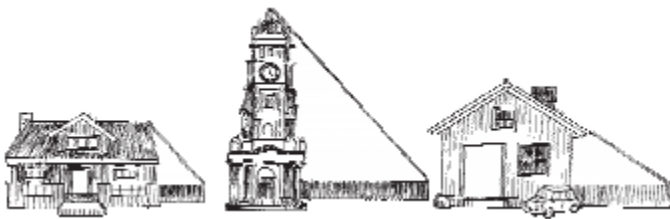


Triangles

Case Study Based Questions

Case Study 1

Digvijay is trying to find the average height of a tower near his house. He is using the properties of similar triangles. The height of Digvijay's house is 20 m when Digvijay's house casts a shadow 10 m long on the ground. At the same time, the tower casts a shadow 50 m long on the ground and the house of Anshul casts 20 m shadow on the ground.



Q1. The height of the tower is:

- a. 10 m
- b. 20 m
- c. 50 m
- d. 100 m

Q2. When Digvijay's house casts a shadow of 18 cm, the length of the shadow of the tower is:

- a. 18 m
- b. 20 m
- c. 90 m
- d. 100 m

Q3. The height of Anshul's house is:

- a. 20 m
- b. 40 m
- c. 50 m
- d. 100 m

Q4. When the tower casts a shadow of 40 m, same time the length of the shadow of Anshul's house is:

- a. 16 m
- b. 40 m
- c. 100 m
- d. None of these

Q5. Which of the following similarity criterion does not exist?

- a. AA
- b. SAS
- c. SSS
- d. RHS

Solutions

1. Let $CD = h$ m be the height of the tower.

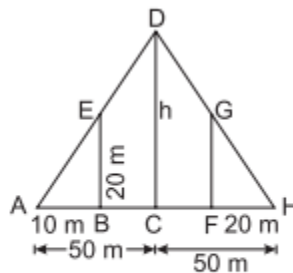
Let $BE = 20$ m be the height of Digvijay house and GF be the height of Anshul's house.

$$\triangle ACD \sim \triangle ABE$$

$$\therefore \frac{AC}{AB} = \frac{CD}{EB}$$

$$\Rightarrow \frac{50}{10} = \frac{h}{20}$$

$$\Rightarrow h = 100 \text{ m}$$



So, option (d) is correct.

2. Given $AB = 18$ m, let $AC = x$
In similar $\triangle ABE$ and $\triangle ACD$

$$\frac{AB}{AC} = \frac{BE}{CD} \Rightarrow \frac{18}{x} = \frac{20}{100}$$

$$\Rightarrow x = \frac{18 \times 100}{20} = 18 \times 5 = 90 \text{ m}$$

3. Let height of Anshul's house be $GF = h_1$

Since, $\triangle HFG \sim \triangle HCD$

$$\therefore \frac{HF}{HC} = \frac{FG}{CD} \Rightarrow \frac{20}{50} = \frac{h_1}{100}$$

$$h_1 = \frac{20 \times 100}{50} = 40 \text{ m}$$

So, option (b) is correct.

4. Given, $HC = 40$ cm

Let length of the shadow of Anshul's house be

$HF = l$ m.

Since, $\triangle HFG \sim \triangle HCD$

$$\therefore \frac{HF}{HC} = \frac{FG}{CD}$$

$$\Rightarrow \frac{l}{40} = \frac{40}{100}$$

$$\Rightarrow l = \frac{40 \times 40}{100} = 16 \text{ m}$$

5. RHS similarity

Criterion does not exist.

So, option (d) is correct.

Case Study 2

Gaurav placed a light bulb at a point O on the ceiling and directly below it placed a table.

He cuts a polygon, say a quadrilateral PQRS, from a plane cardboard and place this

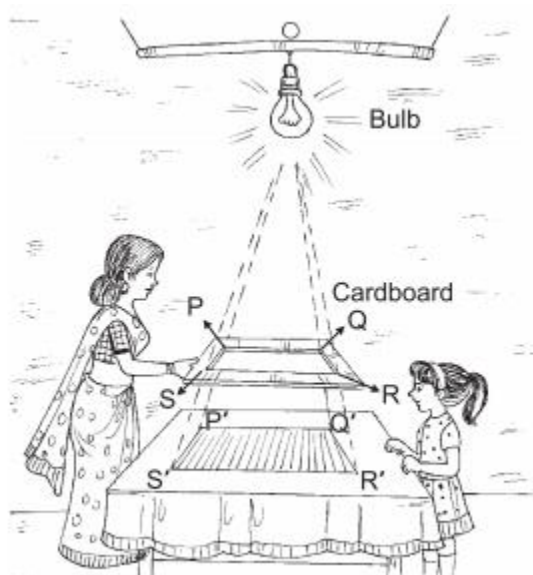
cardboard parallel to the ground between the lighted bulb and the table. Then a shadow

of PQRS is cast on the table as P'Q'R'S'. Quadrilateral P'Q'R'S' is an enlargement of the

quadrilateral PQRS with scale factor 1: 3. Given that $PQ = 2.5$ cm,

$QR = 3.5$ cm, $RS = 3.4$ cm and $PS = 3.1$ cm;

$\angle P = 115^\circ$, $\angle Q = 95^\circ$, $\angle R = 65^\circ$ and $\angle S = 85^\circ$.



Based on the given information, solve the following questions:

Q1. The length of R'S' is:

- a. 3.4 cm
- b. 10.2 cm
- c. 6.8 cm
- d. 9.5 cm

Q 2. The ratio of sides P'Q' and Q'R' is:

- a. 5:7
- b. 7:5
- c. 7:2
- d. 2:7

Q3. The measurement of $\angle Q'$ is:

- a. 115°
- b. 95°
- c. 65°
- d. 85°

Q4. The sum of the lengths Q'R' and P'S' is:

- a. 12.3 cm
- b. 6.7 cm
- c. 19.8 cm
- d. 9 cm

Q5. The sum of angles of quadrilateral P'Q'R'S' is:

- a. 180°
- b. 270°
- c. 300°
- d. 360°

Solutions

1. Given, scale factor is 1:3.

$$R'S' = 3RS$$

$$R'S' = 3 \times 3.4 = 10.2 \text{ cm}$$

So, option (b) is correct.



2. Since, $P'Q' \propto PQ = 3 \times 2.5 = 7.5$ cm
and $Q'R' \propto QR = 3 \times 3.5 = 10.5$ cm

$$\therefore \frac{P'Q'}{Q'R'} = \frac{7.5}{10.5} = \frac{5}{7} \text{ or } 5:7$$

So, option (a) is correct.

3. Quadrilateral $P'Q'R'S'$ is similar to PQRS

$$\angle Q' = \angle Q = 95^\circ$$

So, option (b) is correct.

$$4. Q'R' = 3 QR = 3 \times 3.5 = 10.5 \text{ cm}$$

$$\text{and } P'S' \propto PS = 3 \times 3.1 = 9.3 \text{ cm}$$

$$Q'R' + P'S' = 10.5 + 9.3 = 19.8 \text{ cm}$$

So, option (c) is correct.

5. Since, PQRS \sim $P'Q'R'S'$

$$\angle P' = \angle P = 115^\circ$$

$$\angle Q' = \angle Q = 95^\circ$$

$$\angle R' = \angle R = 65^\circ$$

$$\text{and } \angle S' = \angle S = 85^\circ$$

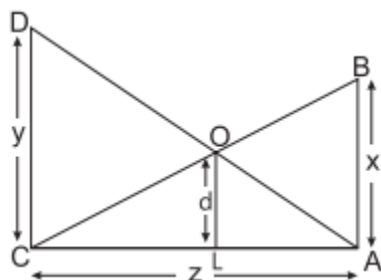
$$\begin{aligned} \angle P' + \angle Q' + \angle R' + \angle S' &= 115^\circ + 95^\circ + 65^\circ + 85^\circ \\ &= 360^\circ \end{aligned}$$

i.e., the sum of angles of quadrilateral $P'Q'R'S'$ is 360° .

So, option (d) is correct.

Case Study 3

Anika is studying in class X. She observe two poles DC and BA. The heights of these poles are x m and y m respectively as shown in figure:



These poles are z m apart and O is the point of intersection of the lines joining the top of each pole to the foot of opposite pole and the distance between point O and L is d . Few questions came to his mind while observing the poles.

Based on the above information, solve the following questions:

Q1. Which similarity criteria is applicable in $\triangle ACAB$ and $\triangle CLO$?

Q2. If $x=y$, prove that $BC : DA = 1 : 1$.

Q3. If $CL = a$, then find a in terms of x , y and d .

OR

If $AL = b$, then find b in terms of x , y and d .

Solutions

1. In $\triangle CAB$ and $\triangle CLO$, we have

$$\angle CAB = \angle CLO = 90^\circ$$

$$\angle C = \angle C \text{ (common)}$$

.. By AA similarity criterion,

$$\triangle CAB \sim \triangle CLO$$

2. In $\triangle DCA$ and $\triangle BAC$,

$$DC = BA \quad [:: x = y \text{ (Given)}]$$

$$\angle DCA = \angle BAC \quad [\text{Each } 90^\circ]$$

$$CA = AC \quad [\text{Common}]$$

By SAS similarity criterion,

$$\triangle DCA \sim \triangle BAC$$

$$\therefore \frac{DA}{BC} = \frac{DC}{BA} = \frac{y}{x}$$

$$\Rightarrow \frac{BC}{DA} = \frac{x}{y} = \frac{x}{x} = 1$$

$$\therefore BC : DA = 1 : 1$$

proved.



3. $\triangle CAB \sim \triangle CLO$

$$\therefore \frac{CA}{CL} = \frac{AB}{LO} \Rightarrow \frac{z}{a} = \frac{x}{d} \Rightarrow a = \frac{zd}{x}$$

OR

In $\triangle ALO$ and $\triangle ACD$,

We have

$$\angle ALO = \angle ACD = 90^\circ$$

$$\angle A = \angle A$$

(common)

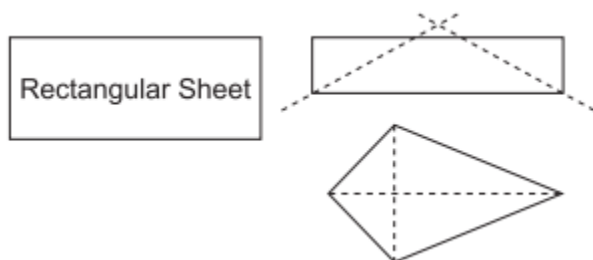
\therefore By AA similarity criterion,

$$\triangle ALO \sim \triangle ACD$$

$$\therefore \frac{AL}{AC} = \frac{OL}{DC} \Rightarrow \frac{b}{z} = \frac{d}{y} \Rightarrow b = \frac{zd}{y}$$

Case Study 4

Before Basant Panchami, Samarth is trying to make kites at home. So, he take a rectangular sheet and fold it horizontally, then vertically and fold it transversally. After cutting transversally, he gets a kite shaped figure as shown below:



Based on the above information, solve the following questions:

Q1. What is the angle between diagonals of a rectangle?

Q2. Prove that two triangles divided by a diagonal in rectangle are similar as well as congruent.

Q3. Prove that the longest diagonal of a kite bisect a pair of opposite angle.

OR

By which similarity criterion the triangles formed by longest diagonal in a kite are similar?

Solutions

1. Diagonals of a rectangle can bisect each other at any angle.

2. In $\triangle ABC$ and $\triangle CDA$

$$AB = CD$$

$$\angle B = \angle D$$

$$BC = DA$$

$$\triangle ABC \cong \triangle CDA$$

(By SAS)

When two triangles are congruent, then they are similar also.

3. In $\triangle AOB$ and $\triangle AOD$,

$AB = AD$
 $OA = OA$ (common)
 $BO = DO$
(diagonal AC bisect the other diagonal BD)

$\therefore \triangle AOB \sim \triangle AOD$
(by SSS similarity)

$\Rightarrow \angle BAO = \angle DAO \dots (1)$

In $\triangle BOC$ and $\triangle DOC$,

$BC = DC$
 $OC = OC$ (common)
 $BO = OD$
[Diagonal AC bisect the other diagonal BD]

$\therefore \triangle BOC \sim \triangle DOC$ [by SSS similarity]

$\Rightarrow \angle BCO = \angle DCO \dots (2)$

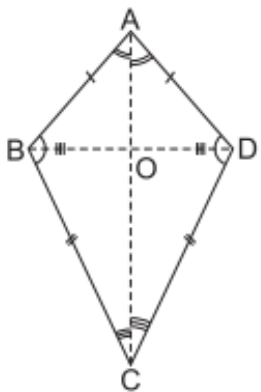
From (1) and (2), It is clear that, the longest diagonal of a kite bisect a pair of opposite angle.

OR

In $\triangle ABC$ and $\triangle ADC$,

$AB = AD$
 $BC = DC$
 $AC = AC$ (common)

$\triangle ABC \sim \triangle ADC$ (by SSS criterion)



In $\triangle ABC$ and $\triangle ADC$,

$$AB = AD$$

$$\angle ABC = \angle ADC$$

$$BC = DC$$

$$\therefore \triangle ABC \sim \triangle ADC$$

(by SAS criterion)

In $\triangle ABC$ and $\triangle ADC$,

$$\angle B = \angle D$$

$$\angle BAC = \angle DAC$$

($\because \angle BAO = \angle BAC, \angle DAO = \angle DAC$, proved above)

$$\angle BCA = \angle DCA$$

($\because \angle BCO = \angle BCA, \angle DCO = \angle DCA$, proved above)

$$\therefore \triangle ABC \sim \triangle ADC \quad (\text{by AAA similarity})$$

So, required similarity criteria are SSS, SAS and AAA.



Solutions for Questions 5 to 14 are Given Below

Case Study 5

Cardboard Pieces Activity

In a classroom, students were playing with some pieces of cardboard as shown below.

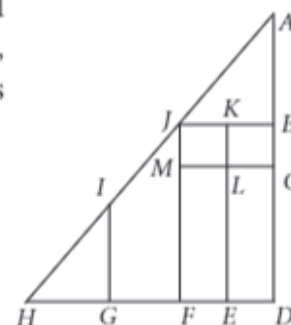


All of a sudden, teacher entered into classroom. She told students to arrange all pieces. On seeing this beautiful image, she observed that $\triangle ADH$ is right angled triangle, which contains

- (i) right triangles ABJ and IGH .
- (ii) quadrilateral $GFJI$
- (iii) squares $JKLM$ and $LCBK$
- (iv) rectangles $MLEF$ and $LCDE$.

After observation, she ask certain questions to students.

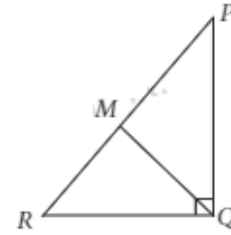
Help them to answer these questions.



- (i) If an insect (small ant) walks 24 m from H to F , then walks 6 m to reach at M , then walks 4 m to reach at L and finally crossing K , reached at J . Find the distance between initial and final position of insect.
 - (a) 25 m (b) 26 m (c) 27 m (d) 28 m
- (ii) If m , n and r are the sides of right triangle ABJ , then which of the following can be correct?
 - (a) $m^2 + n^2 = r^2$ (b) $m^2 + n^2 + r^2 = 0$
 - (c) $m^2 + n^2 = 2r^2$ (d) none of these
- (iii) If $\triangle ABJ \sim \triangle ADH$, then which similarity criterion is used here?
 - (a) AA (b) SAS (c) AAS (d) SSS
- (iv) If $\angle ABJ = 90^\circ$ and B, J are mid points of sides AD and AH respectively and $BJ \parallel DH$, then which of the following option is false?
 - (a) $\triangle ABJ \sim \triangle ADH$ (b) $2BJ = DH$ (c) $AJ^2 = JB^2 + AB^2$ (d) $\frac{AB}{BD} = \frac{AJ}{AH}$

(v) If $\triangle PQR$ is right triangle with $QM \perp PR$, then which of the following is not correct?

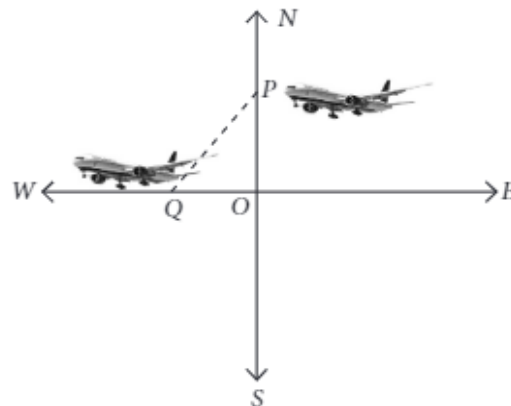
- (a) $\triangle PMQ \sim \triangle PQR$
- (b) $QR^2 = PR^2 - PQ^2$
- (c) $PR^2 = PQ + QR$
- (d) $\triangle PMQ \sim \triangle QMR$



Case Study 6

Application of Pythagoras Theorem

An aeroplane leaves an airport and flies due north at a speed of 1200 km/hr. At the same time, another aeroplane leaves the same station and flies due west at the speed of 1500 km/hr as shown below. After $1\frac{1}{2}$ hr both the aeroplanes reach at point P and Q respectively.



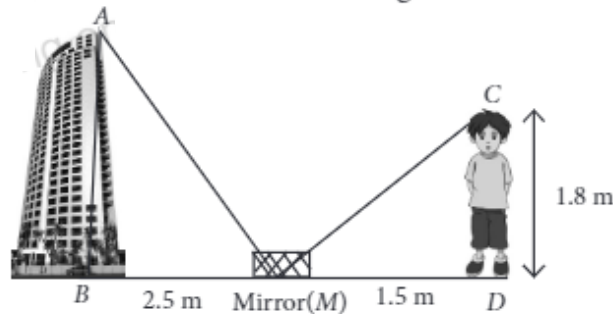
Based on the above information, answer the following questions.

- (i) Distance travelled by aeroplane towards north after $1\frac{1}{2}$ hr is
 - (a) 1800 km
 - (b) 1500 km
 - (c) 1400 km
 - (d) 1350 km
- (ii) Distance travelled by aeroplane towards west after $1\frac{1}{2}$ hr is
 - (a) 1600 km
 - (b) 1800 km
 - (c) 2250 km
 - (d) 2400 km
- (iii) In the given figure, $\angle POQ$ is
 - (a) 70°
 - (b) 90°
 - (c) 80°
 - (d) 100°
- (iv) Distance between aeroplanes after $1\frac{1}{2}$ hr, is
 - (a) $450\sqrt{41}$ km
 - (b) $350\sqrt{31}$ km
 - (c) $125\sqrt{12}$ km
 - (d) $472\sqrt{41}$ km
- (v) Area of $\triangle POQ$ is
 - (a) 185000 km^2
 - (b) 179000 km^2
 - (c) 186000 km^2
 - (d) 2025000 km^2

Case Study 7

Measurement of Height

Rohit's father is a mathematician. One day he gave Rohit an activity to measure the height of building. Rohit accepted the challenge and placed a mirror on ground level to determine the height of building. He is standing at a certain distance so that he can see the top of the building reflected from mirror. Rohit eye level is at 1.8 m above ground. The distance of Rohit from mirror and that of building from mirror are 1.5 m and 2.5 m respectively.



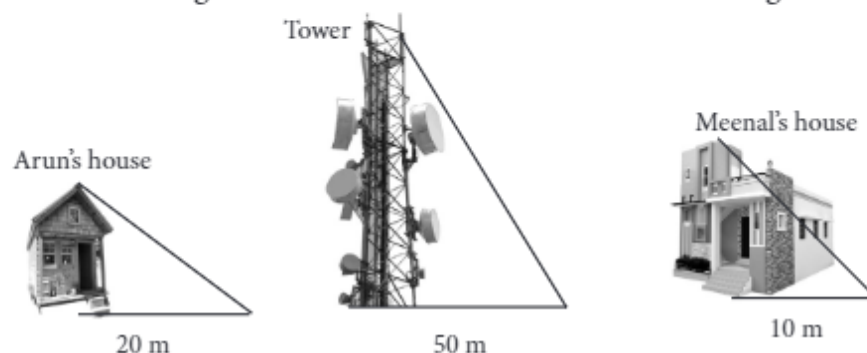
Based on the above information, answer the following questions.

- (i) Two similar triangles formed in the above figure is
(a) $\triangle ABM$ and $\triangle CMD$ (b) $\triangle AMB$ and $\triangle CDM$ (c) $\triangle ABM$ and $\triangle CDM$ (d) None of these
- (ii) Which criterion of similarity is applied here?
(a) AA similarity criterion (b) SSS similarity criterion
(c) SAS similarity criterion (d) ASA similarity criterion
- (iii) Height of the building is
(a) 1 m (b) 2 m (c) 3 m (d) 4 m
- (iv) In $\triangle ABM$, if $\angle BAM = 30^\circ$, then $\angle MCD$ is equal to
(a) 40° (b) 30° (c) 65° (d) 90°
- (v) If $\triangle ABM$ and $\triangle CDM$ are similar where $CD = 6$ cm, $MD = 8$ cm and $BM = 24$ cm, then AB is equal to
(a) 16 cm (b) 18 cm (c) 12 cm (d) 14 cm

Case Study 8

Application of Similar Triangles

Meenal was trying to find the height of tower near his house. She is using the properties of similar triangles. The height of Meenal's house is 20 m. When Meenal's house casts a shadow of 10 m long on the ground, at the same time, tower casts a shadow of 50 m long and Arun's house casts a shadow of 20 m long on the ground as shown below.



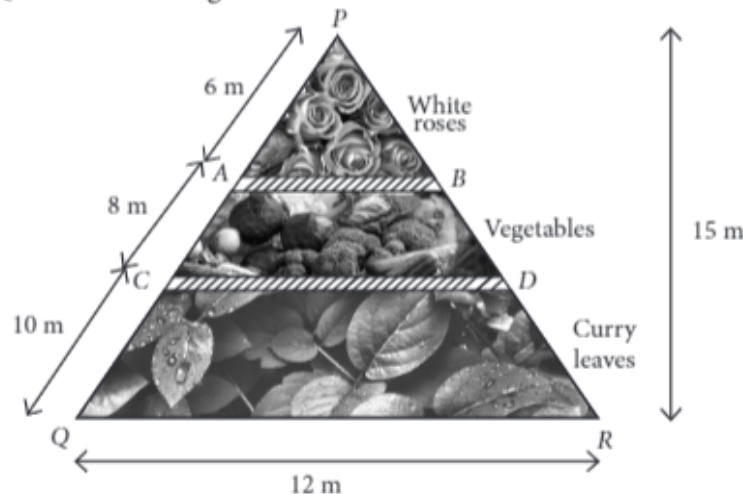
Based on the above information, answer the following questions.

- (i) What is the height of tower?
 (a) 100 m (b) 50 m (c) 15 m (d) 45 m
- (ii) What will be the length of shadow of tower when Meenal's house casts a shadow of 15 m?
 (a) 45 m (b) 70 m (c) 75 m (d) 72 m
- (iii) Height of Arun's house is
 (a) 80 m (b) 75 m (c) 60 m (d) 40 m
- (iv) If tower casts a shadow of 40 m, then find the length of shadow of Arun's house.
 (a) 18 m (b) 16 m (c) 17 m (d) 14 m
- (v) If tower casts a shadow of 40 m, then what will be the length of shadow of Meenal's house?
 (a) 7 m (b) 9 m (c) 4 m (d) 8 m

Case Study 9

Gardening in the Backyard

In the backyard of house, Shikha has some empty space in the shape of a $\triangle PQR$. She decided to make it a garden. She divided the whole space into three parts by making boundaries AB and CD using bricks to grow flowers and vegetables where $AB \parallel CD \parallel QR$ as shown in figure.



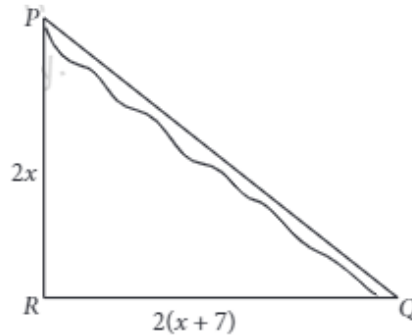
Based on the above information, answer the following questions.

- (i) The length of AB is
 (a) 3 m (b) 4 m (c) 5 m (d) 6 m
- (ii) The length of CD is
 (a) 4 m (b) 5 m (c) 6 m (d) 7 m
- (iii) Area of whole empty land is
 (a) 90 m^2 (b) 60 m^2 (c) 32 m^2 (d) 72 m^2
- (iv) Area of $\triangle PAB$ is
 (a) $\frac{45}{4} \text{ m}^2$ (b) $\frac{45}{8} \text{ m}^2$ (c) $\frac{8}{45} \text{ m}^2$ (d) $\frac{4}{45} \text{ m}^2$
- (v) Area of $\triangle PCD$ is
 (a) $\frac{12}{245} \text{ m}^2$ (b) $\frac{245}{12} \text{ m}^2$ (c) $\frac{243}{8} \text{ m}^2$ (d) $\frac{245}{8} \text{ m}^2$

Case Study 10

Inspection of Road

Minister of a state went to city Q from city P . There is a route via city R such that $PR \perp RQ$. $PR = 2x$ km and $RQ = 2(x + 7)$ km. He noticed that there is a proposal to construct a 26 km highway which directly connects the two cities P and Q .



Based on the above information, answer the following questions.

- (i) Which concept can be used to get the value of x ?
- (a) Thales theorem (b) Pythagoras theorem
(c) Converse of thales theorem (d) Converse of Pythagoras theorem
- (ii) The value of x is
- (a) 4 (b) 6 (c) 5 (d) 8
- (iii) The value of PR is
- (a) 10 km (b) 20 km (c) 15 km (d) 25 km
- (iv) The value of RQ is
- (a) 12 km (b) 24 km (c) 16 km (d) 20 km
- (v) How much distance will be saved in reaching city Q after the construction of highway?
- (a) 10 km (b) 9 km (c) 4 km (d) 8 km

Case Study 11

Class teacher draw the shape of quadrilateral on board. Ankit observed the shape and explored on his notebook in different ways as shown below.

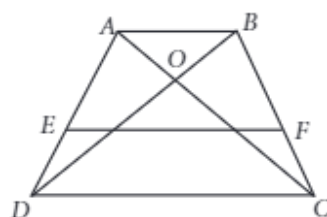


Fig. 1

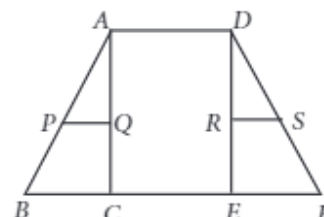


Fig. 2

Based on the above information, answer the following questions.

- (i) In fig. 1, if $ABCD$ is a trapezium with $AB \parallel CD$, E and F are points on non-parallel sides AD and BC respectively such that $EF \parallel AB$, then $\frac{AE}{ED} =$

- (a) $\frac{BE}{CD}$ (b) $\frac{AB}{CD}$ (c) $\frac{BF}{FC}$ (d) None of these

(ii) In fig. 1, if $AB \parallel CD$, and $DO = 3x - 19$, $OB = x - 5$, $OC = x - 3$ and $AO = 3$, then the value of x can be

- (a) 5 or 8 (b) 8 or 9 (c) 10 or 12 (d) 13 or 14

(iii) In fig. 1, if $OD = 3x - 1$, $OB = 5x - 3$, $OC = 2x + 1$ and $AO = 6x - 5$, then the value of x is

- (a) 0 (b) 1 (c) 2 (d) 3

(iv) In fig. 2, in $\triangle ABC$, if $PQ \parallel BC$ and $AP = 2.4$ cm, $AQ = 2$ cm, $QC = 3$ cm and $BC = 6$ cm, then $AB + PQ$ is equal to

- (a) 7.2 cm (b) 5.9 cm (c) 2.6 cm (d) 8.4 cm

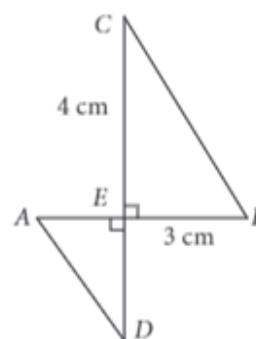
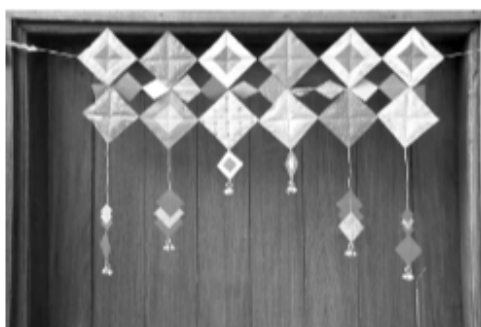
(v) In fig. 2, in $\triangle DEF$, if $RS \parallel EF$, $DR = 4x - 3$, $DS = 8x - 7$, $ER = 3x - 1$ and $FS = 5x - 3$, then the value of x is

- (a) 1 (b) 2 (c) 8 (d) 10

Case Study 12

Diwali Decoration

Ankita wants to make a toran for Diwali using some pieces of cardboard. She cut some cardboard pieces as shown below. If perimeter of $\triangle ADE$ and $\triangle BCE$ are in the ratio 2 : 3, then answer the following questions.



(i) If the two triangles here are similar by SAS similarity rule, then their corresponding proportional sides are

- (a) $\frac{AE}{CE} = \frac{DE}{BE}$ (b) $\frac{BE}{AE} = \frac{CE}{DE}$
 (c) $\frac{AD}{CE} = \frac{BE}{DE}$ (d) None of these

(ii) Length of $BC =$

- (a) 2 cm (b) 4 cm (c) 5 cm (d) None of these

(iii) Length of $AD =$

- (a) $10/3$ cm (b) $9/4$ cm (c) $5/3$ cm (d) $4/3$ cm

(iv) Length of $ED =$

- (a) $4/3$ cm (b) $8/3$ cm (c) $7/3$ cm (d) Can't be determined

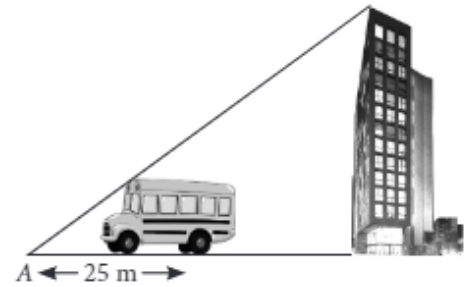
(v) Length of $AE =$

- (a) $\frac{2}{3} \times BE$ (b) $\sqrt{AD^2 - DE^2}$ (c) $\frac{2}{3} \times \sqrt{BC^2 - CE^2}$ (d) All of these

Case Study 13

Aruna visited to her uncle's house. From a point A, where Aruna was standing, a bus and building come in a straight line as shown in the figure.

Based on the above information, answer the following questions.

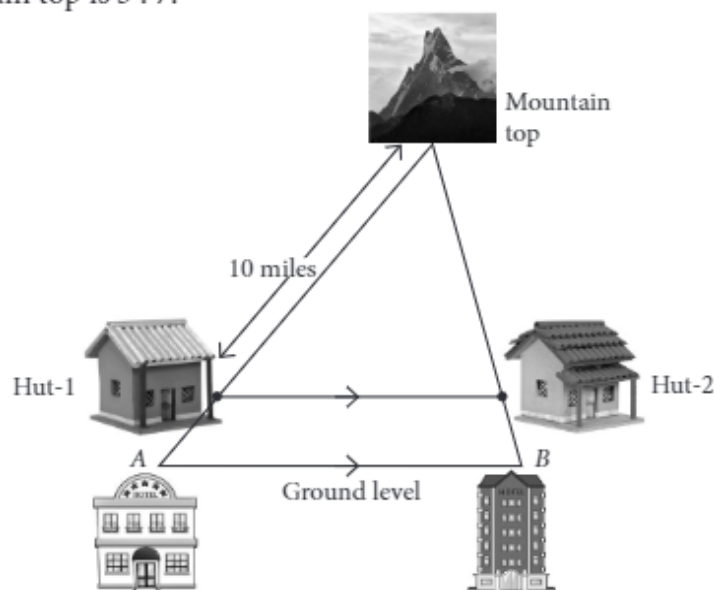


- (i) Which similarity criteria can be seen in this case, if bus and building are considered in a straight line?
- (a) AA (b) SAS (c) SSS (d) ASA
- (ii) If the distance between Aruna and the bus is twice as much as the height of the bus, then the height of the bus is
- (a) 40 m (b) 12.5 m (c) 15 m (d) 25 m
- (iii) If the distance of Aruna from the building is twelve times the height of the bus, then the ratio of the heights of bus and building is
- (a) 3 : 1 (b) 1 : 4 (c) 1 : 6 (d) 2 : 3
- (iv) What is the ratio of the distance between Aruna and top of bus to the distance between the tops of bus and building?
- (a) 1 : 5 (b) 1 : 6 (c) 2 : 5 (d) Can't be determined
- (v) What is the height of the building?
- (a) 50 m (b) 75 m (c) 120 m (d) 30 m

Case Study 14

Mountain Trekking

Two hotels are at the ground level on either side of a mountain. On moving a certain distance towards the top of the mountain two huts are situated as shown in the figure. The ratio between the distance from hotel B to hut-2 and that of hut-2 to mountain top is 3 : 7.



Based on the above information, answer the following questions.

- (i) What is the ratio of the perimeters of the triangle formed by both hotels and mountain top to the triangle formed by both huts and mountain top?
 (a) 5 : 2 (b) 10 : 7 (c) 7 : 3 (d) 3 : 10
- (ii) The distance between the hotel A and hut-1 is
 (a) 2.5 miles (b) 29 miles (c) 4.29 miles (d) 1.5 miles
- (iii) If the horizontal distance between the hut-1 and hut-2 is 8 miles, then the distance between the two hotels is
 (a) 2.4 miles (b) 11.43 miles (c) 9 miles (d) 7 miles
- (iv) If the distance from mountain top to hut-1 is 5 miles more than that of distance from hotel B to mountain top, then what is the distance between hut-2 and mountain top?
 (a) 3.5 miles (b) 6 miles (c) 5.5 miles (d) 4 miles
- (v) What is the ratio of areas of two parts formed in the complete figure?
 (a) 53 : 21 (b) 10 : 41 (c) 51 : 33 (d) 49 : 51

HINTS & EXPLANATIONS

5. (i) (b): As JKLM is a square.

$$\therefore ML = JM = 4 \text{ m}$$

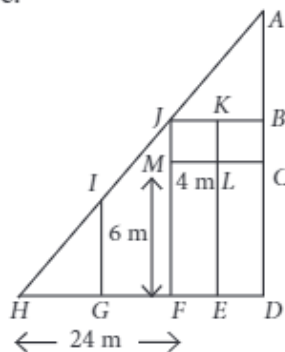
$$\text{So, } JF = 6 + 4 = 10 \text{ m}$$

Required distance between initial and final position of insect = HJ

$$= \sqrt{(HF)^2 + (JF)^2}$$

$$= \sqrt{(24)^2 + (10)^2}$$

$$= \sqrt{676} = 26 \text{ m}$$



- (ii) (a): By Pythagoras, $n^2 + m^2 = r^2$

- (iii) (a): In $\triangle ABJ$ and $\triangle ADH$

$$\angle B = \angle D = 90^\circ$$

$$\angle A = \angle A \text{ (common)}$$

\therefore By AA similarity criterion, $\triangle ABJ \sim \triangle ADH$.

- (iv) (d): Since, $\triangle ABJ \sim \triangle ADH$

[By AA similarity criterion]

$$\therefore \frac{AB}{AD} = \frac{AJ}{AH}$$

- (v) (c): Since, $PR^2 = PQ^2 + QR^2$

[By Pythagoras theorem]

6. (i) (a): Speed = 1200 km/hr

$$\text{Time} = 1\frac{1}{2} \text{ hr} = \frac{3}{2} \text{ hr}$$

$$\therefore \text{Required distance} = \text{Speed} \times \text{Time}$$

$$= 1200 \times \frac{3}{2} = 1800 \text{ km}$$

- (ii) (c): Speed = 1500 km/hr

$$\text{Time} = \frac{3}{2} \text{ hr}$$

$$\therefore \text{Required distance} = \text{Speed} \times \text{Time}$$

$$= 1500 \times \frac{3}{2} = 2250 \text{ km}$$

- (iii) (b): Clearly, directions are always perpendicular to each other.

$$\therefore \angle POQ = 90^\circ$$

- (iv) (a): Distance between aeroplanes after $1\frac{1}{2}$ hour

$$= \sqrt{(1800)^2 + (2250)^2} = \sqrt{3240000 + 5062500}$$

$$= \sqrt{8302500} = 450\sqrt{41} \text{ km}$$

- (v) (d): Area of $\triangle POQ = \frac{1}{2} \times \text{base} \times \text{height}$

$$= \frac{1}{2} \times 2250 \times 1800 = 2250 \times 900 = 2025000 \text{ km}^2$$

7. (i) (c): Since, $\angle B = \angle D = 90^\circ$, $\angle AMB = \angle CMD$

(\because Angle of incident = Angle of reflection)



∴ By similarity criterion, $\triangle ABM \sim \triangle CDM$

(ii) (a)

(iii) (c) ∵ $\triangle ABM \sim \triangle CDM$

$$\therefore \frac{AB}{CD} = \frac{BM}{DM} \Rightarrow \frac{AB}{1.8} = \frac{2.5}{1.5}$$

$$\Rightarrow AB = \frac{2.5 \times 1.8}{1.5} = 3 \text{ m}$$

(iv) (b): Since, $\triangle ABM \sim \triangle CDM$

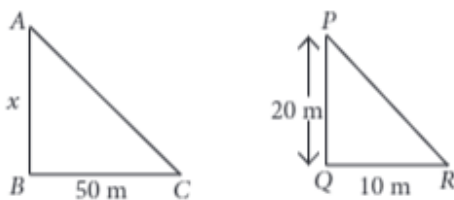
$$\therefore \angle A = \angle C = 30^\circ$$

[∵ Corresponding angles of similar triangles are also equal]

(v) (b): Since, $\triangle ABM \sim \triangle CDM$

$$\therefore \frac{AB}{CD} = \frac{BM}{MD} \Rightarrow \frac{AB}{6} = \frac{24}{8} \Rightarrow AB = 18 \text{ cm}$$

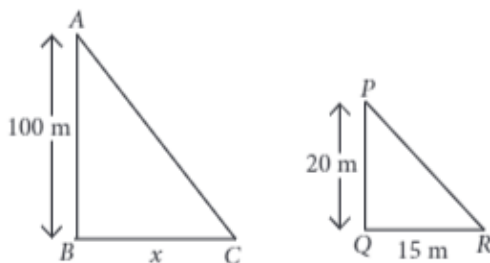
8. (i) (a): Since, $\triangle ABC \sim \triangle PQR$



$$\therefore \frac{AB}{PQ} = \frac{BC}{QR} \Rightarrow \frac{x}{20} = \frac{50}{10} \Rightarrow x = 100$$

Thus, height of tower is 100 m.

(ii) (c): Since, $\triangle ABC \sim \triangle PQR$

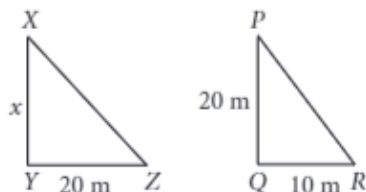


$$\therefore \frac{100}{20} = \frac{x}{15} \Rightarrow x = \frac{1500}{20} = 75 \text{ m}$$

(iii) (d): Since, the shapes are similar

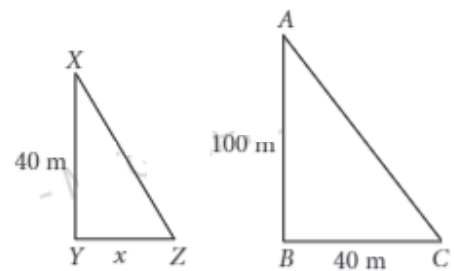
$$\therefore \frac{x}{20} = \frac{20}{10}$$

$$\Rightarrow x = \frac{20 \times 20}{10} = 40 \text{ m}$$



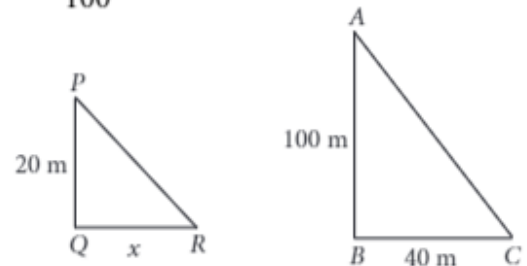
(iv) (b): Since, the shapes are similar, so, $\frac{40}{100} = \frac{x}{40}$

$$\Rightarrow x = 16 \text{ m}$$



(v) (d): Since, the shapes are similar, so, $\frac{20}{100} = \frac{x}{40}$

$$\Rightarrow x = \frac{20 \times 40}{100} = 8 \text{ m}$$



9. (i) (a): In $\triangle PAB$ and $\triangle PQR$,

$\angle P = \angle P$ (Common)

$\angle A = \angle Q$ (Corresponding angles)

By AA similarity criterion, $\triangle PAB \sim \triangle PQR$

$$\therefore \frac{AB}{QR} = \frac{PA}{PQ} \Rightarrow \frac{AB}{12} = \frac{6}{24} \Rightarrow AB = 3 \text{ m}$$

(ii) (d): Similarly, $\triangle PCD$ and $\triangle PQR$ are similar.

$$\therefore \frac{PC}{PQ} = \frac{CD}{QR} \Rightarrow \frac{14}{24} = \frac{CD}{12} \Rightarrow CD = 7 \text{ m}$$

(iii) (a): Area of whole empty land

$$= \frac{1}{2} \times \text{base} \times \text{height} = \frac{1}{2} \times 12 \times 15 = 90 \text{ m}^2$$

(iv) (b): Since, $\triangle PAB \sim \triangle PQR$.

$$\therefore \frac{\text{ar}(\triangle PAB)}{\text{ar}(\triangle PQR)} = \left(\frac{PA}{PQ} \right)^2 = \left(\frac{6}{24} \right)^2 = \frac{1}{16}$$

$$\Rightarrow \text{ar}(\triangle PAB) = \frac{1}{16} \times 90 = \frac{45}{8} \text{ m}^2$$

$$[\because \text{ar}(\triangle PQR) = 90 \text{ m}^2]$$

(v) (d): Since, $\triangle PCD \sim \triangle PQR$.

$$\therefore \frac{\text{ar}(\triangle PCD)}{\text{ar}(\triangle PQR)} = \left(\frac{PC}{PQ} \right)^2 = \left(\frac{14}{24} \right)^2 = \left(\frac{7}{12} \right)^2$$

$$\Rightarrow \text{ar}(\triangle PCD) = \frac{90 \times 49}{144} = \frac{245}{8} \text{ m}^2$$

10. (i) (b)

(ii) (c): Using Pythagoras theorem, we have

$$PQ^2 = PR^2 + RQ^2$$

$$\begin{aligned} \Rightarrow (26)^2 &= (2x)^2 + (2(x+7))^2 \Rightarrow 676 = 4x^2 + 4(x+7)^2 \\ \Rightarrow 169 &= x^2 + x^2 + 49 + 14x \Rightarrow x^2 + 7x - 60 = 0 \\ \Rightarrow x^2 + 12x - 5x - 60 &= 0 \\ \Rightarrow x(x+12) - 5(x+12) &= 0 \Rightarrow (x-5)(x+12) = 0 \\ \Rightarrow x = 5, x = -12 \\ \therefore x &= 5 \quad [\text{Since length can't be negative}] \end{aligned}$$

$$(iii) (a): PR = 2x = 2 \times 5 = 10 \text{ km}$$

$$(iv) (b): RQ = 2(x+7) = 2(5+7) = 24 \text{ km}$$

$$(v) (d): \text{Since, } PR + RQ = 10 + 24 = 34 \text{ km} \\ \text{Saved distance} = 34 - 26 = 8 \text{ km}$$

11. (i) (c)

$$(ii) (b): \text{Since, } \triangle AOB \sim \triangle COD \\ [\text{By AA similarity criterion}]$$

$$\therefore \frac{AO}{OC} = \frac{BO}{OD} \Rightarrow \frac{3}{x-3} = \frac{x-5}{3x-19}$$

$$\begin{aligned} \Rightarrow 3(3x-19) &= (x-5)(x-3) \\ \Rightarrow 9x - 57 &= x^2 - 3x - 5x + 15 \Rightarrow x^2 - 17x + 72 = 0 \\ \Rightarrow (x-8)(x-9) &= 0 \Rightarrow x = 8 \text{ or } 9 \end{aligned}$$

$$(iii) (c): \text{Since, } \triangle AOB \sim \triangle COD \\ [\text{By AA similarity criterion}]$$

$$\therefore \frac{AO}{OC} = \frac{BO}{OD} \Rightarrow \frac{6x-5}{2x+1} = \frac{5x-3}{3x-1}$$

$$\begin{aligned} \Rightarrow (6x-5)(3x-1) &= (5x-3)(2x+1) \\ \Rightarrow 18x^2 - 6x - 15x + 5 &= 10x^2 + 5x - 6x - 3 \\ \Rightarrow 8x^2 - 20x + 8 &= 0 \Rightarrow 2x^2 - 5x + 2 = 0 \end{aligned}$$

From options, $x = 2$ is the only value that satisfies this equation.

$$(iv) (d): \text{Since } \triangle APQ \sim \triangle ABC \\ [\text{By AA similarity criterion}]$$

$$\therefore \frac{AP}{AB} = \frac{AQ}{AC} = \frac{PQ}{BC} \Rightarrow \frac{2.4}{AB} = \frac{2}{5} = \frac{PQ}{6}$$

$$\therefore AB = \frac{2.4 \times 5}{2} = 6 \text{ cm and } PQ = \frac{2 \times 6}{5} = 2.4 \text{ cm}$$

$$\therefore AB + PQ = 6 + 2.4 = 8.4 \text{ cm}$$

$$(v) (a): \text{Since, } \triangle DRS \sim \triangle DEF \\ (\text{By AA similarity criterion})$$

$$\therefore \frac{DE}{DR} = \frac{DF}{DS} \Rightarrow \frac{DE}{DR} - 1 = \frac{DF}{DS} - 1$$

$$\Rightarrow \frac{DE-DR}{DR} = \frac{DF-DS}{DS} \Rightarrow \frac{ER}{DR} = \frac{FS}{DS}$$

$$\Rightarrow \frac{DR}{ER} = \frac{DS}{FS} \Rightarrow \frac{4x-3}{3x-1} = \frac{8x-7}{5x-3}$$

$$\begin{aligned} \Rightarrow 20x^2 - 12x - 15x + 9 &= 24x^2 - 8x - 21x + 7 \\ \Rightarrow 4x^2 - 2x - 2 &= 0 \Rightarrow 2x^2 - x - 1 = 0 \end{aligned}$$

Only option (a) i.e., $x = 1$ satisfies this equation.

12. (i) (b): If $\triangle AED$ and $\triangle BEC$, are similar by SAS similarity rule, then their corresponding proportional sides are $\frac{BE}{AE} = \frac{CE}{DE}$

(ii) (c): By Pythagoras theorem, we have

$$\begin{aligned} BC &= \sqrt{CE^2 + EB^2} = \sqrt{4^2 + 3^2} = \sqrt{16+9} \\ &= \sqrt{25} = 5 \text{ cm} \end{aligned}$$

(iii) (a): Since $\triangle ADE$ and $\triangle BCE$ are similar.

$$\therefore \frac{\text{Perimeter of } \triangle ADE}{\text{Perimeter of } \triangle BCE} = \frac{AD}{BC}$$

$$\Rightarrow \frac{2}{3} = \frac{AD}{5} \Rightarrow AD = \frac{5 \times 2}{3} = \frac{10}{3} \text{ cm}$$

$$(iv) (b): \frac{\text{Perimeter of } \triangle ADE}{\text{Perimeter of } \triangle BCE} = \frac{ED}{CE}$$

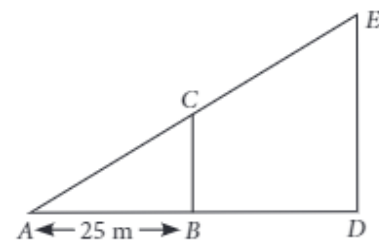
$$\Rightarrow \frac{2}{3} = \frac{ED}{4} \Rightarrow ED = \frac{4 \times 2}{3} = \frac{8}{3} \text{ cm}$$

$$(v) (d): \frac{\text{Perimeter of } \triangle ADE}{\text{Perimeter of } \triangle BCE} = \frac{AE}{BE} \Rightarrow \frac{2}{3} BE = AE$$

$$\Rightarrow AE = \frac{2}{3} \sqrt{BC^2 - CE^2}$$

$$\text{Also, in } \triangle AED, AE = \sqrt{AD^2 - DE^2}$$

13. Let BC represents the height of bus and DE represents the height of building.



(i) (a): In $\triangle ABC$ and $\triangle ADE$,
 $\angle A = \angle A$ (Common)
 $\angle B = \angle D$ (Corresponding angles)
 $\therefore \triangle ABC \sim \triangle ADE$ (By AA similarity criteria)

$$(ii) (b): \text{We have, } AB = 2BC \\ \Rightarrow BC = \frac{25}{2} = 12.5 \text{ m}$$

So, height of bus = 12.5 m

(iii) (c): We have, $AD = 12 BC$

$$\Rightarrow AD = 12 \times 12.5 = 150 \text{ m}$$

$$\therefore \triangle ABC \sim \triangle ADE$$

$$\therefore \frac{AB}{AD} = \frac{BC}{DE} \Rightarrow \frac{BC}{DE} = \frac{25}{150} = \frac{1}{6}$$

So, ratio of heights of bus and building is 1 : 6.

(iv) (a): Since, $\triangle ABC \sim \triangle ADE$

$$\Rightarrow \frac{AB}{AD} = \frac{AC}{AE} \Rightarrow \frac{AC}{AE} = \frac{1}{6}$$

$$\Rightarrow \frac{AC}{AE - AC} = \frac{1}{6 - 1} \Rightarrow \frac{AC}{EC} = \frac{1}{5}$$

\therefore Required ratio = 1 : 5

(v) (b): Height of the building = DE

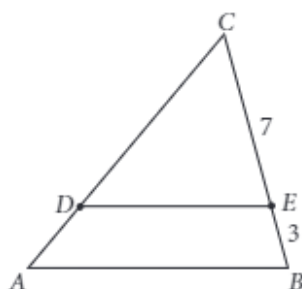
$$\text{Now, } \frac{BC}{DE} = \frac{1}{6}$$

$$\Rightarrow DE = 6BC = 6 \times 12.5 = 75 \text{ m}$$

14. (i) (b): Let $\triangle ABC$ is the triangle formed by both hotels and mountain top. $\triangle CDE$ is the triangle formed by both huts and mountain top.

Clearly, $DE \parallel AB$ and so

$\triangle ABC \sim \triangle DEC$ [By AA-similarity criterion]



Now, required ratio = Ratio of their corresponding sides = $\frac{BC}{EC} = \frac{10}{7}$ i.e., 10 : 7.

(ii) (c): Since, $DE \parallel AB$, therefore

$$\frac{CD}{AD} = \frac{CE}{EB} \Rightarrow \frac{10}{AD} = \frac{7}{3} \Rightarrow AD = \frac{10 \times 3}{7} = 4.29 \text{ miles}$$

(iii) (b): Since, $\triangle ABC \sim \triangle DEC$

$\therefore \frac{BC}{EC} = \frac{AB}{DE}$ [\because Corresponding sides of similar triangles are proportional]

$$\Rightarrow \frac{10}{7} = \frac{AB}{8} \Rightarrow AB = \frac{80}{7} = 11.43 \text{ miles}$$

(iv) (a): Given, $DC = 5 + BC$.

Clearly, $BC = 10 - 5 = 5$ miles

$$\text{Now, } CE = \frac{7}{10} \times BC = \frac{7}{10} \times 5 = 3.5 \text{ miles}$$

(v) (d): Clearly, the ratio of areas of two triangles (i.e., $\triangle ABC$ to $\triangle DEC$)

$$= \left(\frac{BC}{EC} \right)^2 = \left(\frac{10}{7} \right)^2 = \frac{100}{49}$$

$$\therefore \text{ Required ratio} = \frac{\text{ar}(\triangle CDE)}{\text{ar}(EBAD)} = \frac{49}{100 - 49} = \frac{49}{51}$$