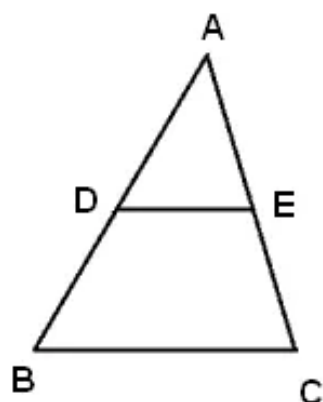


## Chapter 16. Similarity

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### Ex 16.1

#### Answer 1.



(i) In  $\triangle ADE$  and  $\triangle ABC$

$$\angle D = \angle B \text{ and } \angle C = \angle E \quad (DE \parallel BC)$$

$$\Rightarrow \triangle ADE \sim \triangle ABC$$

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

$$\Rightarrow \frac{4}{x-4} = \frac{8}{3x-19}$$

$$\Rightarrow 4x(3x-19) = 8x(x-4)$$

$$\Rightarrow 12x - 76 = 8x - 32$$

$$\Rightarrow 4x = 44$$

$$\Rightarrow x = 11$$

(ii) In  $\triangle ADE$  and  $\triangle ABC$

$$\angle D = \angle B \text{ and } \angle C = \angle E \quad (DE \parallel BC)$$

$$\Rightarrow \triangle ADE \sim \triangle ABC$$

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

$$\Rightarrow \frac{4}{5} = \frac{AE}{2.5}$$

$$\Rightarrow AE = \frac{4 \times 2.5}{5}$$

$$\Rightarrow AE = 2 \text{ cm}$$

(iii) In  $\triangle ADE$  and  $\triangle ABC$

$$\angle D = \angle B \text{ and } \angle C = \angle E \quad (DE \parallel BC)$$

$$\Rightarrow \triangle ADE \sim \triangle ABC$$

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

$$\Rightarrow \frac{4x-3}{3x-1} = \frac{8x-7}{5x-3}$$

$$\Rightarrow (4x-3) \times (5x-3) = (8x-7) \times (3x-1)$$

$$\Rightarrow 20x^2 - 15x - 12x + 9 = 24x^2 - 21x - 8x + 7$$

$$\Rightarrow 20x^2 - 27x + 9 = 24x^2 - 29x + 7$$

$$\Rightarrow 4x^2 - 2x - 2 = 0$$

$$\Rightarrow x(x-1) + \frac{1}{2}(x-1) = 0$$

$$\Rightarrow (x + \frac{1}{2}) = 0; x - 1 = 0$$

$$\Rightarrow x = -\frac{1}{2}; x = 1$$

$$\therefore x = 1$$

(iv) In  $\triangle ADE$  and  $\triangle ABC$

$$\angle D = \angle B \text{ and } \angle C = \angle E \quad (DE \parallel BC)$$

$$\Rightarrow \triangle ADE \sim \triangle ABC$$

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

$$DB = AB - AD = 12 - 8 = 4$$

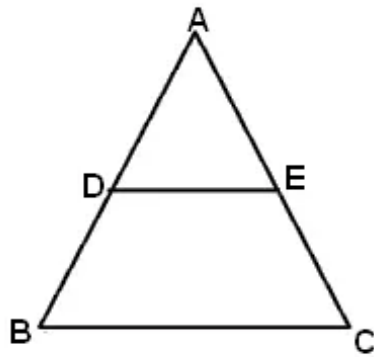
$$\Rightarrow \frac{8}{4} = \frac{12}{EC}$$

$$\Rightarrow 8 \times EC = 12 \times 4$$

$$\Rightarrow EC = \frac{12 \times 4}{8}$$

$$\Rightarrow EC = 6 \text{ cm}$$

**Answer 2.**



(i)  $AB=5.6$  cm,  $AD=1.4$  cm,  $AC=7.2$  cm and  $AE=1.8$  cm

$$\frac{AD}{AB} = \frac{1.4}{5.6} = \frac{7}{28} = \frac{1}{4}$$

$$\frac{AE}{AC} = \frac{1.8}{7.2} = \frac{2}{8} = \frac{1}{4}$$

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

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

$$\Rightarrow \angle D = \angle B; \angle E = \angle C$$

But these are corresponding angles

Hence,  $DE \parallel BC$

~~By the converse of basic proportionality theorem, we can say that DE is parallel to BC.~~

$$AD = AB - BD = 10.8 - 4.5 = 6.3 \text{ cm}$$

$$\frac{AD}{AB} = \frac{6.3}{10.8} = \frac{21}{36} = \frac{7}{12}$$

$$\frac{AE}{AC} = \frac{2.8}{4.8} = \frac{14}{24} = \frac{7}{12}$$

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

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

$$\Rightarrow \angle D = \angle B; \angle E = \angle C$$

But these are corresponding angles

Hence,  $DE \parallel BC$

(iii)  $AD=5.7$  cm,  $BD=9.5$  cm,  $AE=3.3$  cm and  $EC=5.5$  cm

$$\frac{AD}{BD} = \frac{5.7}{9.5} = 0.6$$

$$\frac{AE}{EC} = \frac{3.3}{5.5} = \frac{3}{5} = 0.6$$

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

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

$$\Rightarrow \angle D = \angle B; \angle E = \angle C$$

But these are corresponding angles

Hence,  $DE \parallel BC$

**Answer 3.**

(i) Since  $PQ \parallel BC$

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

$$\Rightarrow \frac{AP}{AB - AP} = \frac{AQ}{QC}$$

$$\Rightarrow \frac{2}{5} = \frac{AQ}{10}$$

$$\Rightarrow AQ = \frac{2 \times 10}{5}$$

$$\Rightarrow AQ = 4$$

(ii) Since  $PQ \parallel BC$

$$\frac{AP}{AB} = \frac{PQ}{BC}$$

$$\Rightarrow \frac{2}{7} = \frac{PQ}{21}$$

$$\Rightarrow PQ = \frac{2 \times 21}{7}$$

$$\Rightarrow PQ = 6$$

**Answer 4.**

(i) Since  $DE \parallel BC$

$$\frac{DE}{BC} = \frac{AD}{AB}$$

$$\Rightarrow \frac{3}{8} = \frac{AD}{AB} \Rightarrow \frac{AD}{AB} = \frac{3}{8}$$

$$\text{Since } DB = AB - AD$$

$$\Rightarrow DB = 8 - 3 = 5$$

$$\text{Therefore, } AD:DB = 3:5$$

(ii)  $DE:BC = 3:8$

Since  $DE \parallel BC$

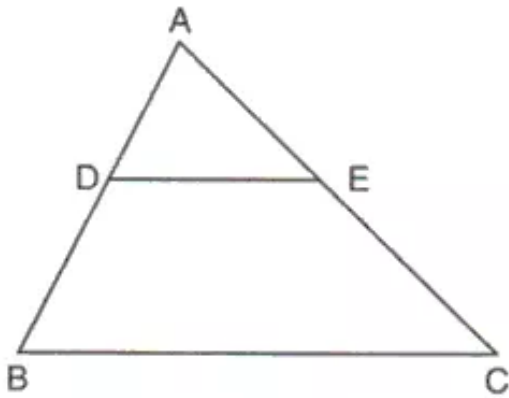
$$\frac{DE}{BC} = \frac{AE}{AC}$$

$$\Rightarrow \frac{3}{8} = \frac{AE}{16}$$

$$\Rightarrow AE = \frac{3 \times 16}{8}$$

$$\Rightarrow AE = 6$$

**Answer 5.**



Considering  $DE \parallel BC$

$$\begin{aligned} \text{(i)} \quad \frac{AD}{DB} &= \frac{AE}{EC} \\ \Rightarrow \frac{AE}{EC} &= \frac{AD}{DB} \\ \Rightarrow \frac{AE}{EC} &= \frac{5}{7} \end{aligned}$$

$$\begin{aligned} \text{(ii)} \quad \frac{AD}{DB} &= \frac{5}{7} \\ \because AB &= AD + DB \\ \Rightarrow AB &= 5 + 7 = 12 \\ \therefore \frac{AD}{AB} &= \frac{5}{12} \end{aligned}$$

$$\begin{aligned} \text{(iii)} \quad \frac{AD}{DB} &= \frac{AE}{EC} \\ \Rightarrow \frac{AE}{EC} &= \frac{AD}{DB} \\ \Rightarrow \frac{AE}{EC} &= \frac{5}{7} \\ \because AC &= AE + EC \\ \Rightarrow AC &= 5 + 7 = 12 \\ \therefore \frac{AE}{AC} &= \frac{5}{12} \end{aligned}$$

(iv) Since  $DE \parallel BC$

$$\begin{aligned} \frac{AD}{AB} &= \frac{DE}{BC} \\ \Rightarrow \frac{5}{12} &= \frac{2.5}{BC} \\ \Rightarrow BC &= \frac{2.5 \times 12}{5} \\ \Rightarrow BC &= 6\text{cm} \end{aligned}$$

(v) Since  $DE \parallel BC$

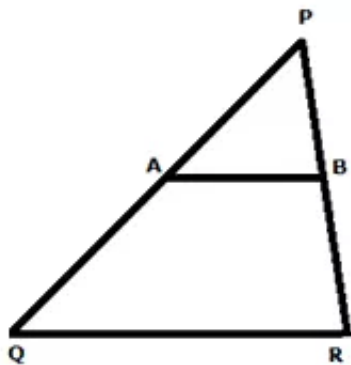
$$\frac{AD}{AB} = \frac{DE}{BC}$$

$$\Rightarrow \frac{5}{12} = \frac{DE}{4.8}$$

$$\Rightarrow DE = \frac{5 \times 4.8}{12}$$

$$\Rightarrow BC = 2\text{cm}$$

**Answer 6.**



$AB \parallel QR$

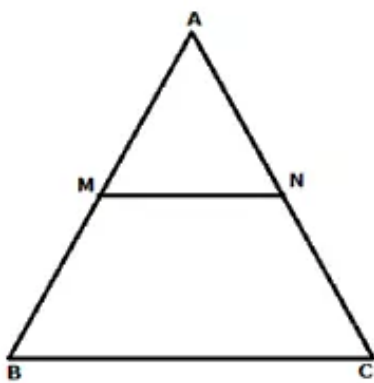
$$\frac{AP}{PQ} = \frac{PB}{PR}$$

$$\Rightarrow \frac{AP}{9} = \frac{4.2}{6}$$

$$\Rightarrow AP = \frac{4.2 \times 9}{6}$$

$$\Rightarrow AP = 6.3\text{cm}$$

**Answer 7.**



(i)  $\frac{AM}{AB} = \frac{5}{7}$

$\therefore AB = 3.5\text{cm}$

$\therefore AM = \frac{5 \times AB}{7}$

$$\Rightarrow AM = \frac{5 \times 3.5}{7}$$

$$\Rightarrow AM = 2.5\text{cm}$$

(ii) Since  $MN \parallel BC$  and  $\frac{AM}{MB} = \frac{AN}{NC}$

$$\therefore AB = 3.5\text{cm}; AM = 2.5\text{cm}$$

$$\therefore MB = AB - AM = 3.5 - 2.5 = 1\text{cm}$$

$$\Rightarrow \frac{AM}{MB} = \frac{AN}{NC}$$

$$\Rightarrow \frac{2.5}{1} = \frac{AN}{2}$$

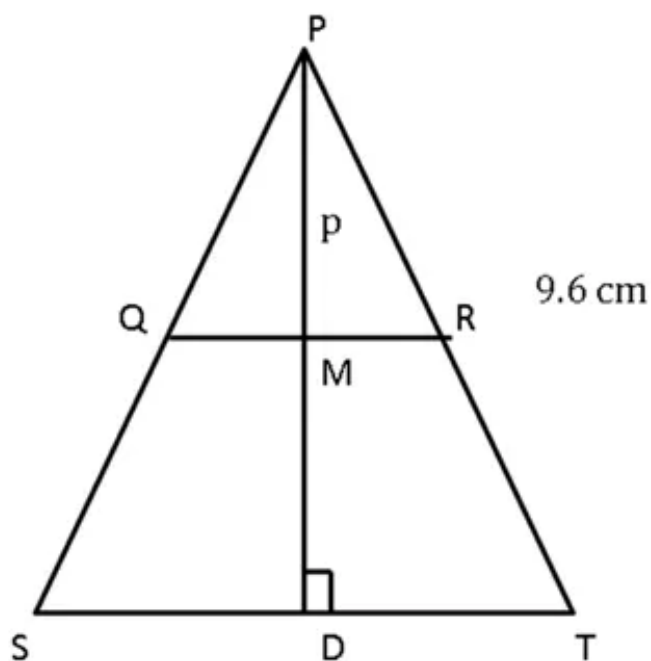
$$\Rightarrow AN = \frac{2.5 \times 2}{1} = 5\text{cm}$$

Now,

$$AC = AN + NC$$

$$\Rightarrow AC = 5 + 2 = 7\text{cm}$$

### Answer 8.



Since  $QR$  is parallel to  $ST$ ,

By Basic Theorem of Proportionality,

$$\frac{PQ}{PS} = \frac{PR}{PT}$$

$$\Rightarrow \frac{3}{4} = \frac{PR}{9.6}$$

$$\Rightarrow PR = \frac{9.6 \times 3}{4} = 7.2\text{ cm}$$

Since QR is parallel to ST,

$QM \parallel SD$

By Basic Theorem of Proportionality,

$$\frac{PQ}{PS} = \frac{PM}{PD}$$

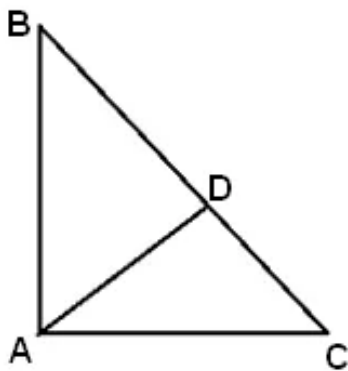
$$\Rightarrow \frac{3}{4} = \frac{p}{PD}$$

$$\Rightarrow PD = \frac{4p}{3}$$

So, the length of the perpendicular from P to ST in

terms of p is  $\frac{4p}{3}$ .

**Answer 9.**



In  $\triangle ABC$ ,

Using Pythagoras theorem

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

$$BC^2 = 8^2 + 6^2$$

$$BC^2 = 64 + 36$$

$$BC = \sqrt{100} = 10 \dots\dots\dots(i)$$

In  $\triangle ABD$ ,

Using Pythagoras theorem

$$AD^2 = AB^2 - BD^2$$

$$AD^2 = 8^2 - BD^2 \dots (ii)$$

In  $\triangle ACD$ ,

Using Pythagoras theorem

$$AD^2 = AC^2 - CD^2$$

$$AD^2 = 6^2 - CD^2 \dots (iii)$$

Equating (ii) and (iii)

$$8^2 - BD^2 = 6^2 - CD^2$$

$$\therefore CD = BC - BD$$

$$8^2 - BD^2 = 6^2 - (BC - BD)^2$$

$$CD = BC - BD$$

$$BC = 10\text{cm (from (i))}$$

$$8^2 - BD^2 = 6^2 - (10 - BD)^2$$

$$8^2 - BD^2 = 6^2 - (100 - 20BD + BD^2)$$

$$64 - BD^2 = 36 - 100 + 20BD - BD^2$$

$$64 = -64 + 20BD$$

$$20BD = 128$$

$$BD = 6.4\text{cm}$$

### Answer 10.

In  $\triangle PRT$  and  $\triangle SQT$

$$\angle PTR = \angle STQ \quad (\text{vertically opposite angles})$$

$$\angle RPT = \angle SQT \quad (\text{alternate angles } \because PR \parallel SQ)$$

$\therefore \triangle PRT \cong \triangle SQT$

$$\Rightarrow \frac{RT}{PT} = \frac{ST}{TQ}$$

$$\Rightarrow \frac{RT}{5} = \frac{9}{6}$$

$$\Rightarrow RT = \frac{5 \times 9}{6}$$

$$\Rightarrow RT = 7.5\text{cm}$$

Also,

$$\frac{PT}{PR} = \frac{TQ}{SQ}$$

$$\Rightarrow \frac{5}{10} = \frac{6}{SQ}$$

$$\Rightarrow SQ = \frac{6 \times 10}{5}$$

$$\Rightarrow SQ = 12\text{cm}$$

**Answer 11.**

In  $\triangle CGB$  and  $\triangle AGP$

$$\angle CGB = \angle AGP \quad (\text{vertically opposite angles})$$

$$\angle GAP = \angle GCB \quad (AD \parallel BC, \text{ therefore alternate angles})$$

Therefore,  $\triangle CGB \sim \triangle AGP$  (AA axiom)

$$\therefore \frac{CG}{GA} = \frac{BC}{AP}$$

$$\Rightarrow \frac{3}{5} = \frac{12}{AP}$$

$$\Rightarrow AP = \frac{5 \times 12}{3}$$

$$\Rightarrow AP = 20\text{cm}$$

**Answer 12.**

(i) In  $\triangle OBQ$  and  $\triangle OPC$

$$\angle OQB = \angle OPC = 90^\circ \quad (\text{QC and BP are altitudes})$$

$$\angle QOB = \angle POC \quad (\text{vertically opposite angles})$$

Therefore,  $\triangle OBQ \sim \triangle OPC$

$$\Rightarrow \frac{PC}{OP} = \frac{QB}{OQ}$$

$$\Rightarrow PC \times OQ = QB \times OP$$

(ii) Since  $\triangle OBQ \sim \triangle OPC$

$$\frac{OC}{PO} \times \frac{OC}{PC} = \frac{OB}{QB} \times \frac{OB}{QO}$$

$$\Rightarrow \frac{OC^2}{PC \times PO} = \frac{OB^2}{QB \times QO}$$

$$\Rightarrow \frac{OC^2}{OB^2} = \frac{PC \times PO}{QB \times QO}$$

**Answer 13.**

In  $\triangle PQS$  and  $\triangle QTR$

$$\angle PQS = \angle TQR \quad (\text{vertically opposite angles})$$

$$\angle SPQ = \angle QRT \quad (\text{alternate angles})$$

Therefore,  $\triangle PQS \sim \triangle QTR$

$$\Rightarrow \frac{PQ}{QS} = \frac{QR}{QT}$$

$$\Rightarrow \frac{PQ}{12} = \frac{15}{10}$$

$$\Rightarrow PQ = \frac{15 \times 12}{10}$$

$$\Rightarrow PQ = 18\text{cm}$$

Also,

$$\Rightarrow \frac{QS}{PS} = \frac{QT}{RT}$$

$$\Rightarrow \frac{12}{PS} = \frac{10}{6}$$

$$\Rightarrow PS = \frac{6 \times 12}{10}$$

$$\Rightarrow PS = 7.2\text{cm}$$

**Answer 14.**

In  $\triangle PQA$  and  $\triangle DQC$

$$\angle PQA = \angle DQC \quad (\text{vertically opposite angles})$$

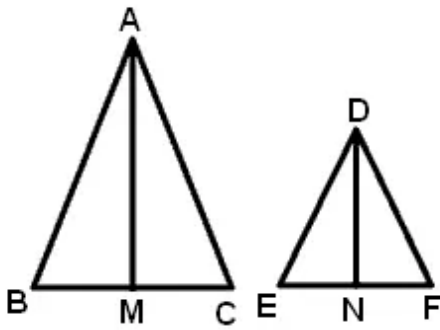
$$\angle APQ = \angle QDC \quad (\text{alternate angles since } AB \parallel DC)$$

Therefore,  $\triangle PQA \sim \triangle DQC$

$$\therefore \frac{CQ}{QD} = \frac{QA}{PQ}$$

$$\Rightarrow CQ \times PQ = QA \times QD$$

**Answer 15.**



Since  $\triangle ABC \sim \triangle DEF$

$$\angle B = \angle E$$

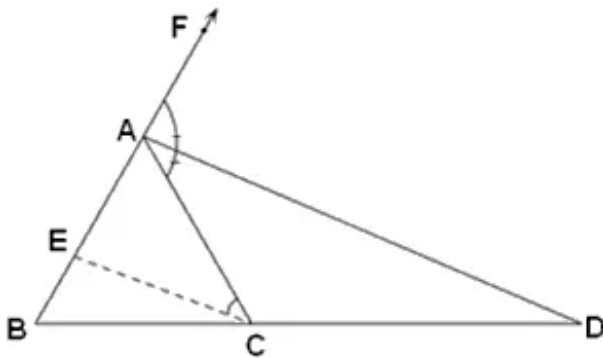
$$\angle AMB = \angle DNE \quad (\text{Both are right angles})$$

Therefore,  $\triangle ANB \sim \triangle DNE$

$$\therefore \frac{AM}{DN} = \frac{AB}{DE}$$

$$\Rightarrow AM:DN = AB:DE$$

**Answer 16.**



In  $\triangle ABC$ ,  $CE \parallel AD$

$$\therefore \frac{BD}{CD} = \frac{AB}{AE} \dots\dots(i)$$

(By Basic Proportionality theorem)

AD is the bisector of  $\angle CAF$

$$\angle FAD = \angle CAD \dots\dots(ii)$$

Since  $CE \parallel AD$

Therefore,

$$\angle ACE = \angle CAD \dots\dots(iii) \quad (\text{alternate angles})$$

$$\angle AEC = \angle FAD \dots\dots(iv) \quad (\text{corresponding angles})$$

From (ii), (iii) and (iv)

$$\angle AEC = \angle ACE$$

In  $\triangle AEC$ ,

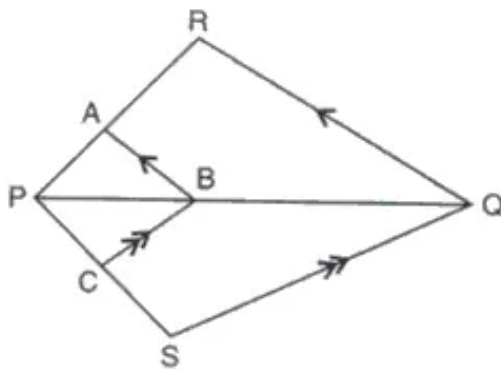
$$\angle AEC = \angle ACE$$

$\Rightarrow AC = AE$  .....(v) (Equal angles have equal sides opposite to them)

From (i) and (v)

$$\frac{BD}{CD} = \frac{AB}{AC}$$

**Answer 17.**



In  $\triangle PQR$ ,  $AB \parallel RQ$

$$\therefore \frac{PA}{PR} = \frac{PB}{PQ} \text{ .....(i) (By Basic Proportionality theorem)}$$

In  $\triangle PQS$ ,  $BC \parallel SQ$

$$\therefore \frac{PC}{PS} = \frac{PB}{PQ} \text{ .....(ii) (By Basic Proportionality theorem)}$$

From (i) and (ii)

$$\frac{PC}{PS} = \frac{PA}{PR}$$

**Answer 18.**

In  $\triangle ABC$ ,  $DE \parallel AC$

$$\therefore \frac{BE}{EC} = \frac{BD}{DA} \text{ .....(i) (By Basic Proportionality theorem)}$$

In  $\triangle ABP$ ,  $CD \parallel AP$

$$\therefore \frac{BC}{CP} = \frac{BD}{DA} \text{ .....(ii) (By Basic Proportionality theorem)}$$

From (i) and (ii)

$$\frac{BE}{EC} = \frac{BC}{CP}$$

**Answer 19.**

In  $\triangle ABD$  and  $\triangle APQ$ ,

$$\angle BDA = \angle PQA = 90^\circ$$

$$\angle A = \angle A$$

Therefore,  $\triangle ABD \sim \triangle APQ$  (AA axiom)

$$\text{And hence, } \frac{AB}{AP} = \frac{BD}{PQ}$$

**Answer 20.**

In  $\triangle PMS$  and  $\triangle MQN$

$$\angle PMS = \angle NMQ \quad (\text{vertically opposite angles})$$

$$\angle SPM = \angle MQN \quad (\text{alternate angles, since } PS \parallel QN)$$

Therefore,  $\triangle PMS \sim \triangle MQN$

$$\therefore \frac{SP}{PM} = \frac{MQ}{QN} \quad \dots\dots\dots(i)$$

In  $\triangle PMS$  and  $\triangle MRS$

$$\angle PMS = \angle MSR \quad (\text{alternate angles, since } PM \parallel SR)$$

$$SM = SM$$

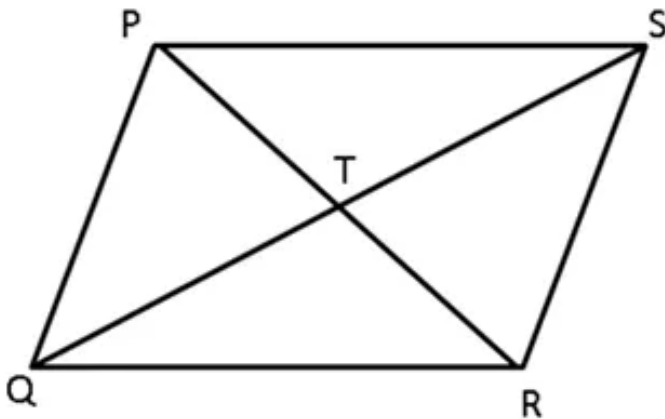
Therefore,  $\triangle PMS \sim \triangle MRS$

$$\therefore \frac{SP}{PM} = \frac{MR}{SR} \quad \dots\dots\dots(ii)$$

From (i) and (ii)

$$\therefore \frac{SP}{PM} = \frac{MQ}{QN} = \frac{MR}{SR}$$

**Answer 21A.**



Consider  $\triangle PTQ$  and  $\triangle RTS$ ,

$$\frac{PT}{TR} = \frac{QT}{TS} = \frac{1}{2} \text{ (Given)}$$

$\angle PTQ = \angle RTS$  (Vertically Opposite angles)

$\Rightarrow \triangle PTQ \sim \triangle RTS$  (SAS criterion for Similarity)

**Answer 21B.**

Consider  $\triangle PTQ$  and  $\triangle RTS$ ,

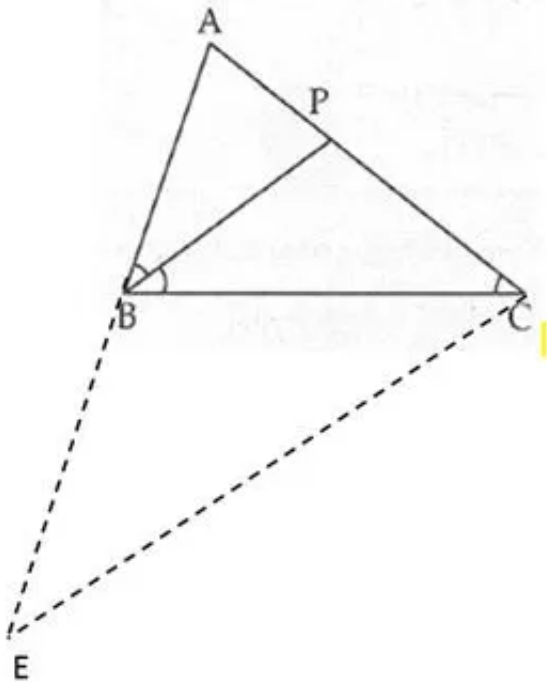
$$\frac{PT}{TR} = \frac{QT}{TS} = \frac{1}{2} \text{ (Given)}$$

$\angle PTQ = \angle RTS$  (Vertically Opposite angles)

$\Rightarrow \triangle PTQ \sim \triangle RTS$  (SAS criterion for Similarity)

$$\Rightarrow \frac{TP}{TQ} = \frac{TR}{TS} \text{ (Re arranging the terms)}$$

**Answer 22A.**



a Construction : Draw  $CE \parallel BP$  and produce  $AB$  to  $E$ .

Proof :  $BP \parallel EC$

$\angle PBC = \angle BCE$  (Alternate angles)

$\angle ABP = \angle AEC$  (Corresponding angles)

Also,  $\angle ABP = \angle PBC$

$\Rightarrow \angle BCE = \angle BEC$

So,  $BE = BC$

In  $\triangle AEC$ ,

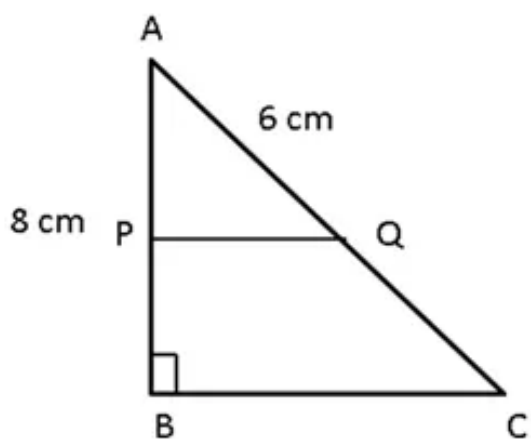
$$\frac{AP}{PC} = \frac{AB}{BE}$$

$$\Rightarrow \frac{AP}{PC} = \frac{AB}{BC}$$

$$\Rightarrow BC \times AP = PC \times AB$$

b. Note : It is not possible to prove this part due to inadequate data.

**Answer 23.**



In right - angled  $\triangle ABC$ ,

$PQ \parallel BC$

$$\Rightarrow \frac{PA}{AB} = \frac{QA}{AC}$$

$$\Rightarrow \frac{1}{3} = \frac{6}{AC}$$

$$\Rightarrow AC = 18 \text{ cm}$$

By Pythagoras Theorem,

$$BC^2 = AC^2 - AB^2$$

$$\Rightarrow BC^2 = 18^2 - 8^2$$

$$\Rightarrow BC^2 = 324 - 64$$

$$\Rightarrow BC = 16.12 \text{ cm}$$

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**Ex 16.2****Answer 1.**

$$\triangle ABC \sim \triangle PRQ$$

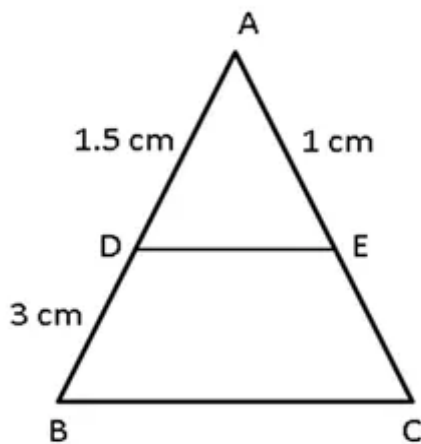
$$A \leftrightarrow P, B \leftrightarrow R, C \leftrightarrow Q$$

$$\angle A \sim \angle P$$

$$\angle B \sim \angle R$$

$$\angle C \sim \angle Q$$

$$AB \sim PR, BC \sim RQ, AC \sim PQ$$

**Answer 2.**

$$DE \parallel BC$$

$$\frac{AD}{AB} = \frac{AE}{AC}$$

$$\Rightarrow \frac{1.5}{4.5} = \frac{1}{AC}$$

$$\Rightarrow AC = 3 \text{ cm}$$

**Answer 3.**

Since the two triangles are similar,  
so the ratio of the corresponding sides are equal.

Let  $x$  and  $y$  be the sides of the triangle,  
where  $y$  is the longest side.

$$\frac{3}{5} = \frac{4.5}{x} \Rightarrow x = 7.5 \text{ cm}$$

$$\frac{5}{6} = \frac{7.5}{y} \Rightarrow y = 9 \text{ cm}$$

So, the sides of the triangles are 4.5 cm, 7.5 cm and 9 cm.

#### Answer 4.

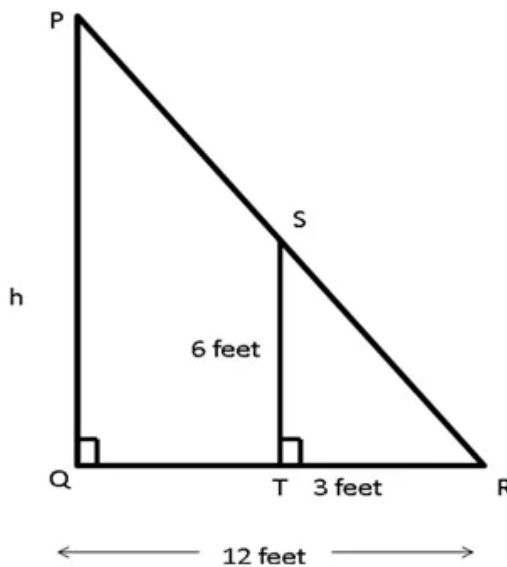
We know that,

for two similar triangles, ratio of the corresponding sides is equal to ratio of the perimeters of the triangles.

$$\Rightarrow \text{Ratio of the corresponding sides} = \frac{8}{16} = \frac{1}{2}$$

that is, ratio of the corresponding sides is 1 : 2.

#### Answer 5.



Harmeet and the pole will be perpendicular to the ground.

So,  $PQ \parallel ST$

In  $\triangle PQR$  and  $\triangle STR$ ,

$\angle PQR = \angle STR$  (Both are right angles)

$\angle PRQ = \angle SRT$  (common angle)

$\triangle PQR \sim \triangle STR$  (AA criterion for similarity)

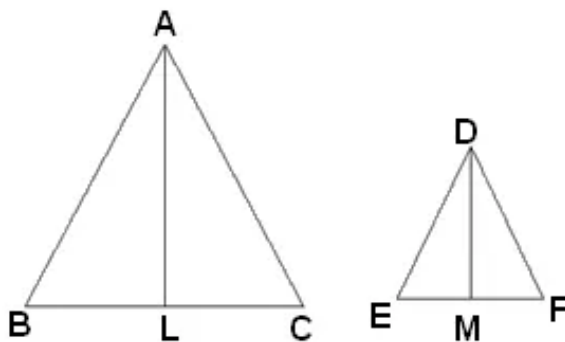
$$\frac{PQ}{ST} = \frac{QR}{TR}$$

$$\Rightarrow \frac{h}{6} = \frac{12}{3}$$

$$\Rightarrow h = 24 \text{ feet}$$

Hence, the height of the pole is 24 feet.

#### Answer 6.



The ratio of the areas of two similar triangles is equal to the ratio of the squares of the corresponding altitudes.

$$\therefore \frac{\text{area}(\triangle ABC)}{\text{area}(\triangle DEF)} = \frac{AL^2}{DM^2}$$

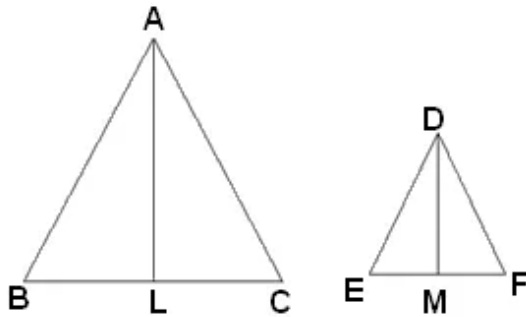
$$\Rightarrow \frac{16}{9} = \frac{AL^2}{1.8^2}$$

$$\Rightarrow AL^2 = \frac{16 \times 3.24}{9}$$

$$\Rightarrow AL^2 = 5.76$$

$$\Rightarrow AL = 2.4 \text{ cm}$$

**Answer 7.**



The ratio of the areas of two similar triangles is equal to the ratio of the squares of the corresponding sides.

$$\therefore \frac{\text{area}(\triangle ABC)}{\text{area}(\triangle DEF)} = \frac{AB^2}{DE^2}$$

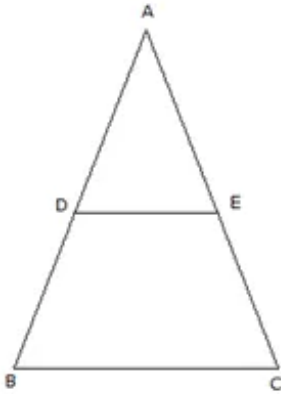
$$\Rightarrow \frac{169}{121} = \frac{26^2}{DE^2}$$

$$\Rightarrow DE^2 = \frac{121 \times 676}{169}$$

$$\Rightarrow DE^2 = 484$$

$$\Rightarrow DE = 22\text{cm}$$

**Answer 8.**



$$\text{Area}(\triangle ADE) = \text{area}(\text{trapezium BCED})$$

$$\Rightarrow \text{Area}(\triangle ADE) + \text{Area}(\triangle ADE) = \text{area}(\text{trapezium BCED}) + \text{Area}(\triangle ADE)$$

$$\Rightarrow 2 \text{Area}(\triangle ADE) = \text{Area}(\triangle ABC)$$

In  $\triangle ADE$  and  $\triangle ABC$ ,

$$\angle ADE = \angle B \quad (\text{corresponding angles})$$

$$\angle A = \angle A$$

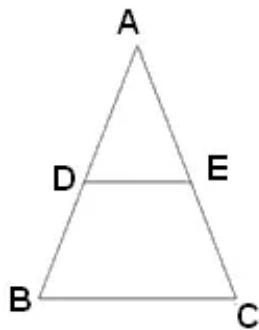
Therefore,  $\triangle ADE \sim \triangle ABC$

$$\therefore \frac{\text{area}(\triangle ADE)}{\text{area}(\triangle ABC)} = \frac{AD^2}{AB^2}$$

$$\Rightarrow \frac{\text{area}(\triangle ADE)}{2 \times \text{area}(\triangle ADE)} = \frac{AD^2}{AB^2}$$

$$\begin{aligned}
\Rightarrow \frac{1}{2} &= \left(\frac{AD}{AB}\right)^2 \\
\Rightarrow \frac{AD}{AB} &= \frac{1}{\sqrt{2}} \\
\Rightarrow AB &= \sqrt{2}AD \\
\Rightarrow AB &= \sqrt{2}(AB - BD) \\
\Rightarrow (\sqrt{2} - 1)AB &= \sqrt{2}BD \\
\Rightarrow \frac{BD}{AB} &= \frac{\sqrt{2} - 1}{\sqrt{2}} = \frac{2 - \sqrt{2}}{2}
\end{aligned}$$

**Answer 9.**



$$AD : DB = 2 : 3$$

$$AB = AD + DB = 2 + 3 = 5$$

$$(i) \frac{\text{area}(\triangle ADE)}{\text{area}(\triangle ABC)} = \frac{AD^2}{AB^2}$$

$$\Rightarrow \frac{\text{area}(\triangle ADE)}{\text{area}(\triangle ABC)} = \frac{2^2}{5^2}$$

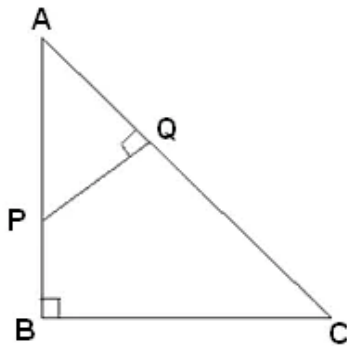
$$\Rightarrow \frac{\text{area}(\triangle ADE)}{\text{area}(\triangle ABC)} = \frac{4}{25}$$

$$(ii) \frac{\text{area}(\text{trapezium EDBC})}{\text{area}(\triangle ABC)} = \frac{\text{area}(\triangle ABC) - \text{area}(\triangle ADE)}{\text{area}(\triangle ABC)}$$

$$\Rightarrow \frac{\text{area}(\text{trapezium EDBC})}{\text{area}(\triangle ABC)} = \frac{25 - 4}{25}$$

$$\Rightarrow \frac{\text{area}(\text{trapezium EDBC})}{\text{area}(\triangle ABC)} = \frac{21}{25}$$

**Answer 10.**



In  $\triangle AQP$  and  $\triangle ABC$

$$\angle A = \angle A$$

$$\angle PQA = \angle ABC \quad (\text{right angles})$$

Therefore,  $\triangle AQP \sim \triangle ABC$

(i) By Pythagoras theorem,

$$BC^2 = AC^2 - AB^2$$

$$\Rightarrow BC^2 = 10^2 - 8^2$$

$$\Rightarrow BC^2 = 100 - 64$$

$$\Rightarrow BC^2 = 36$$

$$\Rightarrow BC = 6\text{cm}$$

$$\text{Area}(\triangle ABC) = \frac{1}{2} \times AB \times BC$$

$$\text{Area}(\triangle ABC) = \frac{1}{2} \times 8 \times 6$$

$$\text{Area}(\triangle ABC) = 24\text{cm}^2$$

Since  $\triangle AQP \sim \triangle ABC$

$$\frac{\text{Area}(\triangle AQP)}{\text{Area}(\triangle ABC)} = \frac{PQ^2}{BC^2}$$

$$\Rightarrow \frac{\text{Area}(\triangle AQP)}{24} = \frac{3^2}{6^2}$$

$$\Rightarrow \text{Area}(\triangle AQP) = \frac{9 \times 24}{36}$$

$$\Rightarrow \text{Area}(\triangle AQP) = 6\text{cm}^2$$

(ii)  $\text{Area}(\text{trapezium EDBC}) = \text{Area}(\triangle ABC) - \text{Area}(\triangle AQP)$

$$\text{Area}(\text{trapezium EDBC}) = 24 - 6 = 18\text{cm}^2$$

$$\frac{\text{Area}(\text{Trapezium EDBC})}{\text{Area}(\triangle ABC)} = \frac{18}{24}$$

$$\Rightarrow \frac{\text{Area}(\text{Trapezium EDBC})}{\text{Area}(\triangle ABC)} = \frac{3}{4}$$

$$\text{Area}(\text{trapezium EDBC}) : \text{Area}(\triangle ABC) = 3 : 4$$

**Answer 11.**

(i) Image length = 6 cm, Actual length = 4 cm.

$$\text{Scale factor} = \frac{\text{Image length}}{\text{Actual length}} = \frac{6}{4}$$

$$\text{Scale factor} = 1.5$$

Since the scale factor  $> 1$

$\Rightarrow$  Type of size transformation = enlargement

(ii) Actual length = 12 cm, Image length = 15 cm

$$\text{Scale factor} = \frac{\text{Image length}}{\text{Actual length}} = \frac{15}{12}$$

$$\text{Scale factor} = 1.25$$

Since the scale factor  $> 1$

$\Rightarrow$  Type of size transformation = enlargement

(iii) Image length = 8 cm, Actual length = 20 cm.

$$\text{Scale factor} = \frac{\text{Image length}}{\text{Actual length}} = \frac{8}{20}$$

$$\text{Scale factor} = 0.4$$

Since the scale factor  $< 1$  and  $> 0$

$\Rightarrow$  Type of size transformation = reduction

(iv) Actual area =  $64\text{m}^2$ , Model area =  $100\text{cm}^2$

$$\text{Actual area} = 64 \times 10000 \text{ cm}^2 = 640000 \text{ cm}^2$$

$$\text{Scale factor} = \sqrt{\frac{\text{Model Area}}{\text{Actual Area}}} = \sqrt{\frac{100}{640000}} = \sqrt{\frac{1}{6400}} = \frac{1}{80}$$

$$\text{Scale factor} = 0.0125$$

Since the scale factor  $< 1$  and  $> 0$

$\Rightarrow$  Type of size transformation = reduction

(v) Model area =  $75\text{cm}^2$ , Actual area =  $3\text{m}^2$

$$\text{Actual area} = 3 \times 10000 \text{ cm}^2 = 30000 \text{ cm}^2$$

$$\text{Scale factor} = \sqrt{\frac{\text{Model Area}}{\text{Actual Area}}} = \sqrt{\frac{75}{30000}} = \sqrt{\frac{1}{400}} = \frac{1}{20}$$

$$\text{Scale factor} = 0.05$$

Since the scale factor  $< 1$  and  $> 0$

$\Rightarrow$  Type of size transformation = reduction

(vi) Model volume = 200 cm<sup>3</sup>, Actual volume = 8 m<sup>3</sup>

$$\text{Actual volume} = 8 \times 1000000 \text{ cm}^3 = 8000000 \text{ cm}^3$$

$$\text{Scale factor} = \sqrt[3]{\frac{\text{Model Volume}}{\text{Actual Volume}}} = \sqrt[3]{\frac{200}{8000000}} = \sqrt[3]{\frac{1}{40000}} = \frac{1}{200}$$

$$\text{Scale factor} = 0.005$$

Since the scale factor < 1 and > 0

⇒ Type of size transformation = reduction

### Answer 12.

$$(i) \frac{\text{Image length}}{\text{Actual length}} = \text{Scale factor}$$

$$\frac{B'C'}{8} = 0.6$$

$$\Rightarrow B'C' = 8 \times 0.6$$

$$\Rightarrow B'C' = 4.8 \text{ cm}$$

$$(ii) \frac{\text{Image length}}{\text{Actual length}} = \text{Scale factor}$$

$$\frac{A'B'}{AB} = 0.6$$

$$\Rightarrow AB = \frac{5.4}{0.6}$$

$$\Rightarrow AB = 9 \text{ cm}$$

### Answer 13.

$$(i) \frac{\text{Image length}}{\text{Actual length}} = \text{Scale factor}$$

$$\frac{A'B'}{AB} = 5$$

$$\Rightarrow A'B' = 4 \times 5$$

$$\Rightarrow A'B' = 20 \text{ cm}$$

$$(ii) \frac{\text{Image length}}{\text{Actual length}} = \text{Scale factor}$$

$$\frac{B'C'}{BC} = 5$$

$$\Rightarrow BC = \frac{16}{5}$$

$$\Rightarrow BC = 3.2 \text{ cm}$$

**Answer 14.**

$$\text{Scale factor} = \frac{\text{Image length}}{\text{Actual length}}$$

$$\text{Scale factor} = \frac{12}{8} = 1.5$$

$$\frac{X'Y'}{XY} = 1.5$$

$$\Rightarrow X'Y' = 1.5 \times 12$$

$$\Rightarrow X'Y' = 18\text{cm}$$

$$\frac{X'Z'}{XZ} = 1.5$$

$$\Rightarrow X'Z' = 1.5 \times 14$$

$$\Rightarrow X'Z' = 21\text{cm}$$

**Answer 15.**

$$\text{Scale} = 1:25000$$

(i) Actual length of AB =  $3 \times 250000$  cm

$$= \frac{3 \times 250000}{100 \times 1000} \text{ km}$$
$$= 7.5 \text{ km}$$

$$\text{AB} = 7.5 \text{ km}$$

(ii) Actual length of BC =  $4 \times 250000$  cm

$$= \frac{4 \times 250000}{100 \times 1000} \text{ km}$$
$$= 10 \text{ km}$$

$$\text{BC} = 10 \text{ km}$$

$$\text{Area}(\Delta ABC) = \frac{1}{2} \times \text{AB} \times \text{BC}$$

$$\text{Area}(\Delta ABC) = \frac{1}{2} \times 7.5 \times 10 \text{ km}^2$$

$$\text{Area}(\Delta ABC) = 37.5 \text{ km}^2$$

$$\text{Area of plot} = 37.5 \text{ km}^2$$

**Answer 16.**

$$1.2\text{m} \times 75\text{ cm} \times 2\text{ m} = 1.2\text{m} \times 0.75\text{ m} \times 2\text{ m}$$

$$\text{Scale factor} = 1:20$$

$$\text{Length} = 2\text{m}$$

$$\text{Actual length} = 20 \times \text{length} = 20 \times 2 = 40\text{m}$$

$$\text{Breadth} = 0.75\text{ m}$$

$$\text{Actual breadth} = 20 \times \text{breadth} = 20 \times 0.75 = 15\text{m}$$

$$\text{Height} = 1.2\text{ m}$$

$$\text{Actual height} = 20 \times \text{height} = 20 \times 1.2 = 24.0\text{m}$$

$$\text{Actual dimensions are} = 24\text{m} \times 15\text{m} \times 40\text{m}$$

**Answer 17.**

$$\text{Scale factor} = 1:50000$$

(i) area of land represented on the map:

$$\begin{aligned} 40\text{ Sq km} &= 40 \times (100 \times 1000)^2 \text{ [as } 1\text{ km} = 100000\text{ cm]} \\ &= 40 \times 10^{10} \end{aligned}$$

$$\frac{\text{Area}(\text{map})}{\text{Area}(\text{land})} = \text{Scale}$$

$$\frac{\text{Area}(\text{map})}{40 \times 10^{10}} = \frac{1}{(50000)^2}$$

$$\text{Area}(\text{map}) = \frac{40 \times 10^{10}}{(50000)^2} = \frac{4000}{25}$$

$$\text{Area}(\text{map}) = 160\text{cm}^2$$

(ii) 1 cm on the map = 50,000 cm on the land (as the scale is 1:50000)

$$1\text{ km} = 100000\text{ cm} = 2 \times 50000\text{ cm}$$

$$\frac{\text{distance}(\text{map})}{\text{distance}(\text{land})} = \text{Scale}$$

$$\frac{1}{\text{distance}(\text{land}) \times (100000)} = \frac{1}{(50000)}$$

$$\text{Hence } 1\text{ cm on map} = \frac{50000}{100000}$$

$$= 0.5\text{ km.}$$

**Answer 18.**

(i) 1 cm on the map = 200,000 cm on the land (as the scale is 1:200000)

$$1 \text{ km} = 100000 \text{ cm}$$

$$\frac{\text{distance}(\text{map})}{\text{distance}(\text{land})} = \text{Scale}$$

$$\frac{2}{\text{distance}(\text{land}) \times (100000)} = \frac{1}{(200000)}$$

$$\begin{aligned} \text{Hence 2 cm on map} &= \frac{2 \times 200000}{100000} \\ &= 4 \text{ km.} \end{aligned}$$

(ii) 1 cm on the map = 200,000 cm on the land (as the scale is 1:200000)

$$1 \text{ cm}^2 \text{ on the map} = (200000)^2 \text{ on the land}$$

$$1 \text{ km} = 100000 \text{ cm} \Rightarrow 1 \text{ km}^2 = 100000 \times 100000 \text{ cm}^2$$

$$\frac{\text{distance}(\text{map})}{\text{distance}(\text{land})} = \text{Scale}$$

$$\frac{2}{\text{distance}(\text{land}) \times (100000)^2} = \frac{1}{(200000)^2}$$

$$\begin{aligned} \text{Hence 2 cm}^2 \text{ on map} &= \frac{2 \times 200000 \times 200000}{100000 \times 100000} \\ &= 8 \text{ km}^2. \end{aligned}$$

(iii) area of land represented on the map:

$$20 \text{ Sq km} = 20 \times (100 \times 1000)^2 \text{ [as 1 km} = 100000 \text{ cm]}$$

$$= 20 \times 10^{10}$$

$$\frac{\text{Area}(\text{map})}{\text{Area}(\text{land})} = \text{Scale}$$

$$\frac{\text{Area}(\text{map})}{20 \times 10^{10}} = \frac{1}{(200000)^2}$$

$$\text{Area}(\text{map}) = \frac{20 \times 10^{10}}{(200000)^2} = \frac{20}{4}$$

$$\text{Area}(\text{map}) = 5 \text{ cm}^2$$

**Answer 19.**

Scale = 1:20000

(i) 1 cm on the map = 20000 cm on the land (as the scale is 1:20000)

1 km = 100000 cm

$$\frac{\text{distance}(\text{map})}{\text{distance}(\text{land})} = \text{Scale}$$

$$\frac{6}{\text{distance}(\text{land}) \times 100000} = \frac{1}{20000}$$

$$\begin{aligned} \text{Hence 6 cm on map} &= \frac{6 \times 20000}{100000} \\ &= 1.2 \text{ km.} \end{aligned}$$

(ii) 1 km = 100000 cm

4 km = 400000 cm

$$\frac{\text{distance}(\text{map})}{\text{distance}(\text{land})} = \text{Scale}$$

$$\frac{\text{distance}(\text{map})}{400000} = \frac{1}{20000}$$

$$\begin{aligned} 4 \text{ km distance on map} &= \frac{400000}{20000} \\ &= 20 \text{ cm} \end{aligned}$$

(iii) area of lake represented on the map:

$$\begin{aligned} 12 \text{ Sq km} &= 12 \times (100 \times 1000)^2 \text{ [as 1 km = 100000 cm]} \\ &= 12 \times 10^{10} \end{aligned}$$

$$\frac{\text{Area}(\text{map})}{\text{Area}(\text{land})} = \text{Scale}$$

$$\frac{\text{Area}(\text{map})}{12 \times 10^{10}} = \frac{1}{(20000)^2}$$

$$\text{Area}(\text{map}) = \frac{12 \times 10^{10}}{(20000)^2} = \frac{1200}{4}$$

$$\text{Area}(\text{map}) = 300 \text{ cm}^2$$

**Answer 20.**

$$\text{Scale} = 1:40$$

- (i) The length of the model = 15 cm

$$\text{The actual length} = 15 \times 40 = 600 \text{ cm} = \frac{600}{100} = 6 \text{ m}$$

- (ii) Volume of the truck =  $64 \text{ m}^3$

$$\frac{\text{volume(model)}}{\text{volume(truck)}} = \text{Scale}$$

$$\frac{\text{volume(model)}}{64 \times (100)^3} = \frac{1}{(40)^3}$$

$$\text{Volume(model)} = \frac{64000000}{64000}$$

$$\text{Volume(model)} = 1000 \text{ cm}^3$$

- (iii)  $\frac{\text{Area(model)}}{\text{Area(truck)}} = \text{Scale}$

$$\frac{30 \times (100)^2}{\text{Area(truck)}} = \frac{1}{(40)^2}$$

$$\text{Area(truck)} = 30 \times 1600 \times 10^4$$

$$\text{Area(truck)} = 4.8 \times 10^8 \text{ cm}^2$$

**Answer 21.**

$$\text{Scale} = 1:500$$

- (i) The length of the model = 1.2 m

$$\text{The actual length} = 1.2 \times 500 = 600 \text{ m}$$

- (ii)  $\frac{\text{Area(deck model)}}{\text{Area(deckship)}} = \text{Scale}$

$$\frac{1.6 \times 100 \times 100}{\text{Area(deckship)} \times 100 \times (1000)^2} = \frac{1}{(500)^2}$$

$$\text{Area(deckship)} = \frac{1.6 \times 2500}{10000}$$

$$\text{Area(deckship)} = 0.4 \text{ km}^2$$

- (iii) Volume of the ship =  $1 \text{ km}^3$

$$\frac{\text{volume(model)}}{\text{volume(ship)}} = \text{Scale}$$

$$\frac{\text{volume(model)}}{1 \times (1000)^3} = \frac{1}{(500)^3}$$

$$\text{Volume(model)} = \frac{1000000000}{125000000}$$

$$\text{Volume(model)} = 8 \text{ m}^3$$

**Answer 22.**

scale = 1:25000

(i) In rectangle ABCD,

AB = 12 cm, BC = 16 cm

AC is the diagonal.

By Pythagoras theorem

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

$$AC^2 = 12^2 + 16^2$$

$$AC^2 = 144 + 256 = 400$$

$$\Rightarrow AC = 20\text{cm}$$

$\therefore$  Scale = 1 : 25000

AC = 20 x 25000cm

$$\Rightarrow AC = \frac{20 \times 25000}{100 \times 1000} \text{km}$$

$$\Rightarrow AC = 5\text{km}$$

(ii) Area ABCD = 12 x 16 x 25000 x 25000 cm<sup>2</sup>

$$= \frac{12 \times 16 \times 25000 \times 25000}{100 \times 1000 \times 100 \times 1000} \text{km}^2$$

$$= \frac{120000}{10000} \text{km}^2$$

$$= 12\text{km}^2$$

**Answer 23.**

Scale = 1:25000

(i) Let AB = 225 cm and BC = 64 cm

Actual length of AB -

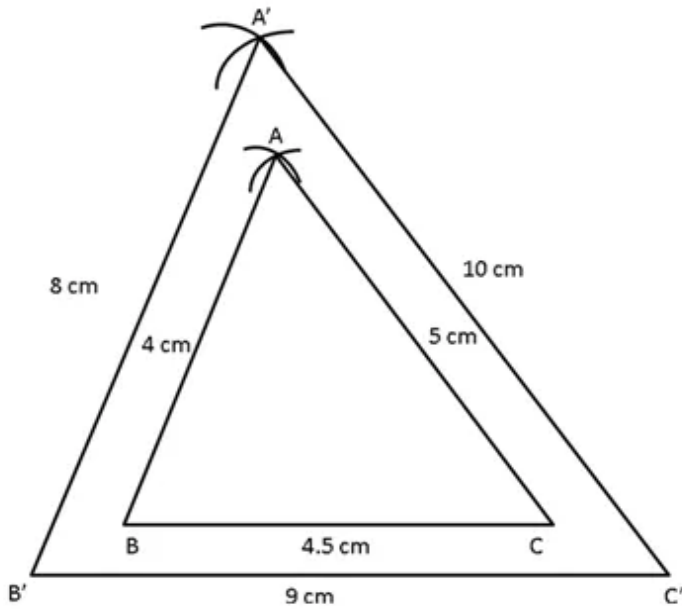
$$\begin{aligned} &= \frac{225 \times 25000}{100 \times 1000} \text{ km} \\ &= \frac{5625}{100} \text{ km} \\ &= 56.25 \text{ km} \end{aligned}$$

Actual length of BC -

$$\begin{aligned} &= \frac{64 \times 25000}{100 \times 1000} \text{ km} \\ &= \frac{16}{100} \text{ km} \\ &= 16 \text{ km} \end{aligned}$$

$$\begin{aligned} \text{(ii) Area ABC} &= \frac{1}{2} \times 12 \times 16 \times 25000 \times 25000 \text{ cm}^2 \\ &= \frac{1 \times 225 \times 64 \times 25000 \times 25000}{2 \times 100 \times 1000 \times 100 \times 1000} \text{ km}^2 \\ &= \frac{9000000}{2 \times 10000} \text{ km}^2 \\ &= 450 \text{ km}^2 \end{aligned}$$

**Answer 24.**



Steps of Construction of the Image ::

1. Draw BC measuring 4 cm.
2. With B as the centre and radius 4.5 cm, make an arc above BC.
3. With C as the centre and radius 5 cm, to cut the previous arc at C.
4.  $\triangle ABC$  is the required triangle.

$$\text{Scale factor} = \frac{A'B'}{AB}$$

$$\Rightarrow 2 = \frac{A'B'}{4}$$

$$\Rightarrow A'B' = 8 \text{ cm}$$

$$\text{Scale factor} = \frac{B'C'}{BC}$$

$$\Rightarrow 2 = \frac{B'C'}{4.5}$$

$$\Rightarrow B'C' = 9 \text{ cm}$$

$$\text{Scale factor} = \frac{A'C'}{AC}$$

$$\Rightarrow 2 = \frac{A'C'}{5}$$

$$\Rightarrow A'C' = 10 \text{ cm}$$

Steps of Construction of the Image ::

1. Draw  $B'C'$  measuring 9 cm.
2. With  $B'$  as the centre and radius 8 cm, make an arc above  $B'C'$ .
3. With  $C'$  as the centre and radius 9 cm, to cut the previous arc at  $C'$ .

4.  $\Delta A'B'C'$  is the required image of the  $\Delta ABC$ .

On measuring the sides, we get

$$\frac{A'B'}{AB} = \frac{B'C'}{BC} = \frac{A'C'}{AC} = \text{Scale factor} = 2$$