Activity 11

OBJECTIVE

To find the values of abscissae and ordinates of various points given in a cartesian plane.

MATERIAL REQUIRED

Cardboard, white paper, graph paper with various given points, geometry box, pen/pencil.

METHOD OF CONSTRUCTION

1. Take a cardboard of a convenient size and paste a white paper on it.
2. Paste the given graph paper alongwith various points drawn on it [see Fig. 1].
3. Look at the graph paper and the points whose abcissae and ordinates are to be found.

DEMONSTRATION

To find abscissa and ordinate of a point, say A, draw perpendiculars AM and AN from A to x-axis and y-axis, respectively. Then abscissa of A is OM and ordinate of A is ON. Here, OM = 2 and AM = ON = 9. The point A is in first quadrant. Coordinates of A are (2, 9).

OBSERVATION

Point	Abscissa	Ordinate	Quadrant	Coordinates
B				
C				
...				
...				
...				
...				

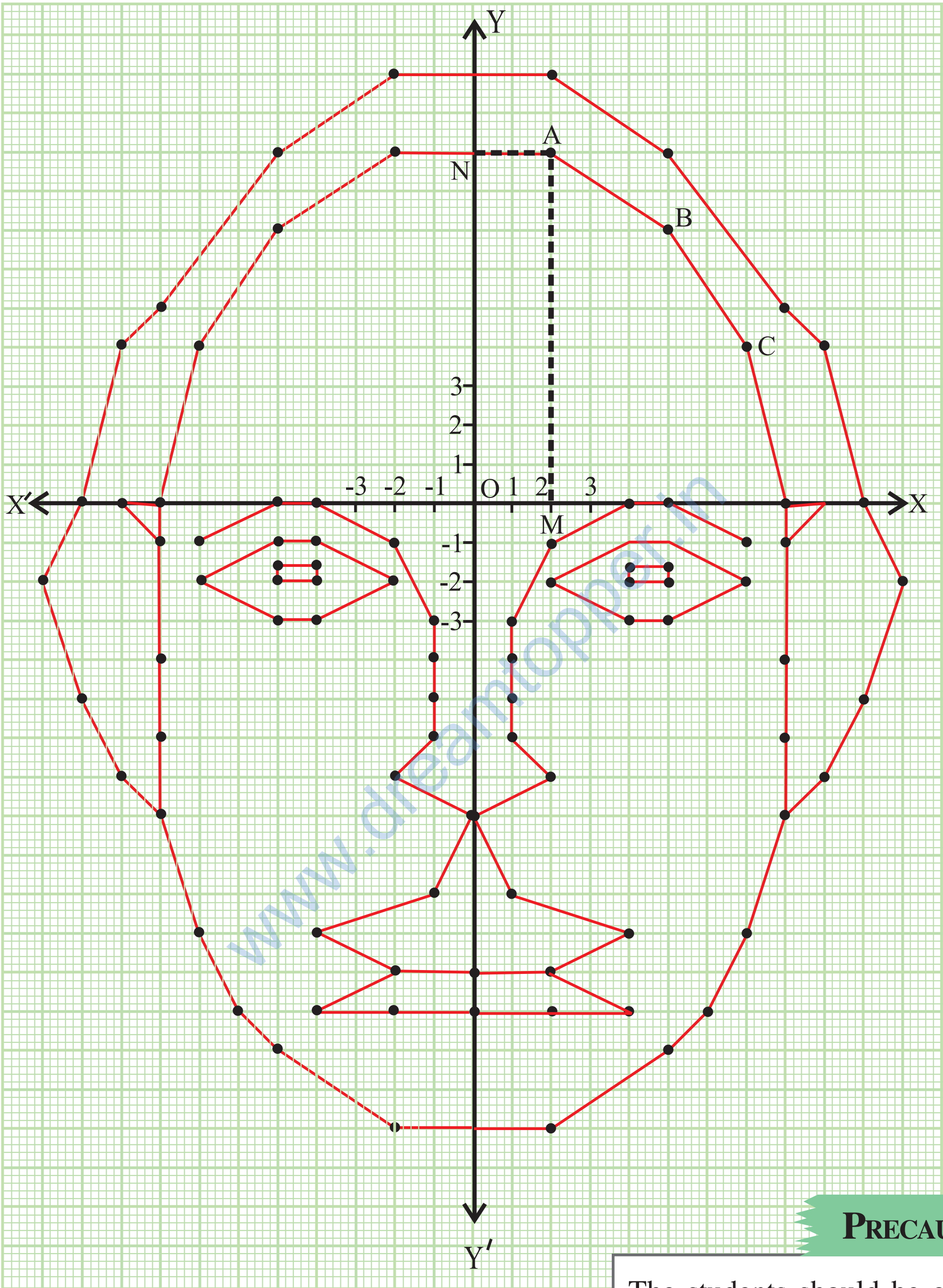

Fig. 1

Application

This activity is helpful in locating the position of a particular city/place or country on map.

Precaution

The students should be careful while reading the coordinates, otherwise the location of the object will differ.

Activity 12

OBJECTIVE

To find a hidden picture by plotting and joining the various points with given coordinates in a plane.

MATERIAL REQUIRED

Cardboard, white paper, cutter, adhesive, graph paper/squared paper, geometry box, pencil.

METHOD OF CONSTRUCTION

1. Take a cardboard of a convenient size and paste a white paper on it.
2. Take a graph paper and paste it on the white paper.
3. Draw two rectangular axes X′OX and Y′OY as shown in Fig. 1.
4. Plot the points A, B, C, ... with given coordinates (*a*, *b*), (*c*, *d*), (*e*, *f*), ..., respectively as shown in Fig. 2.
5. Join the points in a given order say A→B→C→D→.....→A [see Fig. 3].

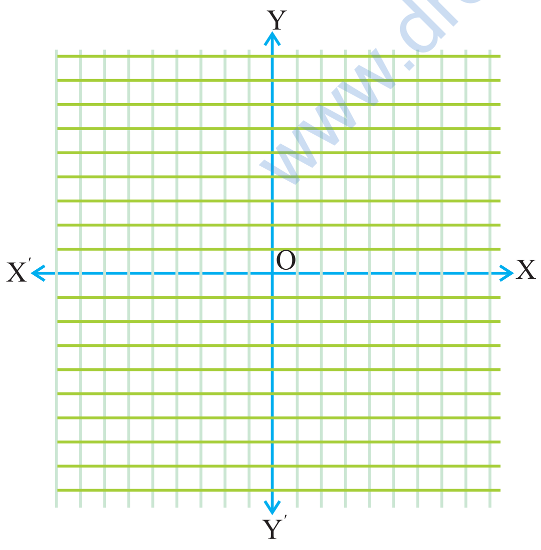

Fig. 1

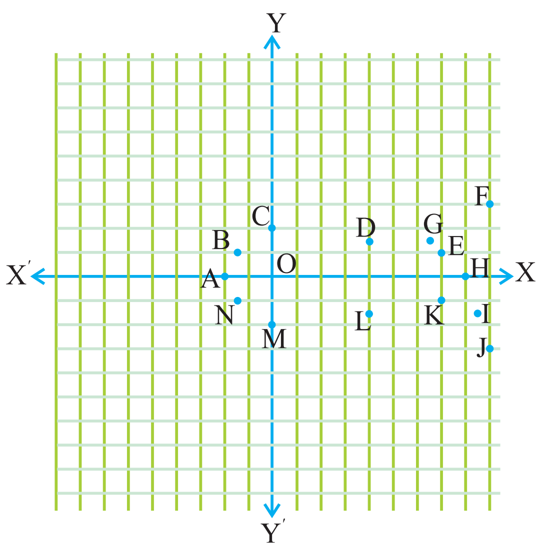

Fig. 2

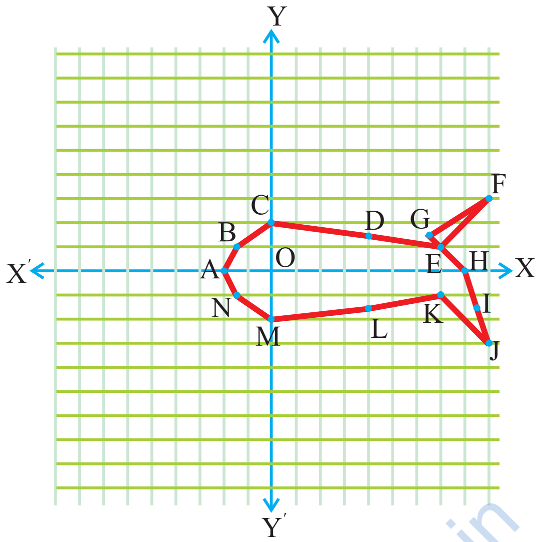

Fig. 3

Demonstration

By joining the points as per given instructions, a 'hidden' picture of an 'aeroplane' is formed.

Observation

In Fig. 3:

Coordinates of points A, B, C, D, ...

are ...., ..., ..., ..., ..., ..., ...

Hidden picture is of ______________.

Application

This activity is useful in understanding the plotting of points in a cartesian plane which in turn may be useful in preparing the road maps, seating plan in the classroom, etc.

Activity 13

Objective

To verify experimentally that if two lines intersect, then

(i) the vertically opposite angles are equal

(ii) the sum of two adjacent angles is 180º

(iii) the sum of all the four angles is 360º.

Material Required

Two transparent strips marked as AB and CD, a full protractor, a nail, cardboard, white paper, etc.

Method of Construction

1. Take a cardboard of a convenient size and paste a white paper on it.
2. Paste a full protractor (0° to 360º) on the cardboard, as shown in Fig. 1.
3. Mark the centre of the protractor as O.
4. Make a hole in the middle of each transparent strip containing two intersecting lines.
5. Now fix both the strips at O by putting a nail as shown in Fig. 1.

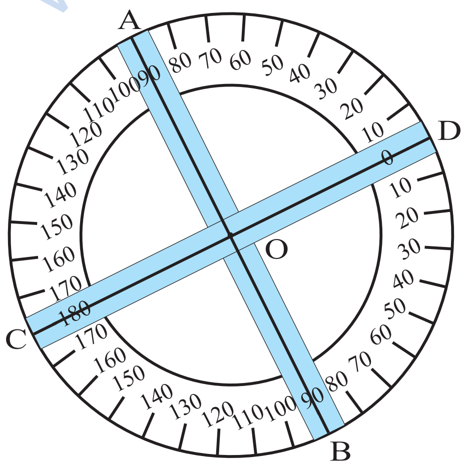

Fig. 1

DEMONSTRATION

1. Observe the adjacent angles and the vertically opposite angles formed in different positions of the strips.
2. Compare vertically opposite angles formed by the two lines in the strips in different positions.
3. Check the relationship between the vertically opposite angles.
4. Check that the vertically opposite angles $\angle AOD$, $\angle COB$, $\angle COA$ and $\angle BOD$ are equal.
5. Compare the pairs of adjacent angles and check that $\angle COA + \angle DOA = 180^\circ$, etc.
6. Find the sum of all the four angles formed at the point O and see that the sum is equal to 360°.

OBSERVATION

On actual measurement of angles in one position of the strips :

1. $\angle AOD$ = ..., $\angle AOC$ = ...

   $\angle COB$ = ..., $\angle BOD$ = ...

Therefore, $\angle AOD = \angle COB$ and $\angle AOC$ = ... (vertically opposite angles).

2. $\angle AOC + \angle AOD$ = ..., $\angle AOC + \angle BOC$ = ...,

   $\angle COB + \angle BOD$ = ...

   $\angle AOD + \angle BOD$ = ... (Linear pairs).

3. $\angle AOD + \angle AOC + \angle COB + \angle BOD$ = ... (angles formed at a point).

APPLICATION

These properties are used in solving many geometrical problems.

Activity 14

Objective

To verify experimentally the different criteria for congruency of triangles using triangle cut-outs.

Material Required

Cardboard, scissors, cutter, white paper, geometry box, pencil/sketch pens, coloured glazed papers.

Method of Construction

1. Take a cardboard of a convenient size and paste a white paper on it.
2. Make a pair of triangles ABC and DEF in which AB = DE, BC = EF, AC = DF on a glazed paper and cut them out [see Fig. 1].
3. Make a pair of triangles GHI, JKL in which GH = JK, GI = JL, ∠G = ∠J on a glazed paper and cut them out [see Fig. 2].

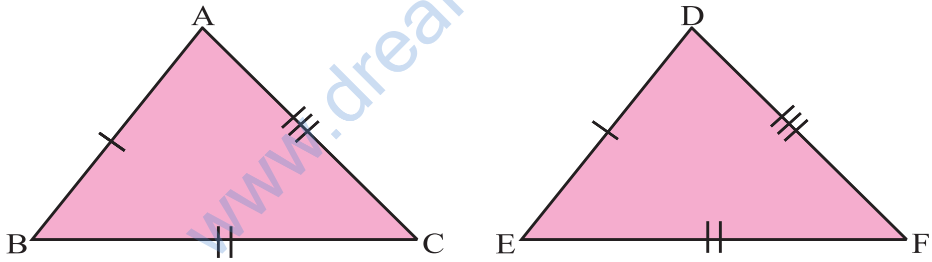

Fig. 1

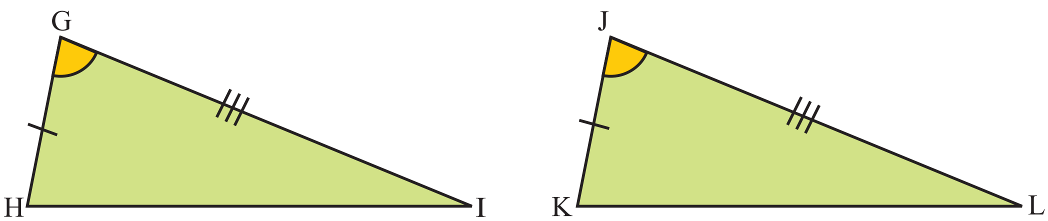

Fig. 2

4. Make a pair of triangles PQR, STU in which QR = TU, ∠Q = ∠T, ∠R = ∠U on a glazed paper and cut them out [see Fig. 3].
5. Make two right triangles XYZ, LMN in which hypotenuse YZ = hypotenuse MN and XZ = LN on a glazed paper and cut them out [see Fig. 4].

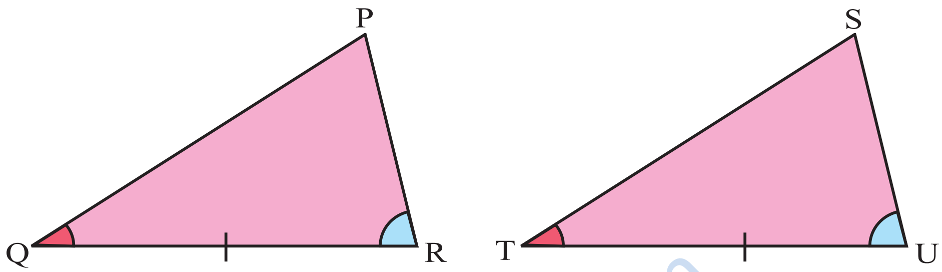

Fig. 3

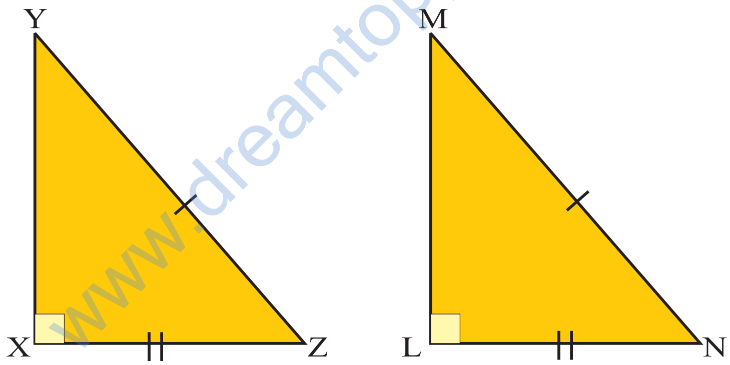

Fig. 4

DEMONSTRATION

1. Superpose DABC on DDEF and see whether one triangle covers the other triangle or not by suitable arrangement. See that ΔABC covers ΔDEF completely only under the correspondence A↔D, B↔E, C→F. So, ΔABC ≅ ΔDEF, if AB = DE, BC = EF and AC = DF.

   This is SSS criterion for congruency.

2. Similarly, establish $\Delta GHI \cong \Delta JKL$ if $GH = JK$. $\angle G = \angle J$ and $GI = JL$. This is SAS criterion for congruency.
3. Establish $\Delta PQR \cong \Delta STU$, if $QR = TU$, $\angle Q = \angle T$ and $\angle R = \angle U$.

   This is ASA criterion for congruency.
4. In the same way, $\Delta STU \cong \Delta LMN$, if hypotenuse YZ = hypotenuse MN and $XZ = LN$.

   This is RHS criterion for right triangles.

Observation

On actual measurement :

In ΔABC and ΔDEF,

$AB = DE =$ ...., $BC = EF =$ ....,

$AC = DF =$ ...., $\angle A =$ ....,

$\angle D =$ ...., $\angle B =$ ...., $\angle E =$ ....,

$\angle C =$ ...., $\angle F =$ ....

Therefore, $\Delta ABC \cong \Delta DEF$.

2. In ΔGHI and ΔJKL,

   $GH = JK =$ ...., $GI = JL =$ ...., $HI =$ ....,

   $KL=$ ...., $\angle G =$ ...., $\angle J =$ ....,

   $\angle H =$ ...., $\angle K =$ ...., $\angle I =$ ....,

   $\angle L =$ ....

   Therefore, $\Delta GHI \cong \Delta JKL$.
3. In ΔPQR and ΔSTU,

   $QR = TU =$ ...., $PQ =$ ...., $ST =$ ....,

   $PR =$ ...., $SU =$ .... $\angle S =$ ....,

   $\angle Q = \angle T =$ ...., $\angle R = \angle U =$ ...., $\angle P =$ ....

   Therefore, $\Delta PQR \cong \Delta STU$.

4. In ΔXYZ and ΔLMN, hypotenuse YZ = hypotenuse MN = ...

$XZ = LN$ = ..., XY = ...,

LM = ..., $\angle X = \angle L = 90°$

$\angle Y$ = ..., $\angle M$ = ..., $\angle Z$ = ...,

$\angle N$ = ...,

Therefore, $\Delta XYZ \cong \Delta LMN$.

APPLICATION

These criteria are useful in solving a number of problems in geometry.

These criteria are also useful in solving some practical problems such as finding width of a river without crossing it.

Activity 15

OBJECTIVE

To verify that the sum of the angles of a triangle is 180º.

MATERIAL REQUIRED

Hardboard sheet, glazed papers, sketch pens/pencils, adhesive, cutter, tracing paper, drawing sheet, geometry box.

METHOD OF CONSTRUCTION

1. Take a hardboard sheet of a convenient size and paste a white paper on it.
2. Cut out a triangle from a drawing sheet, and paste it on the hardboard and name it as ΔABC.
3. Mark its three angles as shown in Fig. 1
4. Cut out the angles respectively equal to $\angle A$, $\angle B$ and $\angle C$ from a drawing sheet using tracing paper [see Fig. 2].

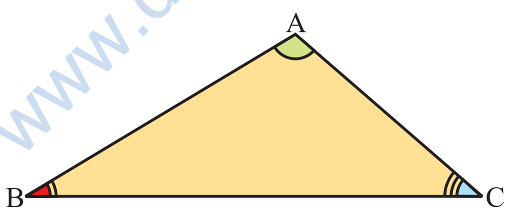

Fig. 1

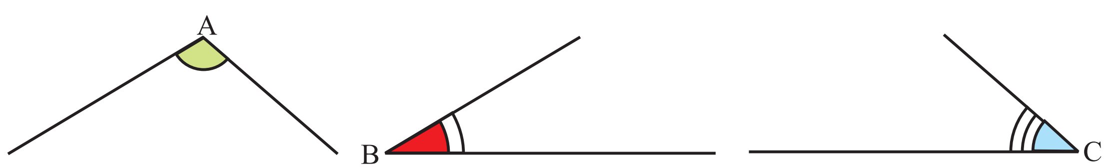

Fig. 2

5. Draw a line on the hardboard and arrange the cut-outs of three angles at a point O as shown in Fig. 3.

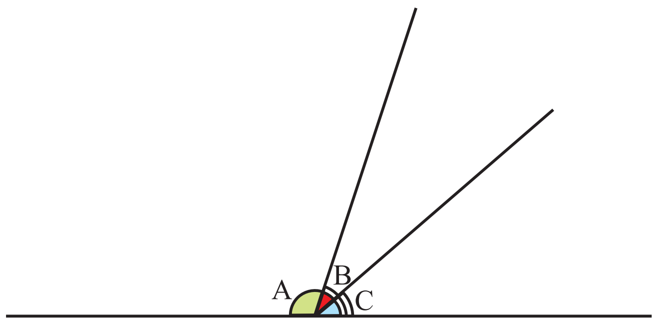

Fig. 3

Demonstration

The three cut-outs of the three angles A, B and C placed adjacent to each other at a point form a line forming a straight angle = 180°. It shows that sum of the three angles of a triangle is 180°. Therefore, $\angle A + \angle B + \angle C = 180°$.

Observation

Measure of $\angle A$ = -------------------.

Measure of $\angle B$ = -------------------.

Measure of $\angle C$ = -------------------.

Sum ($\angle A + \angle B + \angle C$) = -------------------.

Application

This result may be used in a number of geometrical problems such as to find the sum of the angles of a quadrilateral, pentagon, etc.

Activity 16

Objective

To verify exterior angle property of a triangle.

Material Required

Hardboard sheet, adhesive, glazed papers, sketch pens/pencils, drawing sheet, geometry box, tracing paper, cutter, etc.

Method of Construction

1. Take a hardboard sheet of a convenient size and paste a white paper on it.
2. Cut out a triangle from a drawing sheet/glazed paper and name it as ΔABC and paste it on the hardboard, as shown in Fig. 1.
3. Produce the side BC of the triangle to a point D as shown in Fig. 2.

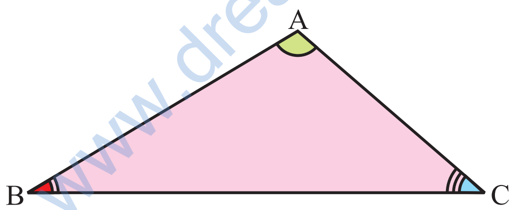

Fig. 1

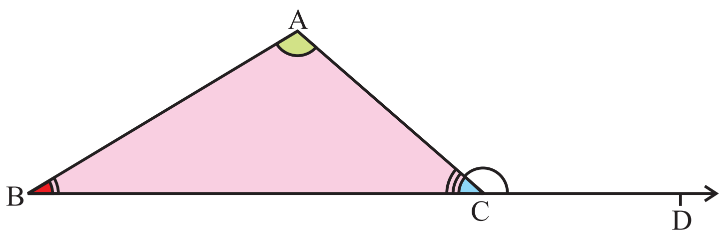

Fig. 2

4. Cut out the angles from the drawing sheet equal to ∠A and ∠B using a tracing paper [see Fig. 3].
5. Arrange the two cutout angles as shown in Fig. 4.

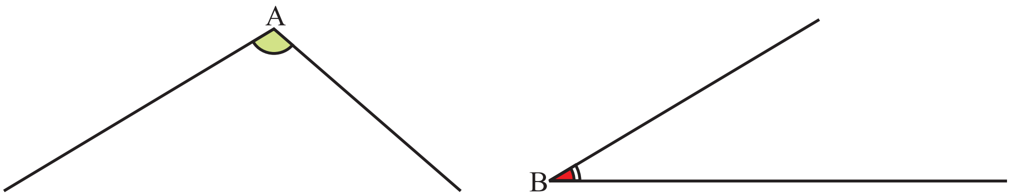

Fig. 3

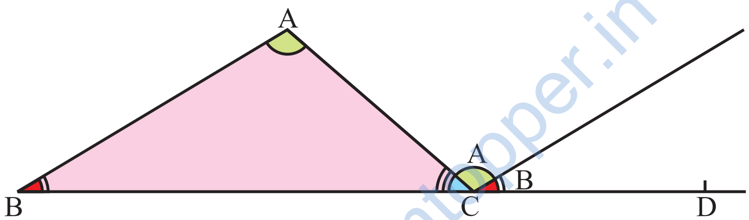

Fig. 4

Demonstration

∠ACD is an exterior angle.

∠A and ∠B are its two interior opposite angles.

∠A and ∠B in Fig. 4 are adjacent angles.

From the Fig. 4, ∠ACD = ∠A + ∠B.

Observation

Measure of ∠A= ___________, Measure of ∠B = ___________, Sum (∠A + ∠B) = ________, Measure of ∠ACD = _______.

Therefore, ∠ACD = ∠A + ∠B.

Application

This property is useful in solving many geometrical problems.

Activity 17

OBJECTIVE

To verify experimentally that the sum of the angles of a quadrilateral is 360º.

MATERIAL REQUIRED

Cardboard, white paper, coloured drawing sheet, cutter, adhesive, geometry box, sketch pens, tracing paper.

METHOD OF CONSTRUCTION

1. Take a rectangular cardboard piece of a convenient size and paste a white paper on it.
2. Cut out a quadrilateral ABCD from a drawing sheet and paste it on the cardboard [see Fig. 1].
3. Make cut-outs of all the four angles of the quadrilateral with the help of a tracing paper [see Fig. 2]

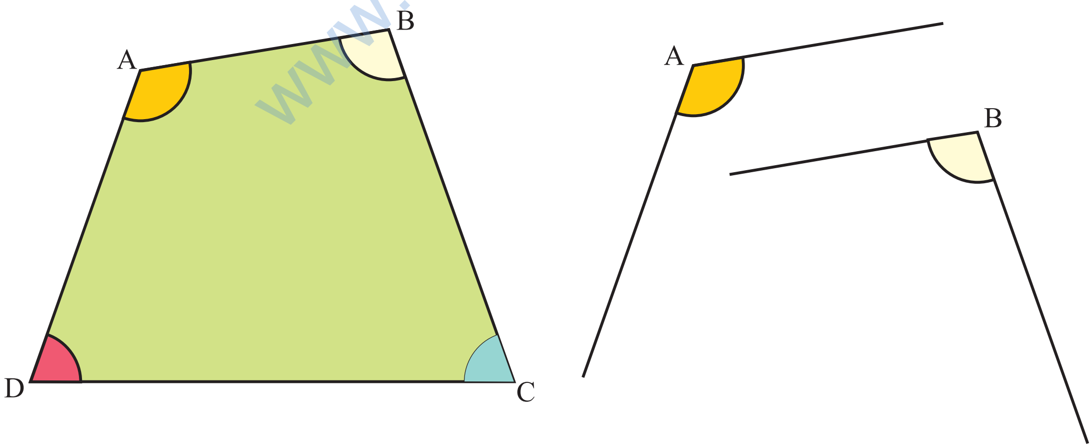

Fig. 1

Fig. 2

4. Arrange the four cut-out angles at a point O as shown in Fig. 3.

Demonstration

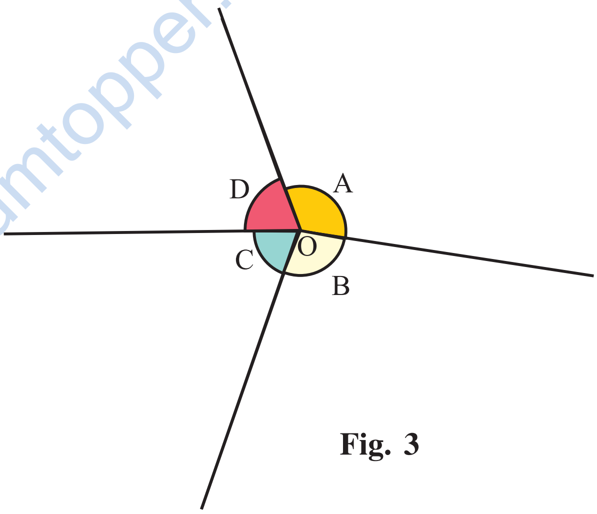

Fig. 3

1. The vertex of each cut-out angle coincides at the point O.
2. Such arrangement of cut-outs shows that the sum of the angles of a quadrilateral forms a complete angle and hence is equal to 360°.

Observation

Measure of $\angle A$ = ----------.

Measure of $\angle B$ = ----------.

Measure of $\angle C$ = ----------.

Measure of $\angle D$ = ----------.

Sum [$\angle A + \angle B + \angle C + \angle D$] = -------------.

Application

This property can be used in solving problems relating to special types of quadrilaterals, such as trapeziums, parallelograms, rhombuses, etc.

Activity 18

Objective

To verify experimentally that in a triangle, the longer side has the greater angle opposite to it.

Material Required

Coloured paper, scissors, tracing paper, geometry box, cardboard sheet, sketch pens.

Method of Construction

1. Take a piece of cardboard of a convenient size and paste a white paper on it.
2. Cut out a ΔABC from a coloured paper and paste it on the cardboard [see Fig. 1].
3. Measure the lengths of the sides of ΔABC.
4. Colour all the angles of the triangle ABC as shown in Fig. 2.
5. Make the cut-out of the angle opposite to the longest side using a tracing paper [see Fig. 3].

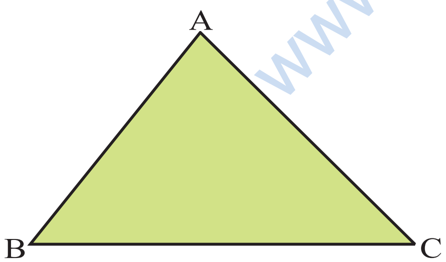

Fig. 1

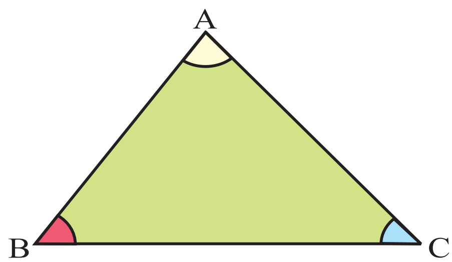

Fig. 2

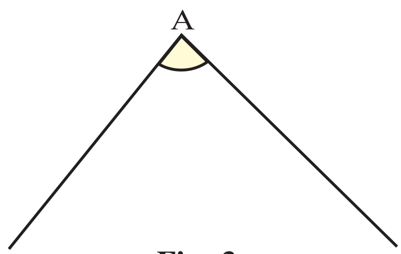

Fig. 3

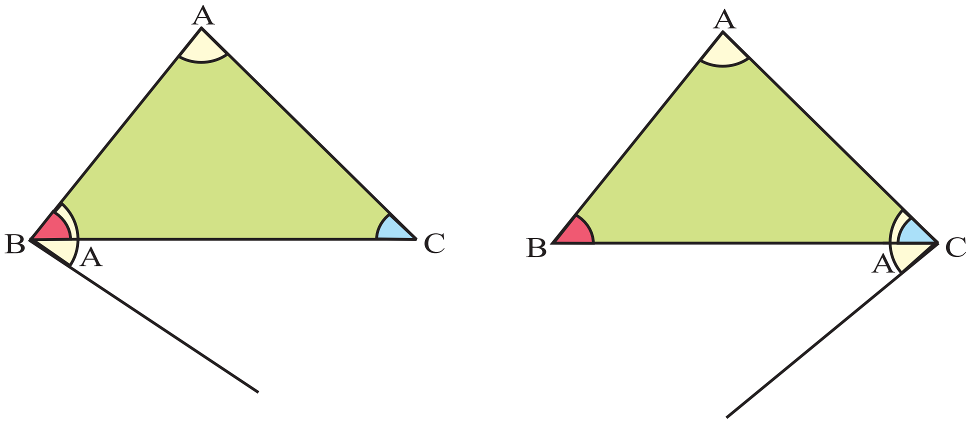

Fig. 4

Demonstration

Take the cut-out angle and compare it with other two angles as shown in Fig. 4.

$\angle A$ is greater than both $\angle B$ and $\angle C$.

i.e., the angle opposite the longer side is greater than the angle opposite the other side.

Observation

Length of side AB = ...

Length of side BC = ...

Length of side CA = ...

Measure of the angle opposite to longest side = ...

Measure of the other two angles = ... and ....

The angle opposite the .... side is .... than either of the other two angles.

Application

The result may be used in solving different geometrical problems.

Activity 19

Objective

To verify experimentally that the parallelograms on the same base and between same parallels are equal in area.

Material Required

A piece of plywood, two wooden strips, nails, elastic strings, graph paper.

Method of Construction

1. Take a rectangular piece of plywood of convenient size and paste a graph paper on it.
2. Fix two horizontal wooden strips on it parallel to each other [see Fig. 1].

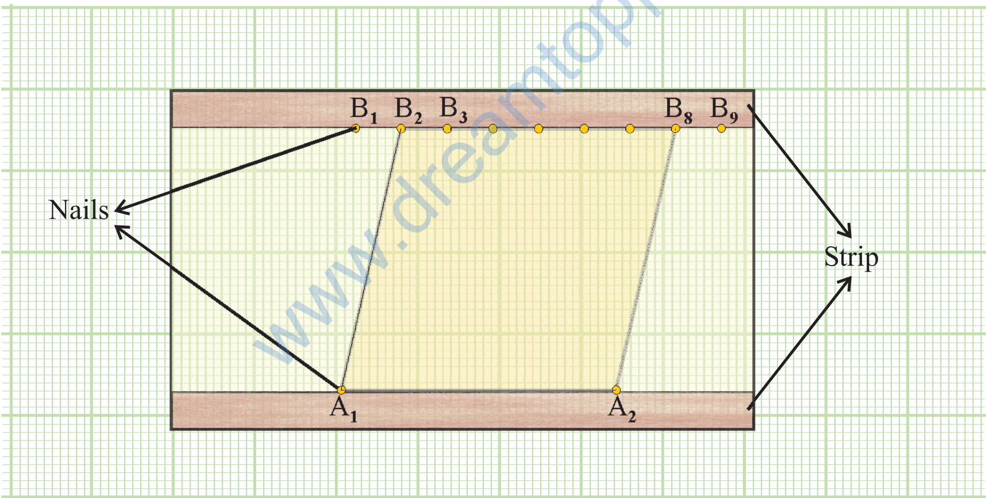

Fig. 1

3. Fix two nails A_1 and A_2 on one of the strips [see Fig. 1].
4. Fix nails at equal distances on the other strip as shown in the figure.

Demonstration

1. Put a string along A_1, A_2, B_8, B_2 which forms a parallelogram $A_1A_2B_8B_2$. By counting number of squares, find the area of this parallelogram.

2. Keeping same base A_1A_2, make another parallelogram $A_1A_2B_9B_3$ and find the area of this parallelogram by counting the squares.

3. Area of parallelogram in Step 1 = Area of parallelogram in Step 2.

Observation

Number of squares in 1st parallelogram = --------------.

Number of squares in 2nd parallelogram = -------------------.

Number of squares in 1st parallelogram = Number of squares in 2nd parallelogram.

Area of 1st parallelogram = --------- of 2nd parallelogram

Application

This result helps in solving various geometrical problems. It also helps in deriving the formula for the area of a paralleogram.

Note

In finding the area of a parallelogram, by counting squares, find the number of complete squares, half squares, more than half squares. Less than half squares may be ignored.

Activity 20

Objective

To verify that the triangles on the same base and between the same parallels are equal in area.

Material Required

A piece of plywood, graph paper, pair of wooden strips, colour box , scissors, cutter, adhesive, geometry box.

Method of Construction

1. Cut a rectangular plywood of a convenient size.
2. Paste a graph paper on it.
3. Fix any two horizontal wooden strips on it which are parallel to each other.
4. Fix two points A and B on the paper along the first strip (base strip).
5. Fix a pin at a point, say at C, on the second strip.
6. Join C to A and B as shown in Fig. 1.

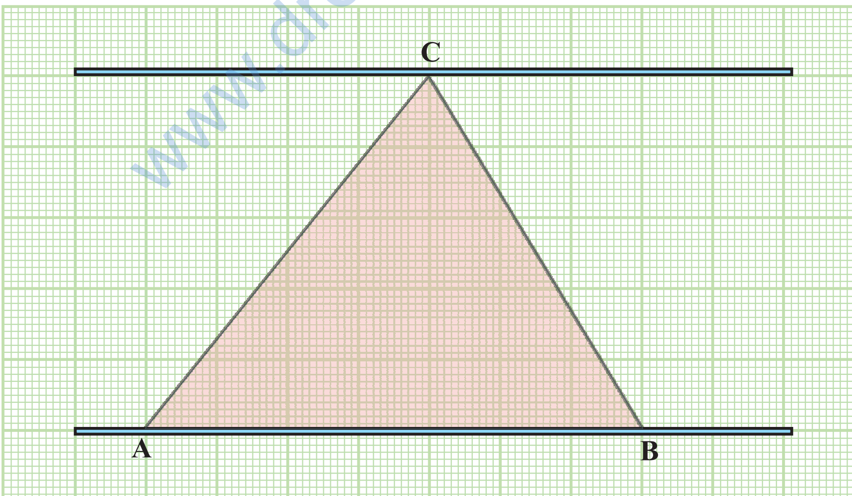

Fig. 1

7. Take any other two points on the second strip say C′ and C″ [see Fig. 2].
8. Join C′A, C′B, C″A and C″B to form two more triangles.

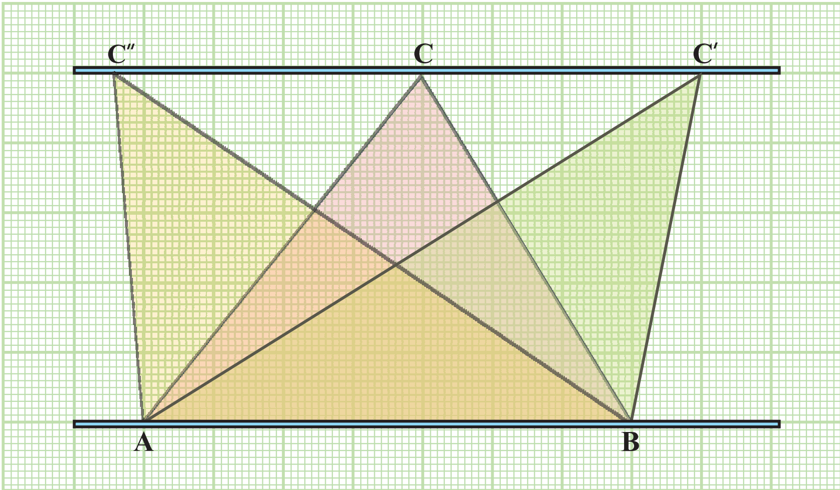

Fig. 2

Demonstration

1. Count the number of squares contained in each of the above triangles, taking half square as $\frac{1}{2}$ and more than half as 1 square, leaving those squares which contain less than $\frac{1}{2}$ squares.
2. See that the area of all these triangles is the same. This shows that triangles on the same base and between the same parallels are equal in area.

Observation

1. The number of squares in triangle ABC =.........., Area of ΔABC = ... units
2. The number of squares in triangle ABC′ =......., Area of D ABC′ = ... units
3. The number of squares in triangle ABC″ =....... , Area of D ABC″ = ... units

Therefore, area (ΔABC) = ar(ABC′) = ar(ABC″).

Application

This result helps in solving various geometric problems. It also helps in finding the formula for area of a triangle.