Activity 11

OBJECTIVE

To verify section formula by graphical method.

MATERIAL REQUIRED

Cardboard, chart paper, graph paper, glue, geometry box and pen/pencil.

METHOD OF CONSTRUCTION

1. Paste a chart paper on a cardboard of a convenient size.
2. Paste a graph paper on the chart paper.
3. Draw the axes X′OX and Y′OY on the graph paper [see Fig. 1].

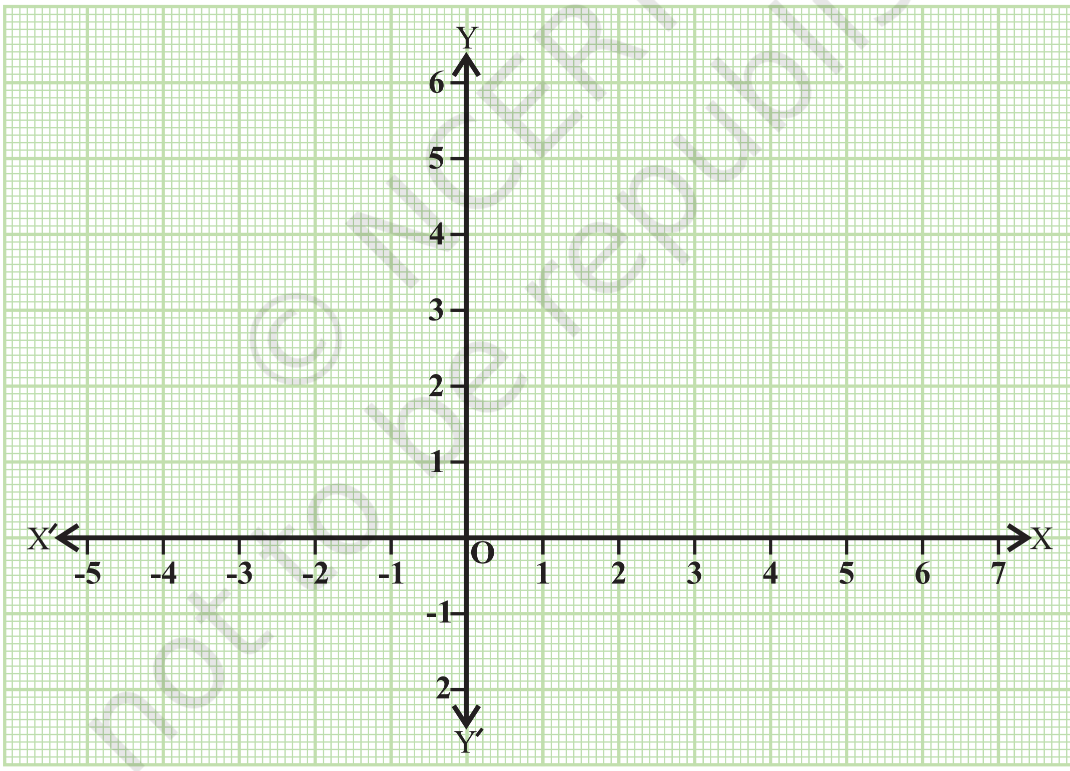

Fig. 1

4. Take two points A (x_1, y_1) and B (x_2, y_2) on the graph paper [see Fig. 2].
5. Join A to B to get the line segment AB.

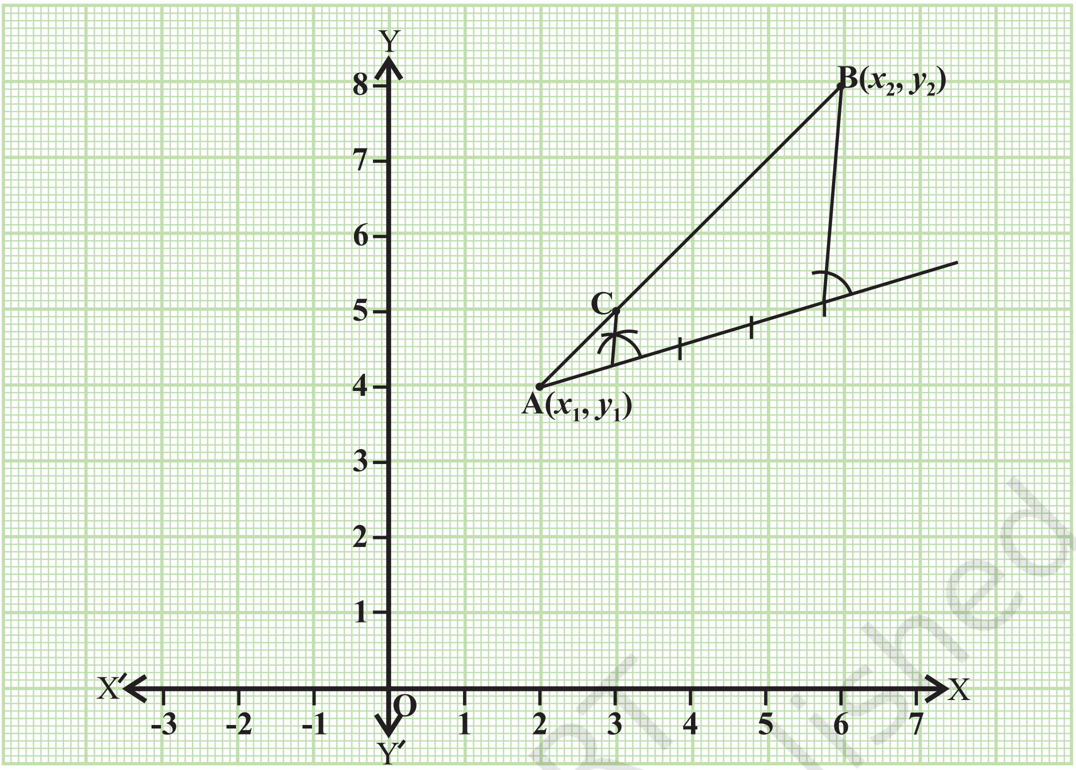

Fig. 2

Demonstration

1. Divide the line segment AB internally (in the ratio *m:n*) at the point C [see Fig. 2].
2. Read the coordinates of the point C from the graph paper.
3. Using section formula, find the coordinates of C.
4. Coordinates of C obtained from Step 2 and Step 3 are the same.

Observation

1. Coordinates of A are __________.
2. Coordinates of B are __________.
3. Point C divides AB in the ratio __________.
4. Coordinates of C from the graph paper are __________.
5. Coordinates of C by using section formula are __________.
6. Coordinates of C from the graph paper and from section formula are ______.

Application

This formula is used to find the centroid of a triangle in geometry, vector algebra and 3–dimensional geometry.

Activity 12

Objective

To verify the formula for the area of a triangle by graphical method.

Material Required

Cardboard, chart paper, graph paper, glue, pen/pencil and ruler.

Method of Construction

1. Take a cardboard of convenient size and paste a chart paper on it [see Fig. 1].
2. Paste a graph paper on the chart paper.
3. Draw the axes X′OX and Y′OY on the graph paper [see Fig. 1].

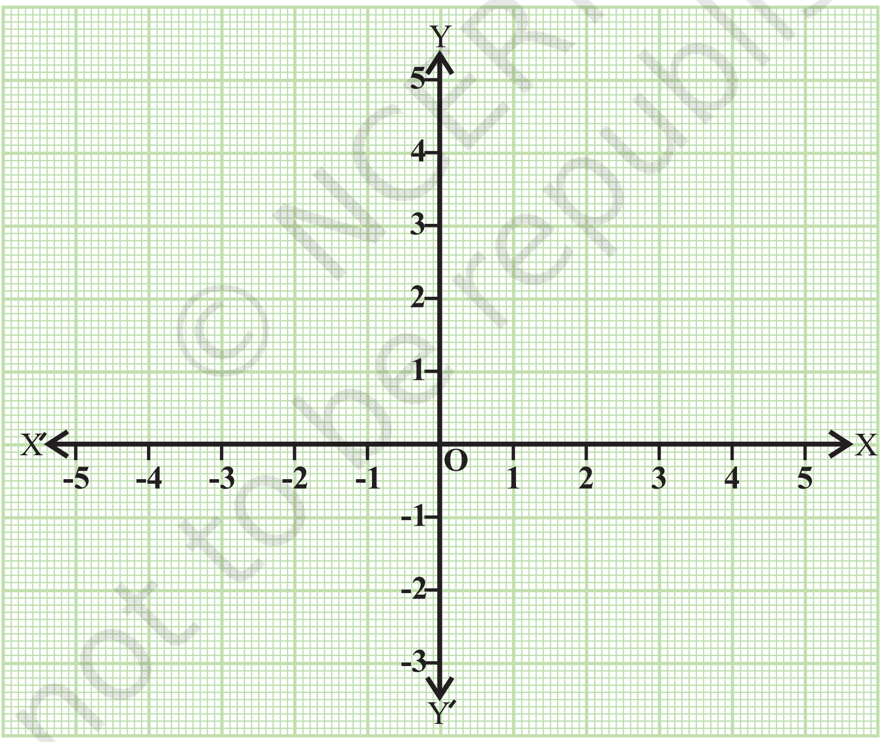

Fig. 1

4. Take three points A(x_1,y_1), B(x_2,y_2) and C(x_3,y_3) on the graph paper.
5. Join the points to get a triangle ABC [see Fig. 2].

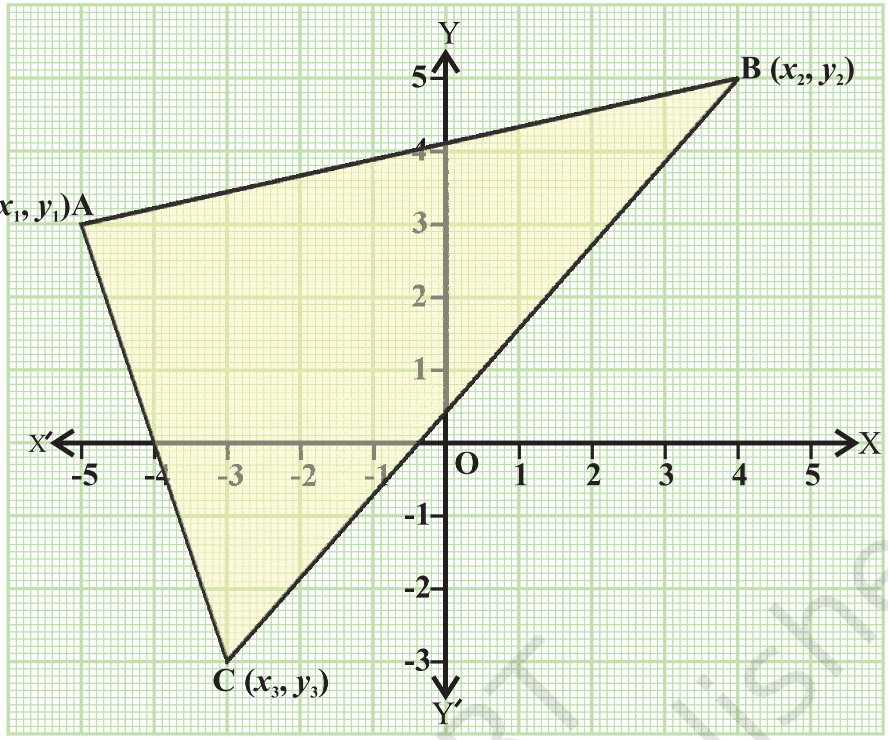

Fig. 2

Demonstration

1. Calculate the area of the triangle ABC using the formula:

$$\text{Area} = \frac{1}{2}\left[x_1(y_2 - y_3) + x_2(y_3 - y_1) + x_3(y_1 - y_2)\right].$$

2. Find the area of the triangle ABC by counting the number of squares enclosed in it in the following way:

   (i) take a complete square as 1

   (ii) take more than half a square as 1

   (iii) take half a square as $\frac{1}{2}$

   (iv) ignore the squares which are less than half a square.

3. Area calculated from formula and by actually counting the squares is nearly the same [see steps 1 and 2].

Observation

1. Coordinates of A are _______________.

   Coordinates of B are _______________.

   Coordinates of C are _______________.

2. Area of ΔABC by using formula = ______________.

3. (i) Number of complete squares = ______________.

   (ii) Number of more than half squares = ___________.

   (iii) Number of half squares = ______________.

   (iv) Total area by counting the squares = ______________.

4. Area calculated by using formula and by counting the number of squares are ______________.

Application

The formula for the area of the triangle is useful in various results in geometry such as checking collinearity of three points, calculating area of a triangle/ quadrilateral/polygon.

Activity 13

Objective

To establish the criteria for similarity of two triangles.

Material Required

Coloured papers, glue, sketch pen, cutter, geometry box .

Method of Construction

I

1. Take a coloured paper/chart paper. Cut out two triangles ABC and PQR with their corresponding angles equal.

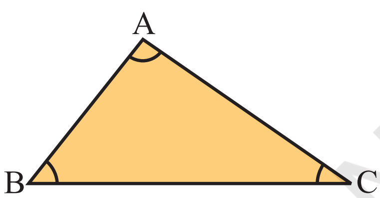

Fig. 1

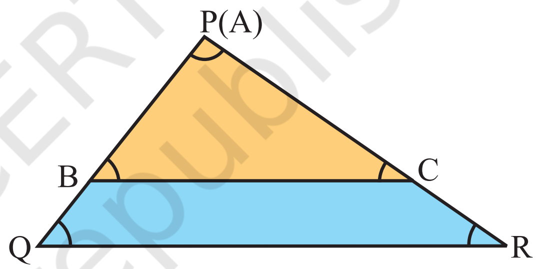

Fig. 2

2. In the triangles ABC and PQR, $\angle A = \angle P$; $\angle B = \angle Q$ and $\angle C = \angle R$.
3. Place the ΔABC on ΔPQR such that vertex A falls on vertex P and side AB falls along side PQ (side AC falls along side PR) as shown in Fig. 2.

Demonstration I

1. In Fig. 2, $\angle B = \angle Q$. Since corresponding angles are equal, BC||QR
2. By BPT, $\frac{PB}{BQ} = \frac{PC}{CR}$ or $\frac{AB}{BQ} = \frac{AC}{CR}$

or $$\frac{BQ}{AB} = \frac{CR}{AC}$$

or $$\frac{BQ+AB}{AB}=\frac{CR+AC}{AC} \text{ [Adding 1 to both sides]}$$

or $$\frac{AQ}{AB}=\frac{AR}{AC} \text{ or } \frac{PQ}{AB}=\frac{PR}{AC} \text{ or } \frac{AB}{PQ}=\frac{AC}{PR} \qquad (1)$$

II

1. Place the ΔABC on ΔPQR such that vertex B falls on vertex Q, and side BA falls along side QP (side BC falls along side QR) as shown in Fig. 3.

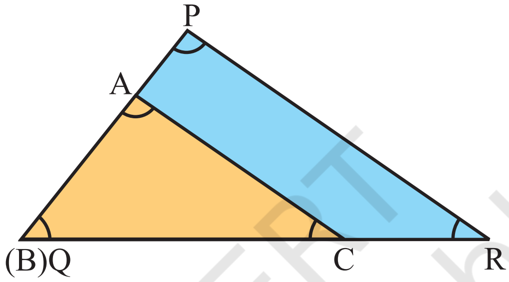

Fig. 3

Demonstration II

1. In Fig. 3, $\angle C = \angle R$. Since corresponding angles are equal, AC||PR

2. By BPT, $\frac{AP}{AB}=\frac{CR}{BC}$; or $\frac{BP}{AB}=\frac{BR}{BC}$ [Adding 1 on both sides]

or $$\frac{PQ}{AB}=\frac{QR}{BC} \text{ or } \frac{AB}{PQ}=\frac{BC}{QR} \qquad (2)$$

From (1) and (2), $\frac{AB}{PQ}=\frac{AC}{PR}=\frac{BC}{QR}$

Thus, from Demonstrations I and II, we find that when the corresponding angles of two triangles are equal, then their corresponding sides are proportional. Hence, the two triangles are similar. This is AAA criterion for similarity of triangles.

Alternatively, you could have measured the sides of the triangles ABC and PQR and obtained

$$\frac{AB}{PQ} = \frac{AC}{PR} = \frac{BC}{QR}.$$

From this result, ΔABC and ΔPQR are similar, i.e., if three corresponding angles are equal, the corresponding sides are proportional and hence the triangles are similar. This gives AAA criterion for similarity of two triangles.

III

1. Take a coloured paper/chart paper, cut out two triangles ABC and PQR with their corresponding sides proportional.

i.e., $$\frac{AB}{PQ} = \frac{BC}{QR} = \frac{AC}{PR}$$

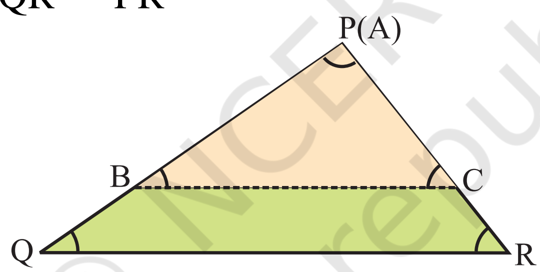

Fig. 4

2. Place the ΔABC on ΔPQR such that vertex A falls on vertex P and side AB falls along side PQ. Observe that side AC falls along side PR [see Fig. 4].

DEMONSTRATION III

1. In Fig. 4, $\frac{AB}{PQ} = \frac{AC}{PR}$. This gives $\frac{AB}{BQ} = \frac{AC}{CR}$. So, BC||QR (by converse of BPT)

i.e., ∠B = ∠Q and ∠C = ∠R. Also ∠A = ∠P. That is, the corresponding angles of the two triangles are equal.

Thus, when the corresponding sides of two triangles are proportional, their corresponding angles are equal. Hence, the two triangles are similar. This is the SSS criterion for similarity of two triangles.

Alternatively, you could have measured the angles of ΔABC and ΔPQR and obtained $\angle A = \angle P$, $\angle B = \angle Q$ and $\angle C = \angle R$.

From this result, ΔABC and ΔPQR are similar, i.e., if three corresponding sides of two triangles are proportional, the corresponding angles are equal, and hence the triangles are similar. This gives SSS criterion for similarity of two triangles.

IV

1. Take a coloured paper/chart paper, cut out two triangles ABC and PQR such that their one pair of sides is proportional and the angles included between the pair of sides are equal.

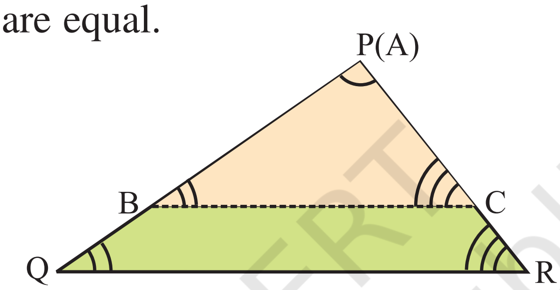

Fig. 5

i.e., In ΔABC and ΔPQR, $\frac{AB}{PQ} = \frac{AC}{PR}$ and $\angle A = \angle P$.

2. Place triangle ABC on triangle PQR such that vertex A falls on vertex P and side AB falls along side PQ as shown in Fig. 5.

Demonstration IV

1. In Fig. 5, $\frac{AB}{PQ} = \frac{AC}{PR}$. This gives $\frac{AB}{BQ} = \frac{AC}{CR}$. So, BC||QR (by converse of BPT)

   Therefore, $\angle B = \angle Q$ and $\angle C = \angle R$.

   From this demonstration, we find that when two sides of one triangle are proportional to two sides of another triangle and the angles included between the two pairs of sides are equal, then corresponding angles of two triangles are equal.

Hence, the two triangles are similar. This is the SAS criterion for similarity of two triangles.

Alternatively, you could have measured the remaining sides and angles of ΔABC and ΔPQR and obtained $\angle B = \angle Q$, $\angle C = \angle R$ and

$$\frac{AB}{PQ} = \frac{AC}{PR} = \frac{BC}{QR}.$$

From this, ΔABC and ΔPQR are similar and hence we obtain SAS criterion for similarity of two triangles.

Observation

By actual measurement:

I. In ΔABC and ΔPQR,

$\angle A$ = ______, $\angle P$ = ______, $\angle B$ = ______, $\angle Q$ = ______, $\angle C$ = ______, $\angle R$ = ______,

$\frac{AB}{PQ}$ = ________; $\frac{BC}{QR}$ = __________; $\frac{AC}{PR}$ = __________

If corresponding angles of two triangles are __________, the sides are _________. Hence the triangles are __________.

II. In ΔABC and ΔPQR

$\frac{AB}{PQ}$ = ________; $\frac{BC}{QR}$ = __________; $\frac{AC}{PR}$ = __________

$\angle A$ = ________, $\angle B$ = ________, $\angle C$ = ________, $\angle P$ = ________,

$\angle Q$ = ________, $\angle R$ = ________.

If the corresponding sides of two triangles are ______, then their corresponding angles are _________. Hence, the triangles are _________.

III. In ΔABC and ΔPQR ,

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

$\angle A$ = _______, $\angle P$ = _______, $\angle B$ = _______, $\angle Q$ = _______,

$\angle C$ = _______, $\angle R$ = _______.

If two sides of one triangle are ______ to the two sides of other triangle and angles included between them are _______, then the triangles are _______.

APPLICATION

The concept of similarity is useful in reducing or enlarging images or pictures of objects.

Activity 14

OBJECTIVE

To draw a system of similar squares, using two intersecting strips with nails.

MATERIAL REQUIRED

Two wooden strips (each of size 1 cm wide and 30 cm long), adhesive, hammer, nails.

METHOD OF CONSTRUCTION

1. Take two wooden strips say AB and CD.
2. Join both the strips intersecting each other at right angles at the point O [see Fig. 1].
3. Fix five nails at equal distances on each of the strips (on both sides of O) and name them, say A_1, A_2, ..., A_5, B_1, B_2, ..., B_5, C_1, C_2, ..., C_5 and D_1, D_2, ..., D_5 [see Fig. 2].

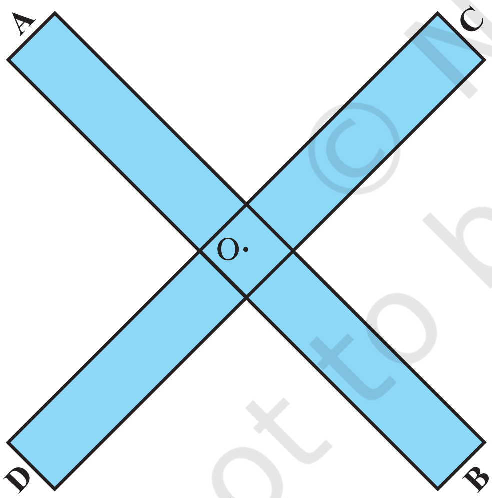

Fig. 1

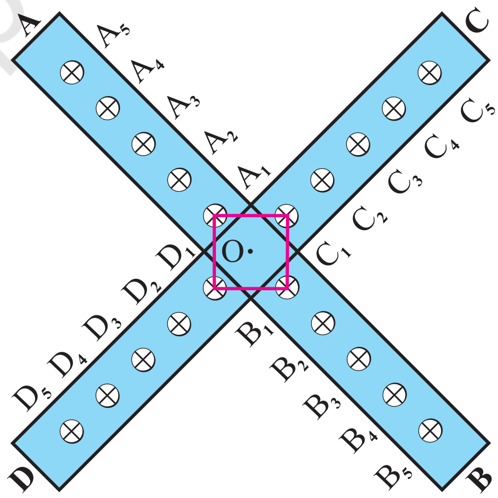

Fig. 2

4. Wind the thread around nails of subscript 1 ($A_1C_1B_1D_1$) on four ends of two strips to get a square [see Fig. 3].
5. Similarly, wind the thread around nails of same subscript on respective strips [see Fig. 3]. We get squares $A_1C_1B_1D_1$, $A_2C_2B_2D_2$, $A_3C_3B_3D_3$, A_4C_4 B_4 D_4 and $A_5C_5B_5D_5$.

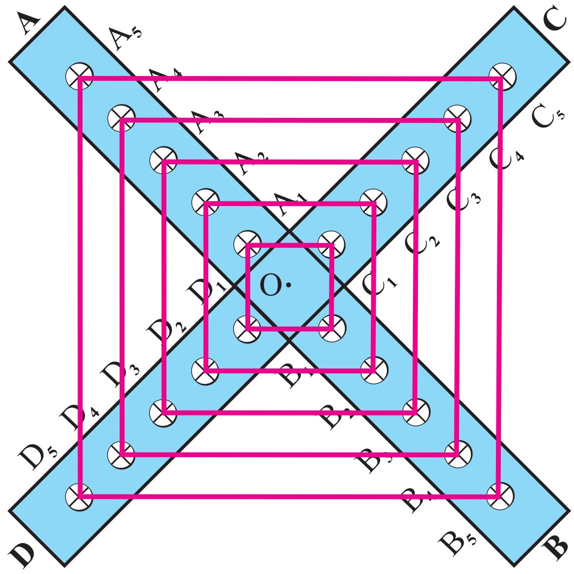

Fig. 3

Demonstration

1. On each of the strips AB and CD, nails are positioned equidistant to each other, such that

   $A_1A_2 = A_2A_3 = A_3A_4 = A_4A_5$, $\quad B_1B_2 = B_2B_3 = B_3B_4 = B_4B_5$

   $C_1C_2 = C_2C_3 = C_3C_4 = C_4C_5$, $\quad D_1D_2 = D_2D_3 = D_3D_4 = D_4D_5$

2. Now in any one quadrilateral say $A_4C_4B_4D_4$ [see Fig. 3].

   $A_4O = OB_4 = 4$ units.

   Also, $D_4O = OC_4 = 4$ units,

   where 1 unit = distance between two consecutive nails.

   Therefore, diagonals bisect each other.

   Therefore, $A_4C_4B_4D_4$ is a parallelogram.

   Moreover, $A_4B_4 = C_4D_4 = 4 \times 2 = 8$ units, i.e., diagonals are equal to each other.

   In addition to this, A_4B_4 is perpendicular to C_4D_4 (The strips are perpendicular to each other).

   Therefore, $A_4C_4B_4D_4$ is a square.

Similarly, we can say that $A_1C_1B_1D_1$, $A_2C_2B_2D_2$, $A_3C_3B_3D_3$ and $A_5C_5B_5D_5$ are all squares.

3. Now to show similarity of squares [see Fig. 3], measure A_1C_1, A_2C_2, A_3C_3, A_4C_4, A_5C_5, C_1B_1, C_2B_2, C_3B_3, C_4B_4, C_5B_5 and so on.

   Also, find ratios of their corresponding sides such as $\frac{A_2C_2}{A_3C_3}$, $\frac{C_2B_2}{C_3B_3}$, ...

OBSERVATION

By actual measurement:

A_2C_2 = ______, A_4C_4 = ______

C_2B_2 = ______, C_4B_4 = ______

B_2D_2 = ______, B_4D_4 = ______

D_2A_2 = ______, D_4A_4 = ______.

$\frac{A_2C_2}{A_4C_4}$ = ______, $\frac{C_2B_2}{C_4B_4}$ = ______, $\frac{B_2D_2}{B_4D_4}$ = ______, $\frac{D_2A_2}{D_4A_4}$ = ______.

Also, $\angle A_2$ = _______, $\angle C_2$ = _______, $\angle B_2$ = _______,

$\angle D_2$ = _______, $\angle A_4$ = _______, $\angle C_4$ = _______,

$\angle B_4$ = _______, $\angle D_4$ = _______.

Therefore, square $A_2C_2B_2D_2$ and square $A_4C_4B_4D_4$ are ________.

Similarly, each square is ______ to the other squares.

NOTE

By taking the lengths of the two diagonals unequal and angle between the strips other than a right angle, we can obtain similar parallelograms/rectangles by adopting the same procedure.

APPLICATION

Concept of similarity can be used in enlargement or reduction of images like maps in atlas and also in making photographs of different sizes from the same negative.

PRECAUTIONS

1. Care should be taken while using nails and hammer.
2. Nails should be fixed at equal distances.

Activity 15

OBJECTIVE

To draw a system of similar triangles, using Y shaped strips with nails.

MATERIAL REQUIRED

Three wooden strips of equal lengths (approx. 10 cm long and 1 cm wide), adhesive, nails, cello-tape, hammer.

METHOD OF CONSTRUCTION

1. Take three wooden strips say P, Q, R and cut one end of each strip [see Fig. 1]. Using adhesive/tape, join three ends of each strip such that they all lie in different directions [see Fig. 1].
2. Fix five nails at equal distances on each of the strips and name them $P_1, P_2, ..., P_5, Q_1, Q_2, ..., Q_5$ and $R_1, R_2, ..., R_5$ on strips P, Q and R, respectively [see Fig. 2].

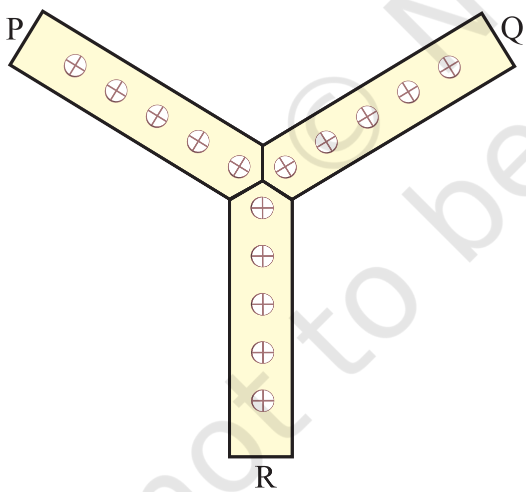

Fig. 1

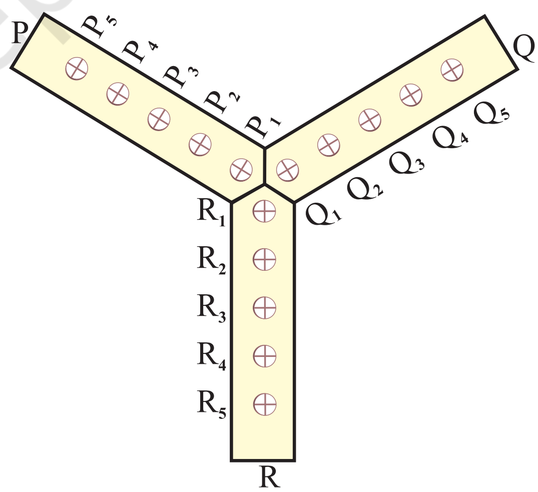

Fig. 2

3. Wind the thread around the nails of subscript 1 (P_1, Q_1, R_1) on three respective strips [see Fig. 3].

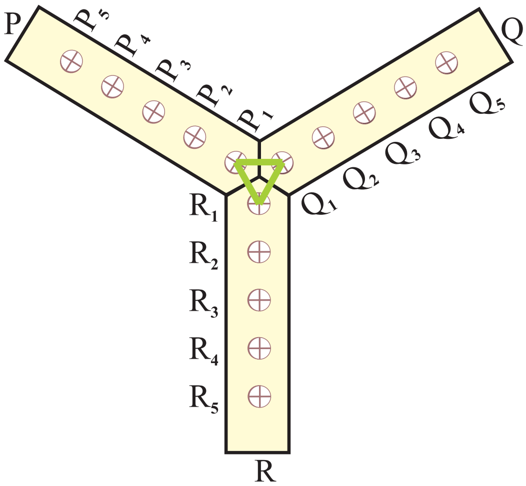

Fig. 3

4. To get more triangles, wind the thread around the nails of the same subscript on the respective strips. We get triangles $P_1Q_1R_1$, $P_2Q_2R_2$, $P_3Q_3R_3$, $P_4Q_4R_4$ and $P_5Q_5R_5$ [see Fig. 4].

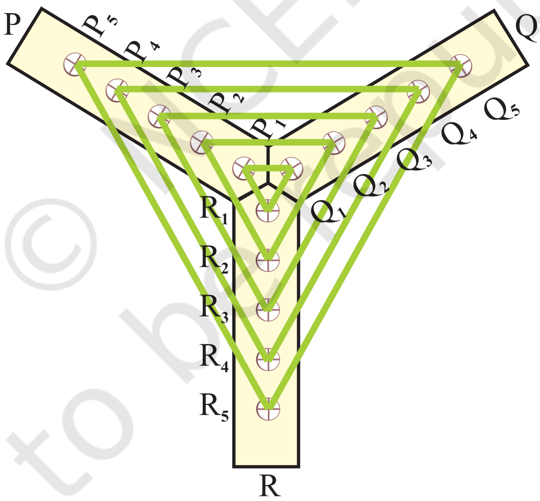

Fig. 4

DEMONSTRATION

1. Three wooden strips are fixed at some particular angles.
2. On each of the strips P, Q, R, nails are positioned at equal distances such that $P_1P_2=P_2P_3=P_3P_4=P_4P_5$ on strip P and similarly $Q_1Q_2=Q_2Q_3=Q_3Q_4=Q_4Q_5$ and $R_1R_2=R_2R_3=R_3R_4=R_4R_5$ on strip Q and R, respectively.

3. Now take any two triangles say $P_1Q_1R_1$ and $P_5Q_5R_5$. Measure the sides P_1Q_1, P_5Q_5, P_1R_1, P_5R_5, R_1Q_1 and R_5Q_5.

4. Find the ratios $\frac{P_1Q_1}{P_5Q_5}$, $\frac{P_1R_1}{P_5R_5}$ and $\frac{R_1Q_1}{R_5Q_5}$.

5. Observe that $\frac{P_1Q_1}{P_5Q_5} = \frac{P_1R_1}{P_5R_5} = \frac{R_1Q_1}{R_5Q_5}$

   Thus, $\Delta P_1Q_1R \sim P_5Q_5R_5$ (SSS similarity criterion)

6. It can be easily shown that any two triangles formed on Y shaped strips are similar.

Observation

By actual measurement:

P_1Q_1 = ______, Q_1R_1 = ______, R_1P_1 = ______,

P_5Q_5 = ______, Q_5R_5 = ______, R_5P_5 = ______,

$\frac{P_1Q_1}{P_5Q_5}$ = ______, $\frac{Q_1R_1}{Q_5R_5}$ = ______, $\frac{R_1P_1}{R_5P_5}$ = ______

Therefore, $\Delta P_1Q_1R_1$ and $\Delta P_5Q_5R_5$ are ______.

Application

1. Concept of similarity can be used in reducing or enlarging images (like maps in atlas) and also in making photographs of different sizes from the same negative.

2. Using the concept of similarity, unknown dimensions of an object can be determined using a similar object with known dimensions.

Note

By winding a thread at suitable nails, we can obtain non-equilateral similar triangles also.

3. Using concept of similarity and length of the shadow of pole in sunlight, height of a pole can be found out.

14/04/18

Activity 16

Objective

To verify Basic Proportionality Theorem (Thales theorem).

Material Required

Two wooden strips (each of size 1 cm wide and 30 cm long), cutter, adhesive, hammer, nails, bard board, white paper, pulleys, thread, scale and screw etc.

Method of Construction

1. Cut a piece of hardboard of a convenient size and paste a white paper on it.

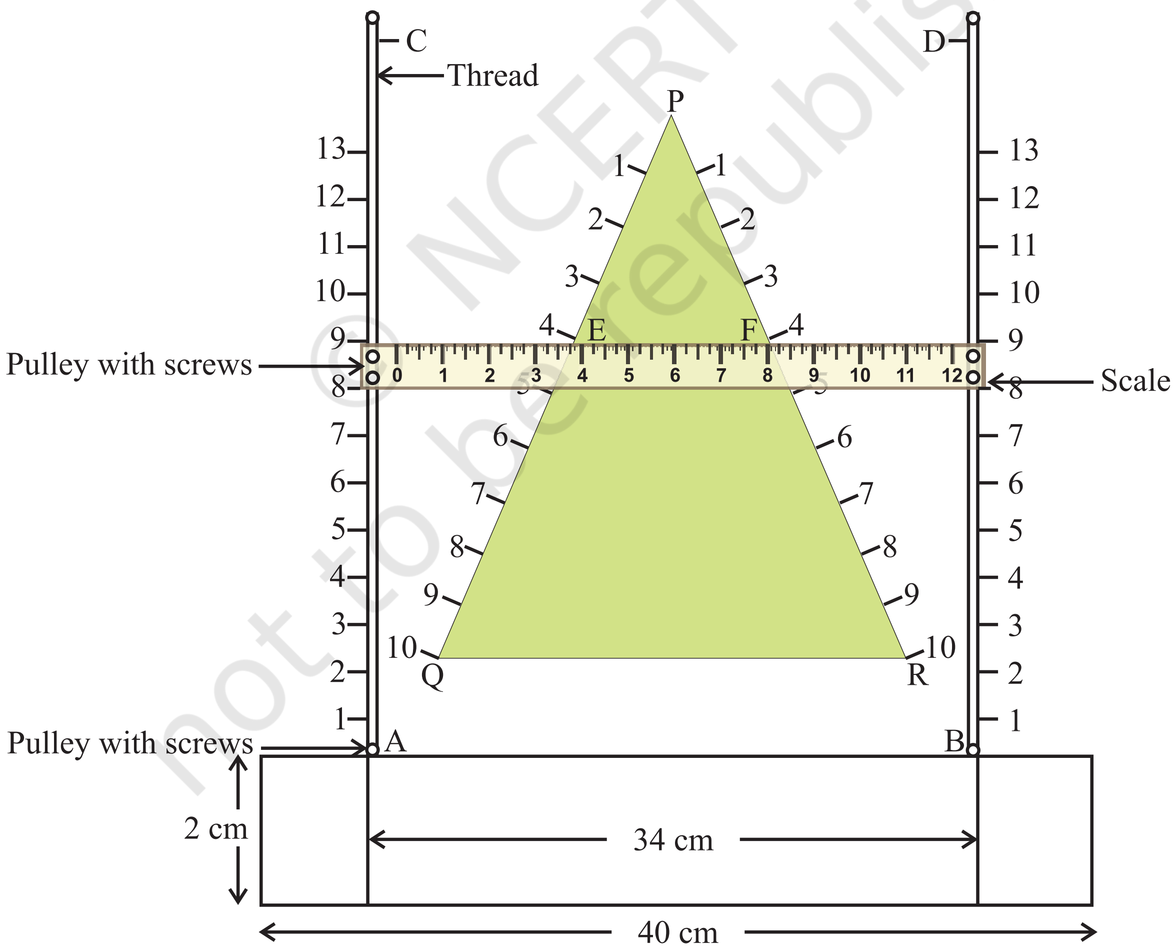

Fig. 1

14/04/18

2. Take two thin wooden strips with markings 1, 2, 3, ... at equal distances and fix them vertically on the two ends of the horizontal strip as shown in Fig. 1 and call them AC and BD.
3. Cut a triangular piece PQR from hardboard (thickness should be negligible) and paste coloured glazed paper on it and place it between the parallel strips AC and BD such that its base QR is parallel to the horizontal strip AB as drawn in Fig. 1.
4. Graduate the other two sides of the triangular piece as shown in the figure.
5. Put the screws along the horizontal strip and two more screws on the top of the board at the points C and D such that A, B, D and C become four vertices of a rectangle.
6. Take a ruler (scale) and make four holes on it as shown in the figure and fix four pulleys at these holes with the help of screws.
7. Fix the scale on the board using the thread tied to nails fixed at points A, B, C and D passing through the pulleys as shown in the figure, so that the scale slides parallel to the horizontal strip AB and can be moved up and down over the triangular piece freely.

Demonstration

1. Set the scale on vertical strips parallel to the base QR of D PQR, say at the points E and F. Measure the distances PE and EQ and also measure the distance PF and FR. It can be easily verified that

   $$\frac{PE}{EQ} = \frac{PF}{FR}$$

   This verifies Basic Proportionality Theorem (Thales theorem).
2. Repeat the activity as stated above, sliding the scale up and down parallel to the base of the triangle PQR and verify the Thales theorem for different positions of the scales.

Observation

By actual measurement:

PE = ______________, PF = ______________, EQ = ______________,

FR = ______________

$\frac{PE}{EQ}$ = _________, $\frac{PF}{FR}$ = ______________

Thus, $\frac{PE}{EQ} = \frac{PF}{FR}$. It verifies the Theorem.

Application

The theorem can be used to establish various criteria of similarity of triangles. It can also be used for constructing a polygon similar to a given polygon with a given scale factor.

Activity 17

Objective

To find the relationship between areas and sides of similar triangles.

Material Required

Coloured papers, glue, geometry box, scissors/cutters, white paper.

Method of Construction

1. Take a coloured paper of size 15 cm × 15 cm.
2. On a white paper, draw a triangle ABC.
3. Divide the side AB of ΔABC into some equal parts [say 4 parts].
4. Through the points of division, draw line segments parallel to BC and through points of division of AC, draw line segments parallel to AB [see Fig. 1].

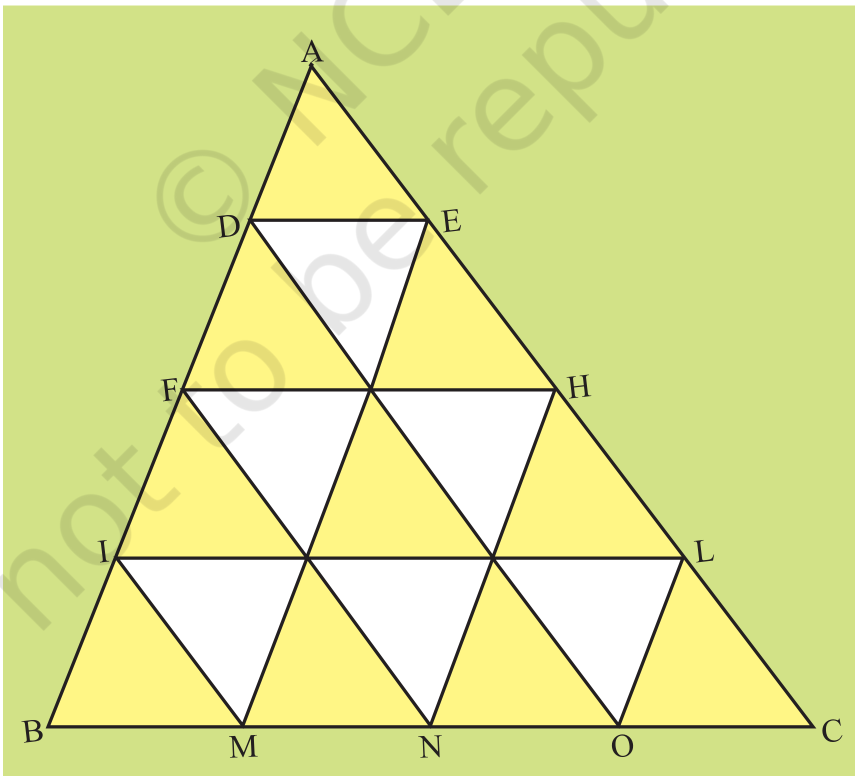

Fig. 1

5. Paste the triangle on the coloured paper.
6. ΔABC is divided into 16 congruent triangles [see Fig. 1].

Demonstration

1. ΔAFH contains 4 congruent triangles, with base FH = 2DE.
2. ΔAIL contains 9 congruent triangles, with base IL = 3 DE = $\frac{3}{2}$ FH.
3. In ΔABC, base BC = 4DE = 2 FH = $\frac{4}{3}$ IL.
4. $\Delta ADE \sim \Delta AFH \sim \Delta AIL \sim \Delta ABC$
5. $$\frac{ar(\Delta\ AFH)}{ar(\Delta\ ADE)} = \frac{4}{1} = \left(\frac{FH}{DE}\right)^2.$$

$$\frac{ar(\Delta\ AIL)}{ar(\Delta\ AFH)} = \frac{9}{4} = \left(\frac{IL}{FH}\right)^2.$$

$$\frac{ar(\Delta ABC)}{ar(\Delta AFH)} = \frac{16}{4} = \left(\frac{BC}{FH}\right)^2$$

Therefore, areas of similar triangles are proportional to ratio of the squares of their corresponding sides.

Observation

By actual measurement:

BC = _______________, IL = _______________, FH = _______________, DE = _______________.

Let area of ΔADE be 1 sq. unit. Then

$$\frac{\text{ar}(\Delta \text{ADE})}{\text{ar}(\Delta \text{AFH})} = \text{\_\_\_\_\_\_\_\_\_\_\_\_}, \qquad \frac{\text{ar}(\Delta \text{ADE})}{\text{ar}(\Delta \text{AIL})} = \text{\_\_\_\_\_\_\_\_\_\_\_\_},$$

$$\frac{\text{ar}(\Delta \text{ADE})}{\text{ar}(\Delta \text{ABC})} = \text{\_\_\_\_\_\_\_\_\_\_\_\_}, \qquad \frac{\text{DE}}{\text{FH}}^{2} = \text{\_\_\_\_\_\_\_\_\_\_\_\_},$$

$$\frac{\text{DE}}{\text{IL}}^{2} = \text{\_\_\_\_\_\_\_\_\_\_\_\_}, \qquad \frac{\text{DE}}{\text{BC}}^{2} = \text{\_\_\_\_\_\_\_\_\_\_\_\_}$$

which shows that ratio of the areas of similar triangles is ______ to the ratio of the squares of their corresponding sides.

APPLICATION

This result is useful in comparing the areas of two similar figures.

Activity 18

OBJECTIVE

To verify experimentally that the ratio of the areas of two similar triangles is equal to the ratio of the squares of their corresponding sides.

MATERIAL REQUIRED

Coloured papers, geometry box, sketch pen, white paper, cardboard.

METHOD OF CONSTRUCTION

1. Take a cardboard of a convenient size and paste a white paper on it.
2. Make a triangle (equilateral) on a coloured paper of side x units and cut it out [see Fig. 1]. Call it a unit triangle.
3. Make sufficient number of triangles congruent to the unit triangle using coloured papers.

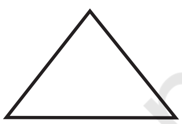

Fig. 1

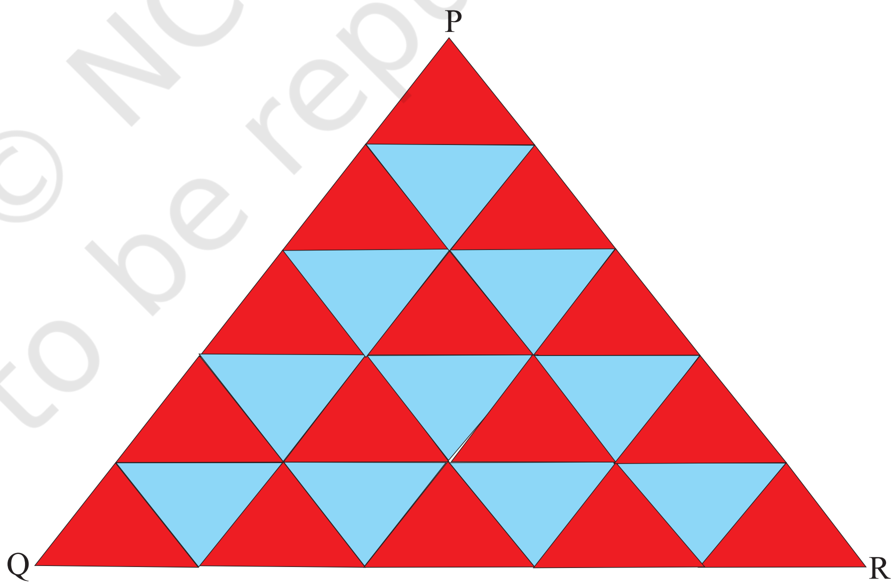

Fig. 2

4. Arrange and paste these triangles on the cardboard as shown in Fig. 2 and Fig. 3.

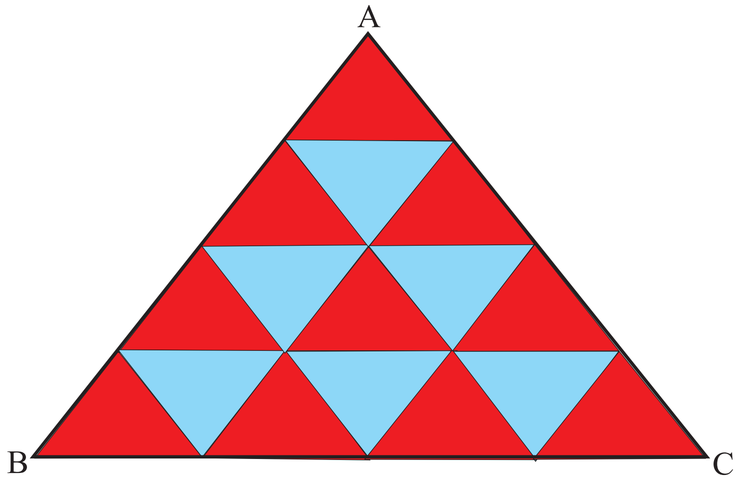

Fig. 3

Demonstration

ΔABC and ΔPQR are similar. Side BC of $\Delta ABC = (x + x + x + x)$ units $= 4x$ units

Side QR of $\Delta PQR = 5x$ units

Ratio of the corresponding sides of ΔABC and ΔPQR is

$$\frac{BC}{QR} = \frac{4x}{5x} = \frac{4}{5}$$

Area of ΔABC = 16 unit triangles

Area of ΔPQR = 25 unit triangles

Ratio of the areas of ΔABC and ΔPQR = $\frac{16}{25} = \frac{4^2}{5^2}$ = Ratios of the square of corresponding sides of ΔABC and ΔPQR

Observation

By actual measurement:

x = _______. Area of the unit triangle [equilateral triangle in Fig. 1] =_____

Area of ΔABC = _______, Area of ΔPQR = _______

Side BC of ΔABC = ______, Side QR of ΔPQR = ______

BC^2 = ____________, QR^2 = ____________,

AB = ____________, AC = ____________,

PQ = ____________, PR = ____________,

AB^2 = ____________, AC^2 = ____________,

PQ^2 = ____________, PR^2 = ____________,

$\dfrac{BC^2}{QR^2}$ = ____________, $\dfrac{\text{Area of } \Delta ABC}{\text{Area of } \Delta PQR}$ = ____________

$$\frac{\text{Area of } \Delta ABC}{\text{Area of } \Delta PQR} = \frac{BC^2}{-} = \left(\frac{AB}{-}\right)^2 = \left(\frac{-}{PR}\right)^2$$

Application

This result can be used for similar figures other than triangles also, which in turn helps in preparing maps for plots etc.

Note

This activity can be performed by taking any triangle as a unit triangle.

Activity 19

OBJECTIVE

To draw a quadrilateral similar to a given quadrilateral as per given scale factor (less than 1).

MATERIAL REQUIRED

Chart paper (coloured and white), geometry box, cutter, eraser, drawing pins, glue, pins, sketch pens, tape.

METHOD OF CONSTRUCTION

1. Take a cut-out of the given quadrilateral ABCD from a coloured chart paper and paste it on another chart paper [see Fig. 1].
2. Divide the base (here AB) of the quadrilateral ABCD internally in the ratio (given by scale factor) at P [see Fig. 2].
3. With the help of ruler (scale), join the diagonal AC of the quadrilateral ABCD.
4. From P, draw a line-segment PQ||BC, with the help of compasses (set squares or paper folding) meeting AC at R [see Fig. 3].

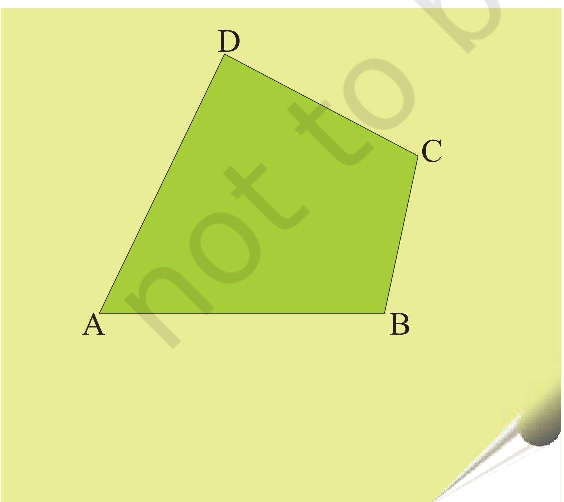

Fig. 1

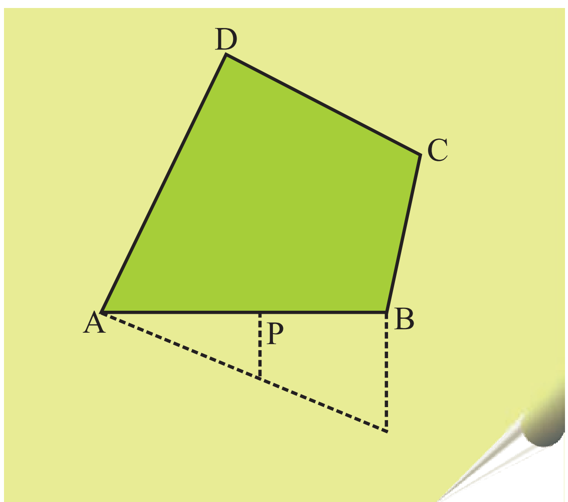

Fig. 2

5. From R, draw a line-segment RS parallel to CD using pair of compasses (set-squares/paper folding) meeting AD in S [see Fig. 4].
6. Colour the quadrilateral APRS using sketch pen.

   APRS is the required quadrilateral, similar to the given quadrilateral ABCD for given scale factor [see Fig. 5].

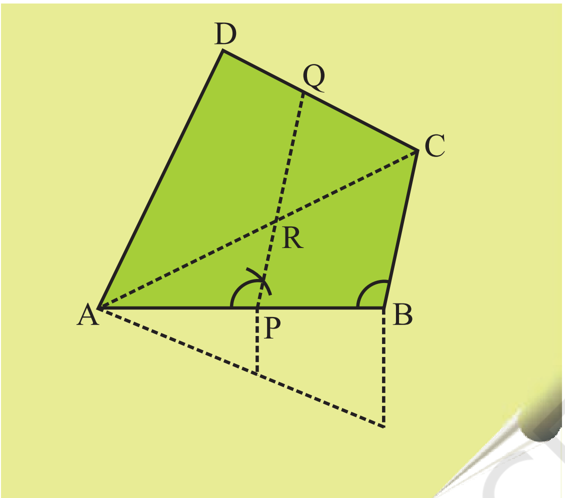

Fig. 3

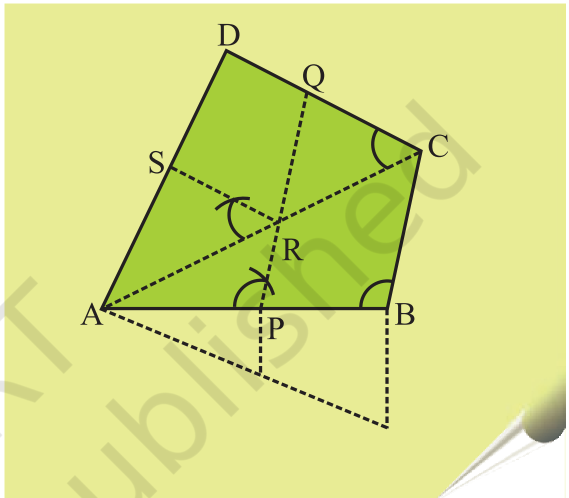

Fig. 4

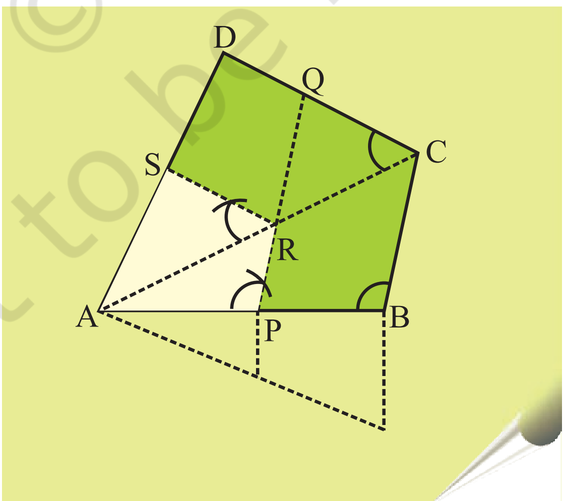

Fig. 5

DEMONSTRATION

1. In ΔABC, $PR \parallel BC$. Therefore, $\Delta APR \sim \Delta ABC$
2. In ΔACD, $RS \parallel CD$. Therefore, $\Delta ARS \sim \Delta ACD$
3. From Steps (1) and (2), quadrilateral APRS ~ quadrilateral ABCD

OBSERVATION

By actual measurement:

AB = _____, AP = _____, BC = _____,

PR = _____, CD = _____, RS = _____,

AD = _____, AS = _____

$\angle A$ = _____, $\angle B$ = _____, $\angle C$ = _____,

$\angle D$ = _____, $\angle P$ = _____, $\angle R$ = _____,

$\angle S$ = _____.

$\frac{AP}{AB}$ = ______, $\frac{PR}{BC}$ = ______, $\frac{RS}{CD}$ = ______, $\frac{AS}{AD}$ = ______,

$\angle A$ = Angle _____, $\angle P$ = Angle_____, $\angle R$ = Angle_____, $\angle S$ = Angle_____,

Hence, quadrilateral APRS and ABCD are _______.

APPLICATION

This activity can be used in day to day life in making pictures (photographs) of same object in different sizes.

Activity 20

Objective

To verify Pythagoras Theorem.

Material Required

Chart paper, glazed papers of different colours, geometry box, scissors, adhesive.

Method of Construction

1. Take a glazed paper and draw a right angled triangle whose base is 'b' units and perpendicular is 'a' units as shown in Fig. 1.
2. Take another glazed paper and draw a right angled triangle whose base is 'a' units and perpendicular is 'b' units as shown in Fig. 2.

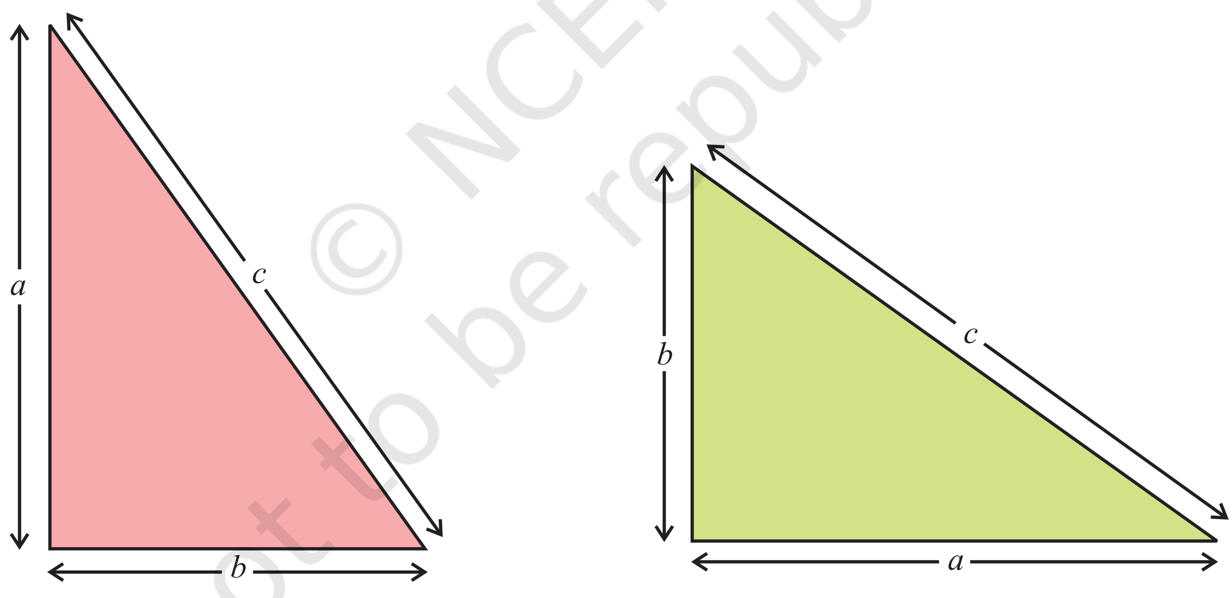

Fig. 1   Fig. 2

3. Cut-out the two triangles and paste them on a chart paper in such a way that the bases of the two triangles make a straight line as shown in Fig. 3. Name the triangles as shown in the figure.

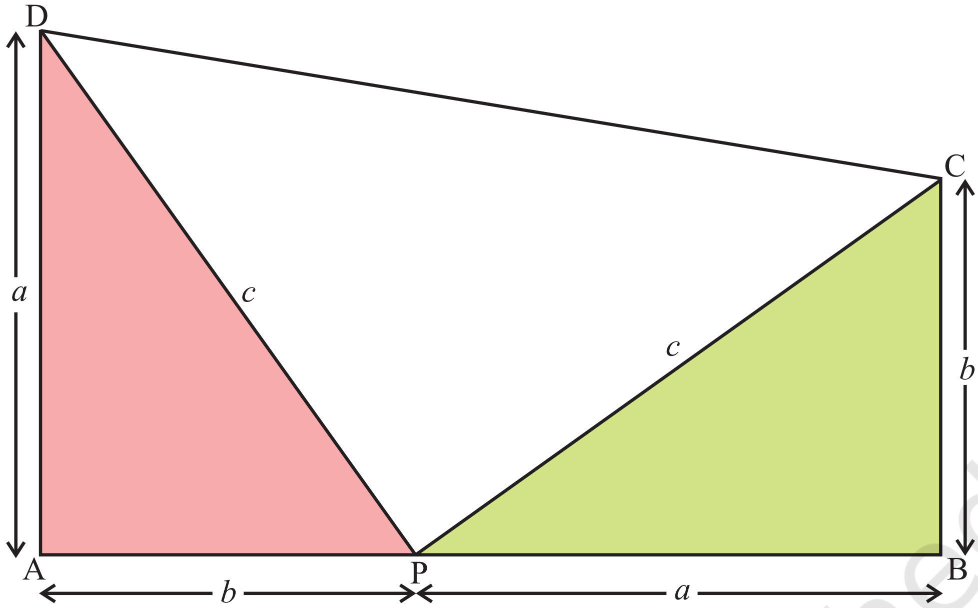

Fig. 3

4. Join CD.
5. ABCD is a trapezium.
6. The trapezium is divided into three triangles: APD, PBC and PCD.

DEMONSTRATION

1. ΔDPC is right angled at P.
2. Area of Δ APD $= \frac{1}{2}ba$ sq. units.

   Area of Δ PBC $= \frac{1}{2}ab$ sq. units.

   Area of Δ PCD $= \frac{1}{2}c^2$ sq. units.
3. Area of the trapezium ABCD = ar(ΔAPD) + ar(ΔPBC) + ar(ΔPCD)

So, $\frac{1}{2}(a+b)(a+b) = \frac{1}{2}ab + \frac{1}{2}ab + \frac{1}{2}c^2$

i.e., $(a+b)^2 = (ab + ab + c^2)$

i.e., $a^2 + b^2 + 2ab = (ab + ab + c^2)$

i.e., $a^2 + b^2 = c^2$

Hence, Pythagoras theorem is verified.

OBSERVATION

By actual measurement:

AP = _______, AD = _______, DP = _______,

BP = _______, BC = _______, PC = _______,

$AD^2 + AP^2$ = _______, DP^2 = _______,

$BP^2 + BC^2$ = _______, PC^2 = _______,

Thus, $a^2 + b^2$ = _______

APPLICATION

Whenever two, out of the three sides, of a right triangle are given, the third side can be found out by using Pythagoras theorem.