

Activity 2

OBJECTIVE

To draw the graph of a quadratic polynomial and observe:

- (i) The shape of the curve when the coefficient of x^2 is positive.
- (ii) The shape of the curve when the coefficient of x^2 is negative.
- (iii) Its number of zeroes.

MATERIAL REQUIRED

Cardboard, graph paper, ruler, pencil, eraser, pen, adhesive.

METHOD OF CONSTRUCTION

1. Take cardboard of a convenient size and paste a graph paper on it.
2. Consider a quadratic polynomial $f(x) = ax^2 + bx + c$
3. Two cases arise:

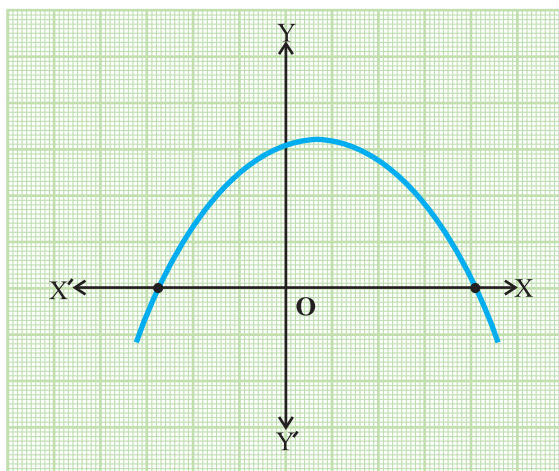


Fig. 1

- (i) $a > 0$ (ii) $a < 0$

4. Find the ordered pairs $(x, f(x))$ for different values of x .

5. Plot these ordered pairs in the cartesian plane.

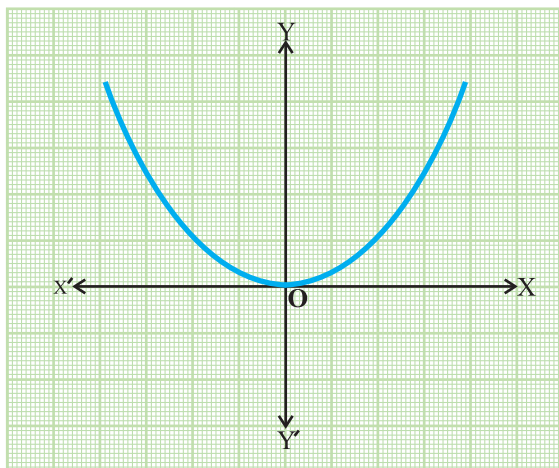


Fig. 2

6. Join the plotted points by a free hand curve [Fig. 1, Fig. 2 and Fig. 3].

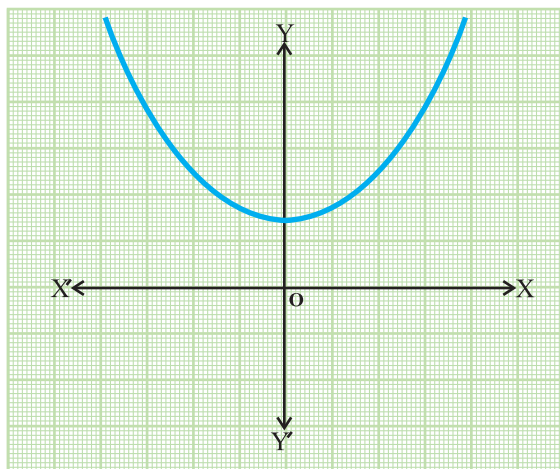


Fig. 3

DEMONSTRATION

1. The shape of the curve obtained in each case is a parabola.
2. Parabola opens upward when coefficient of x^2 is positive [see Fig. 2 and Fig. 3].
3. It opens downward when coefficient of x^2 is negative [see Fig. 1].
4. Maximum number of zeroes which a quadratic polynomial can have is 2.

OBSERVATION

1. Parabola in Fig. 1 opens _____
2. Parabola in Fig. 2 opens _____
3. In Fig. 1, parabola intersects x -axis at _____ point(s).
4. Number of zeroes of the given polynomial is _____.
5. Parabola in Fig. 2 intersects x -axis at _____ point(s).
6. Number of zeroes of the given polynomial is _____.
7. Parabola in Fig.3 intersects x -axis at _____ point(s).
8. Number of zeroes of the given polynomial is _____.
9. Maximum number of zeroes which a quadratic polynomial can have is _____.

APPLICATION

This activity helps in

1. understanding the geometrical representation of a quadratic polynomial
2. finding the number of zeroes of a quadratic polynomial.

NOTE

Points on the graph paper should be joined by a free hand curve only.

Activity 9

OBJECTIVE

To establish a formula for the sum of first n terms of an Arithmetic Progression.

MATERIAL REQUIRED

Cardboard, coloured drawing sheets, white paper, cutter, adhesive.

METHOD OF CONSTRUCTION

1. Take a rectangular cardboard of a convenient size and paste a white paper on it. Draw a rectangle ABCD of length $(2a+9d)$ units and breadth 10 units.
2. Make some rectangular strips of equal length a units and breadth one unit and some strips of length d units and breadth 1 unit, using coloured drawing sheets.
3. Arrange/paste these strips on the rectangle ABCD as shown in Fig. 1.

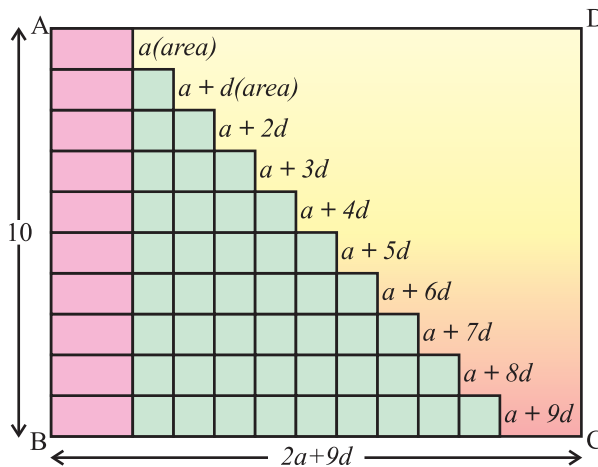


Fig. 1

DEMONSTRATION

1. The strips so arranged look like a stair case.
2. The first stair is of length a units, the second stair is of length $a+d$ (units), third of $a+2d$ units and so on and each is of breadth 1 unit. So, the areas (in sq. units) of these strips are $a, a + d, a + 2d, \dots, a+9d$, respectively.

3. This arrangement of strips gives a pattern $a, a + d, a + 2d, a + 3d, \dots$ which is an AP with first term a and the common difference d .

4. The sum of the areas (in square units) of these strips
 $= a + (a + d) + (a + 2d) + \dots + (a + 9d) = 10a + 45d \quad (1)$

5. Area of the designed formed by the stair case $= \frac{1}{2}$ (area of rectangle ABCD)

$$= \frac{1}{2}(10)(2a + 9d)$$

$= (10a + 45d)$, which is the same as obtained in (1) above.

This shows that the sum of first 10 terms of the AP $= \frac{1}{2}(10)(2a + 9d)$

$$= \frac{1}{2}(10) [2a + (10 - 1)d]$$

This can be further generalised to find the sum of first n terms of an AP as

$$S_n = \frac{n}{2} [2a + (n - 1)d]$$

OBSERVATION

On actual measurement:

$$a = \text{-----}, \quad d = \text{-----}, \quad n = \text{-----} \quad S_n = \text{-----}$$

$$\text{So, } S_n = \frac{n}{2} [- + (n - 1) -].$$

APPLICATION

This result may be used to find the sum of first n terms of the list of numbers :

$$1. \quad 1^2, 2^2, 3^2, \dots \quad 2. \quad 1^3, 2^3, 3^3, \dots$$

to be studied in Class XI.

Activity 10

OBJECTIVE

To verify the distance formula by graphical method.

MATERIAL REQUIRED

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

METHOD OF CONSTRUCTION

1. Paste a chart paper on a cardboard of a convenient size.
2. Paste the graph paper on the chart paper.
3. Draw the axes $X'OX$ and $Y'OY$ on the graph paper [see Fig. 1].
4. Take two points $A(a, b)$ and $B(c, d)$ on the graph paper and join them to get a line segment AB [see Fig. 2].

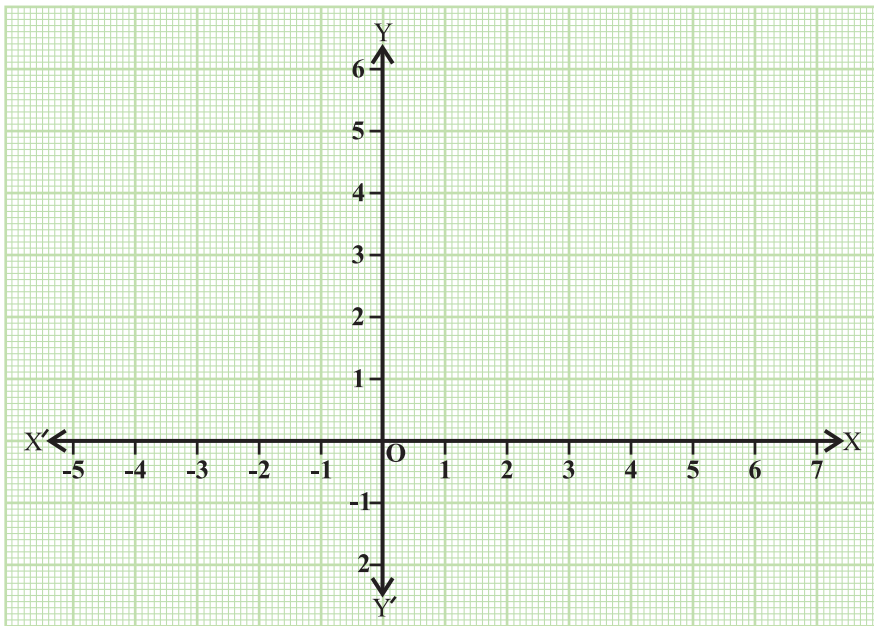


Fig. 1

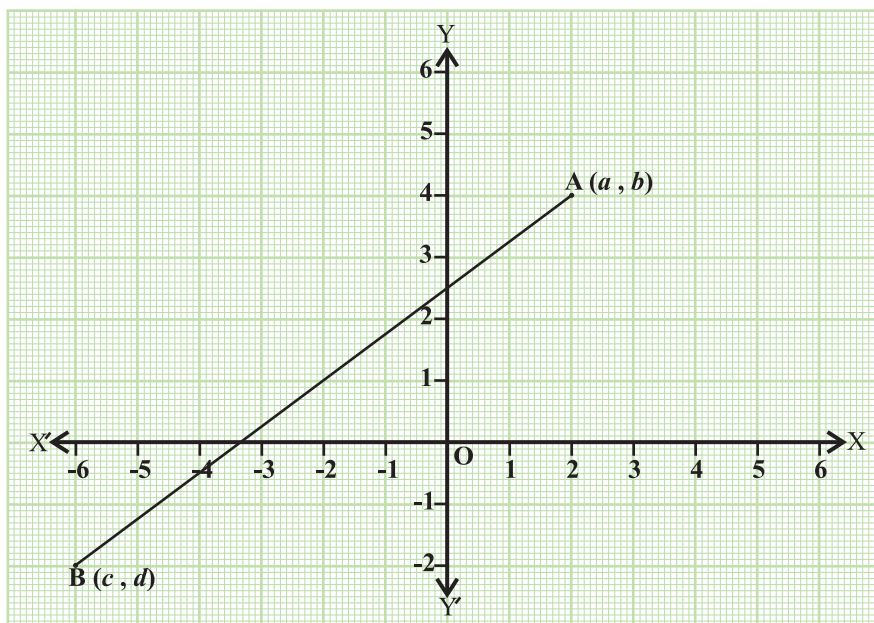


Fig. 2

DEMONSTRATION

1. Calculate the distance AB using distance formula.
2. Measure the distance between the two points A and B using a ruler.
3. The distance calculated by distance formula and distance measured by the ruler are the same.

OBSERVATION

1. Coordinates of the point A are _____.
Coordinates of the point B are _____.
2. Distance AB, using distance formula is _____.
3. Actual distance AB measured by ruler is _____.
4. The distance calculated in (2) and actual distance measured in (3) are ____.

APPLICATION

The distance formula is used in proving a number of results in geometry.

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 $P_1, P_2, \dots, P_5, Q_1, Q_2, \dots, Q_5$ and $R_1, R_2, \dots, R_5$ on strips P, Q and R, respectively [see Fig. 2].

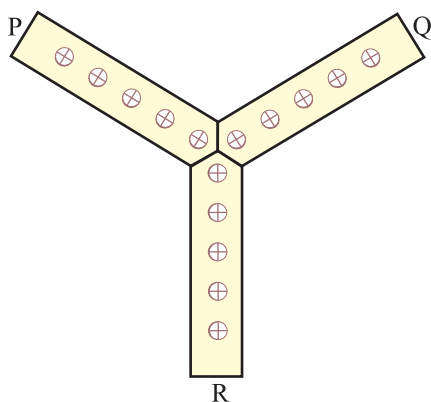


Fig. 1

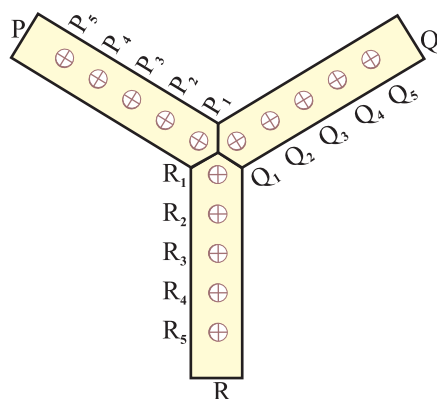


Fig. 2

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

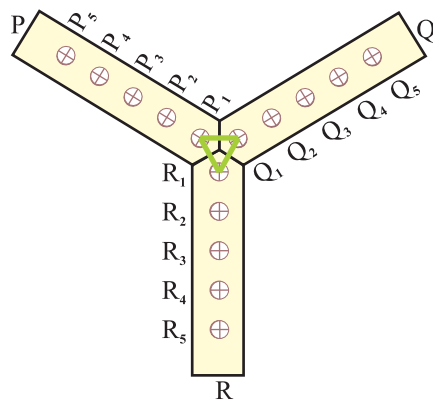


Fig. 3

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].

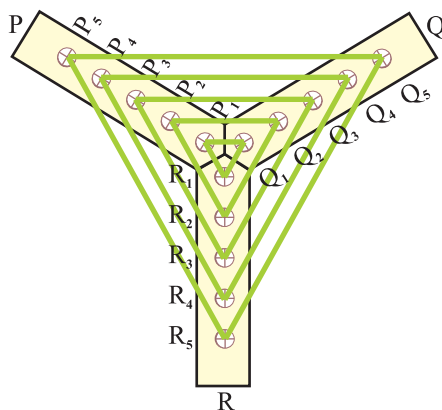


Fig. 4

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, $\Delta P_1Q_1R_1 \sim \Delta P_5Q_5R_5$ (SSS similarity criterion)

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

OBSERVATION

By actual measurement:

$$\begin{array}{lll} P_1Q_1 = \underline{\hspace{2cm}}, & Q_1R_1 = \underline{\hspace{2cm}}, & R_1P_1 = \underline{\hspace{2cm}}, \\ P_5Q_5 = \underline{\hspace{2cm}}, & Q_5R_5 = \underline{\hspace{2cm}}, & R_5P_5 = \underline{\hspace{2cm}}, \\ \frac{P_1Q_1}{P_5Q_5} = \underline{\hspace{2cm}}, & \frac{Q_1R_1}{Q_5R_5} = \underline{\hspace{2cm}}, & \frac{R_1P_1}{R_5P_5} = \underline{\hspace{2cm}} \end{array}$$

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

NOTE

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

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.

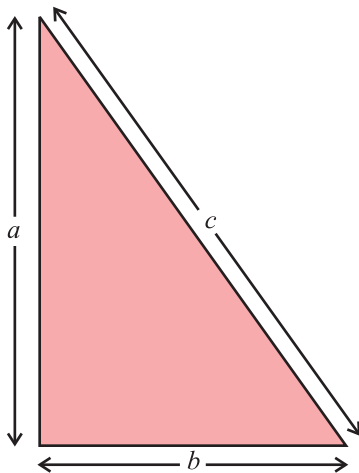


Fig. 1

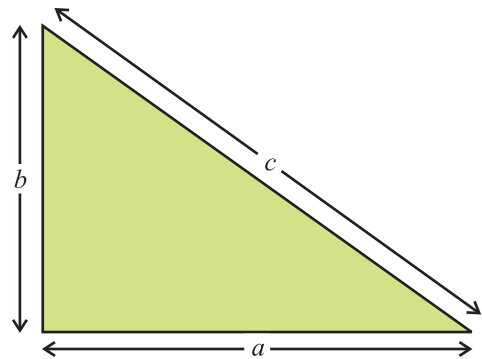


Fig. 2

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.

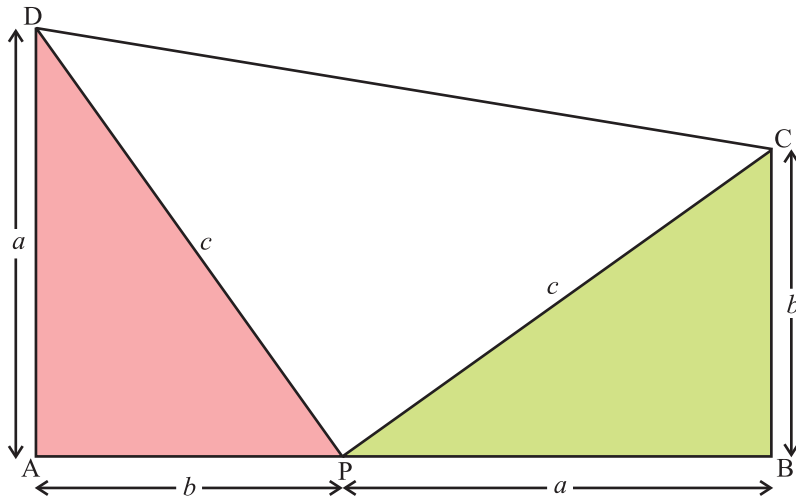


Fig. 3

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

DEMONSTRATION

1. $\triangle DPC$ is right angled at P.

2. Area of $\triangle APD = \frac{1}{2}ba$ sq. units.

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

$$\text{Area of } \triangle PCD = \frac{1}{2}c^2 \text{ sq. units.}$$

3. Area of the trapezium ABCD = ar($\triangle APD$) + ar($\triangle PBC$) + ar($\triangle PCD$)

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

$$\text{i.e., } (a+b)^2 = (ab + ab + c^2)$$

$$\text{i.e., } a^2 + b^2 + 2ab = (ab + ab + c^2)$$

$$\text{i.e., } a^2 + b^2 = c^2$$

Hence, Pythagoras theorem is verified.

OBSERVATION

By actual measurement:

$$AP = \underline{\hspace{2cm}}, \quad AD = \underline{\hspace{2cm}}, \quad DP = \underline{\hspace{2cm}},$$

$$BP = \underline{\hspace{2cm}}, \quad BC = \underline{\hspace{2cm}}, \quad PC = \underline{\hspace{2cm}},$$

$$AD^2 + AP^2 = \underline{\hspace{2cm}}, \quad DP^2 = \underline{\hspace{2cm}},$$

$$BP^2 + BC^2 = \underline{\hspace{2cm}}, \quad PC^2 = \underline{\hspace{2cm}},$$

$$\text{Thus, } a^2 + b^2 = \underline{\hspace{2cm}}$$

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.

Activity 25

OBJECTIVE

To find the height of a building using a clinometer.

MATERIAL REQUIRED

Clinometer (a stand fitted with a square plate which is fitted with a movable 0° – 360° protractor and a straw), a measuring tape 50 m long, table or stool.

METHOD OF CONSTRUCTION

1. Place a table on the ground of a school.
2. Place a clinometer (a stand fitted with 0° – 360° protractor and a straw whose central line coincides with 0° – 360° line) on the table.
3. Now face it towards the building of the school.
4. Peep out through the straw to the top of the school building and note the angle (θ) through which the protractor turns from 0° – 360° line.

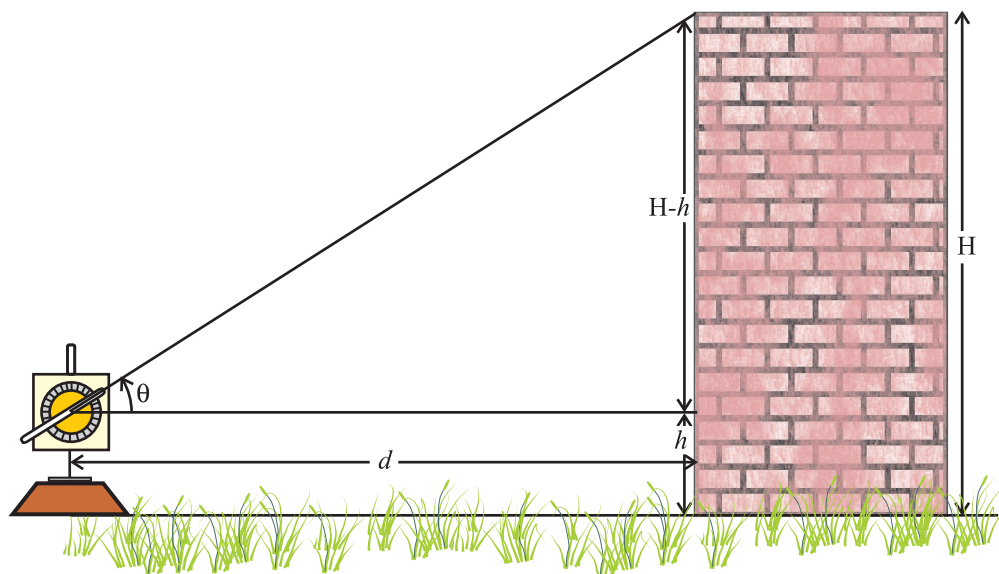


Fig. 1

5. Measure the height (h) of the centre of the protractor from the ground.
6. Measure the distance (d) of the building from the point lying on the vertical line of the stand (centre of the protractor) kept on table [see Fig. 1].
7. Repeat the above method keeping the clinometer at different positions and collect the values of q , h , d for different settings.

DEMONSTRATION

Using the knowledge of trigonometric ratios, we have :

$$\tan \theta = \frac{H - h}{d}, \text{ where } H \text{ is the height of the building.}$$

$$\text{i.e., } H = h + d \tan \theta$$

OBSERVATION

S.No.	Angle measured through protractor (Angle of elevation) θ	Height of the protractor from ground (h)	Distance (d) of the building from the centre of the protractor	$\tan \theta$	$H = h + d \tan \theta$
1.	----	---	---	---	---
2.	----	---	---	---	---
3.	----	---	---	---	---
...	----	---	---	---	---
...	----	---	---	---	---
...	----	---	---	---	---

APPLICATION

1. A clinometer can be used in measuring an angle of elevation and an angle of depression.
2. It can be used in measuring the heights of distant (inaccessible) objects, where it is difficult to measure the height directly.

Activity 26

OBJECTIVE

To obtain formula for area of a circle experimentally.

MATERIAL REQUIRED

Threads of different colours, scissors, cardboard, thick sheet of paper, adhesive, ruler.

METHOD OF CONSTRUCTION

1. Draw a circle of radius say r units on a thick sheet of paper, cut it out and paste it on the cardboard.
2. Cut the coloured threads of different sizes in pairs.
3. Fill up the circle by pasting one set of coloured threads of different sizes in concentric pattern so that there is no gap left in between the threads as shown in Fig. 1.
4. Arrange the other set of coloured threads starting from smallest to the largest in the pattern shown in Fig. 2. Last thread will be of same colour and same length as that of the outermost thread of the circle as shown in Fig. 2.

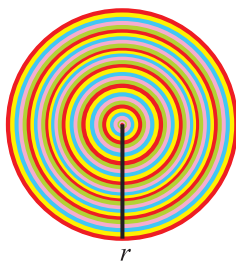


Fig. 1

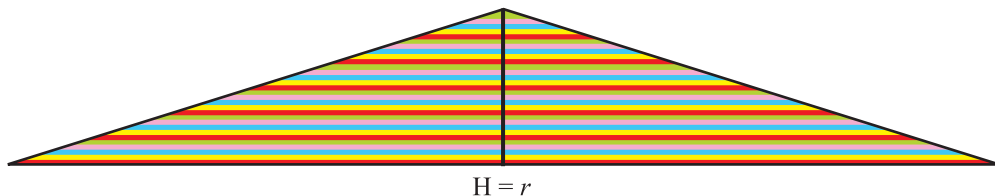


Fig. 2

DEMONSTRATION

1. Number and size of threads pasted on the circle and number and size of thread pasted in the form of triangle are the same.
2. Therefore, area covered by threads on the circle and area of triangular shaped figure formed by threads is the same.
3. Area of triangle $= \frac{1}{2} \text{ Base} \times \text{Height}$
4. Base of triangle is equal to the circumference of the circle ($2\pi r$) and height of the triangle is equal to radius of circle, i.e., r .
5. Area of the circle = Area of triangle $= \frac{1}{2} \times 2\pi r \times r = \pi r^2$

OBSERVATION

On actual measurement:

1. Base of the triangle = ----- units.
2. Height of triangle = ----- units (i.e., radius of the circle).
3. Area of triangle $= \frac{1}{2} (\text{Base} \times \text{Height})$ sq. units.
4. Area of circle = Area of triangle = -----.

APPLICATION

This result can be used in finding areas of flower beds of circular and semi-circular shapes and also for making circular designs and in estimating the number of circular tiles required to cover a floor.

NOTE

Thinner the thread more is the accuracy. Fig. 2 is not drawn to scale.