 12 m.

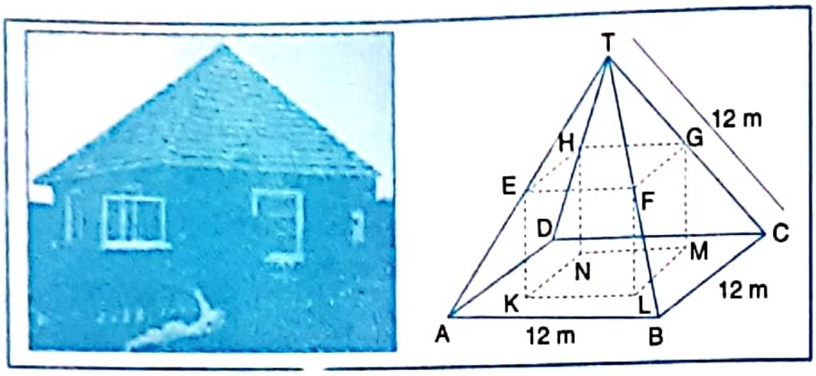

Fig. 7.36

What is the length of EF, where EF is one of the horizontal edges of the block?

(a) 24 m (b) 3 m (c) 6 m (d) 10 m

33. Rahul is studying in X standard. He is making a kite to fly it on a Sunday. Few questions came to his mind while making the kite. Give answers to his questions by looking at the figure. (Fig. 7.37).

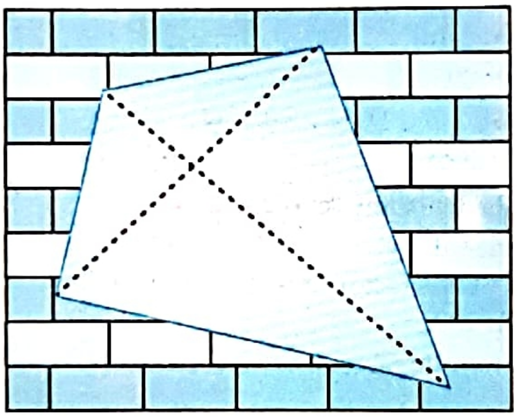

Fig. 7.37

(i) Rahul tied the sticks at what angles to each other?

(a) 30° (b) 60° (c) 90° (d) 60°

(ii) Which is the correct similarity criteria applicable for smaller triangles at the upper part of this kite?

(a) RHS (b) SAS (c) SSA (d) AAS

(iii) Sides of two similar triangles are in the ratio 4 : 9. Corresponding medians of these triangles are in the ratio

(a) 2 : 3 (b) 4 : 9 (c) 81 : 16 (d) 16 : 81

(iv) In a triangle, if square of one side is equal to the sum of the squares of the other two sides, then the angle opposite the first side is a right angle. This theorem is called as,

(a) Pythagoras theorem (b) Thales theorem
(c) Converse of Thales theorem (d) Converse of Pythagoras theorem

(v) What is the area of the kite, formed by two perpendicular sticks of length 6 cm and 8 cm ?

(a) 48 cm^2 (b) 14 cm^2 (c) 24 cm^2 (d) 96 cm^2

34. In a room a bulb is fixed at a point O on the ceiling. Just below the bulb a large table is placed as shown in Fig. 7.38. A cardboard is cut in the form of quadrilateral $ABCD$ and is fixed between

the bulb and the table. When bulb is switched on, shadow $A'B'C'D'$ of cardboard $ABCD$ is formed on the top of the table such that quadrilateral $A'B'C'D'$ is an enlargement of quadrilateral $ABCD$ with scale factor 1 : 2. If AB = 1.5 cm, BC = 2.5 cm, CD = 2.4 cm, AD = 2.1 cm, $\angle A = 105°, \angle B = 100°, \angle C = 70°$ and $\angle D = 85°$ cm, answer the following questions:

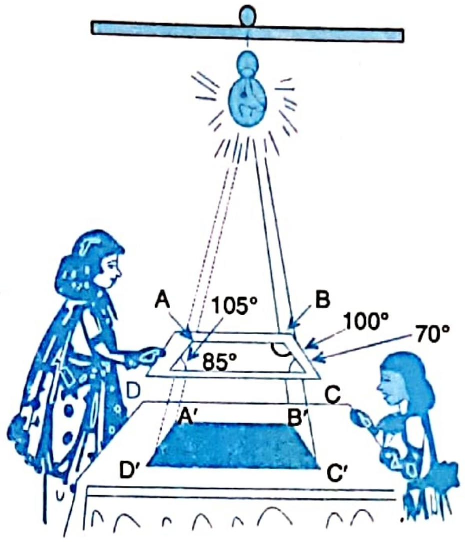

Fig. 7.38

(i) The measurement of $\angle A'$ is
(a) 105° (b) 100° (c) 70° (d) 80°

(ii) The sum of the angles $\angle A'$ and $\angle C'$ of quadrilateral $A'B'C'D'$ is
(a) 185° (b) 205° (c) 175° (d) 155°

(iii) Perimeter of quadrilateral $A'B'C'D'$ is
(a) 8.5 cm (b) 5 cm (c) 10 cm (d) 17 cm

(iv) The length of side $A'B'$ of quadrilateral $A'B'C'D'$ is
(a) 1.5 cm (b) 3 cm (c) 2.5 cm (d) 5 cm

(v) The sum of the angles C' and D' of quadrilateral $A'B'C'D'$ is
(a) 105° (b) 100° (c) 155° (d) 140°

35. Observe the below given figures carefully and answer the questions:

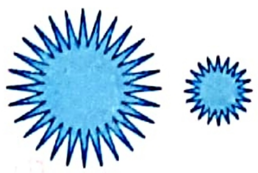

Fig. A

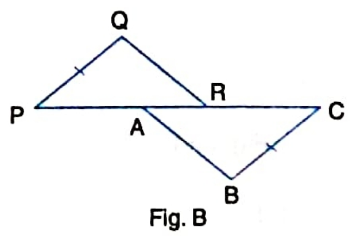

Fig. B

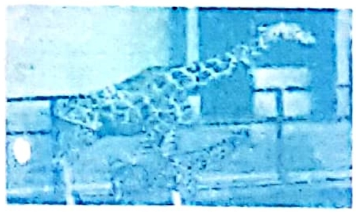

Fig. C

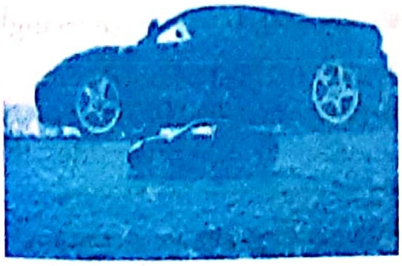

Fig. D

Fig. E

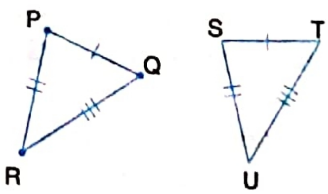

Fig. F

Fig. 7.39

(i) Which among the above shown figures are congruent figures?
(a) A and C (b) E and F (c) D and F (d) B and F

(ii) Which of the following statements is correct?
   (a) All similar figures are congruent.
   (b) All congruent figures are similar.
   (c) The criterion for similarity and congruency is same.
   (d) Similar figures have same size and shape.

(iii) If a line divides any two sides of the triangle in the same ratio, then the line is parallel to the third side. Which theorem is depicted by this statement?
   (a) Pythagoras (b) Thales Theorem
   (c) Converse of Thales theorem (d) Converse of Pythagoras theorem

(iv) Using the concept of similarity, the height of the tree is

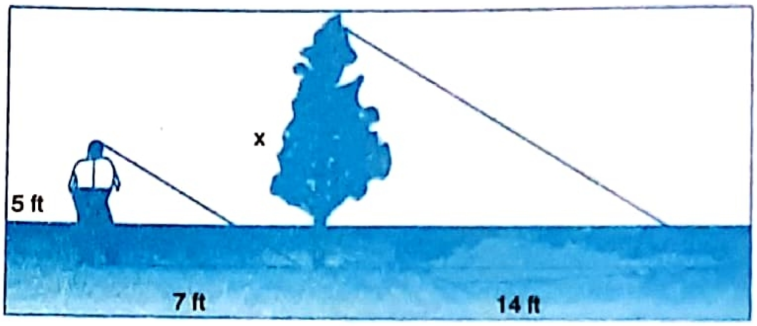

Fig. 7.40

   (a) 12 ft (b) 10 ft (c) 15 ft (d) 7 ft

(v) The height of the tree, when its shadow is 84 m long and at the same time a girl 2 m high standing in the same straight line casts a shadow 12 m is

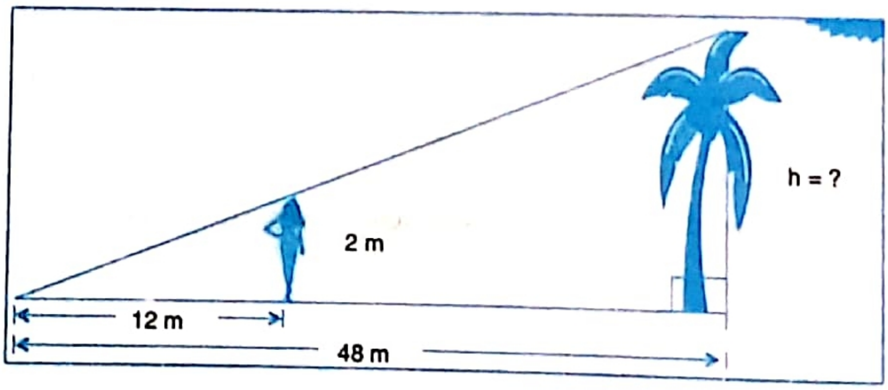

Fig. 7.41

   (a) 14 m (b) 24 m (c) 6 m (d) 12 m

ASSERTION-REASON BASED MCQs

Each of the following questions contains STATEMENT-1 (A) and STATEMENT-2 (Reason) and has following four choices (a), (b), (c) and (d), only one of which is the correct answer. Mark the correct choice.

(a) Statement-1 is true, Statement-2 is true; Statement-2 is a correct explanation for Statement-1.
(b) Statement-1 is true, Statement-2 is true; Statement-2 is not a correct explanation for Statement-1.
(c) Statement-1 is true, Statement-2 is false.
(d) Statement-1 is false, Statement-2 is true.

36. Statement-1 (A): Two similar triangles are always congruent.
    Statement-2 (R): Two congruent triangles are always similar.

37. Statement-1 (A): If ΔABC and ΔPQR are right triangles right angled at C and R respectively such that $\frac{AB}{PQ} = \frac{AC}{PR}$, then $\angle B = \angle Q$.

Statement-2 (R): If in two right triangles, hypotenuse and one side of one triangle are proportional to the hypotenuse and one side of the other triangle, then the two triangles are similar.

38. Statement-1 (A): In ΔPQR, if $PQ = 12$ cm, $QR = 9$ cm and $PR = 15$ cm, then ΔPQR is a right triangle right angled at Q.

Statement-2 (R): If in a triangle, square of one side is equal to the sum of the squares of the other two sides, then the angle opposite to the first side is a right angle.

39. Statement-1 (A): In two triangles, if corresponding angles are equal then the triangles are similar.

Statement-2 (R): If the areas of two similar triangles are equal, then the triangles are congruent.

40. Statement-1 (A): D and E are points on sides AB and AC of ΔABC such that $AD = (7x - 4)$ cm, $AE = (5x - 2)$ cm, $DB = (3x + 4)$ cm and $EC = 3x$ cm. If $DE \parallel BC$, then $x = 5$.

Statement-2 (R): If a line is drawn parallel to one side of a triangle to intersect the other two sides in distinct points, then the other two sides are divided in the same ratio.

41. Statement-1 (A): In Fig. 7.42, if $AB \parallel CD$, then $x = 3$.

Statement-2 (R): Diagonals of a trapezium divide each other proportionally.

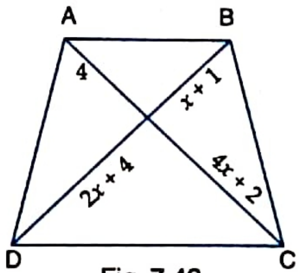

Fig. 7.42

ANSWERS

1. (d)	2. (c)	3. (c)	4. (c)	5. (a)	6. (a)	7. (b)
8. (a)	9. (b)	10. (c)	11. (a)	12. (b)	13. (b)	14. (d)
15. (c)	16. (d)	17. (b)	18. (b)	19. (a)	20. (d)	21. (d)
22. (d)	23. (d)	24. (c)	25. (d)	26. (d)	27. (b)	28. (d)
29. (c)	30. (d)	31. (c)				

32. (i) (c)	(ii) (d)	(iii) (b)	(iv) (d)	(v) (c)
33. (i) (c)	(ii) (b)	(iii) (b)	(iv) (d)	(v) (a)
34. (i) (a)	(ii) (c)	(iii) (d)	(iv) (b)	(v) (c)
35. (i) (d)	(ii) (b)	(iii) (c)	(iv) (b)	(v) (a)
36. (d)	37. (a)	38. (a)	39. (b)	40. (d)
41. (a)				