

Activity 11

OBJECTIVE

To interpret geometrically the meaning of $i = \sqrt{-1}$ and its integral powers.

MATERIAL REQUIRED

Cardboard, chart paper, sketch pen, ruler, compasses, adhesive, nails, thread.

METHOD OF CONSTRUCTION

1. Paste a chart paper on the cardboard of a convenient size.
2. Draw two mutually perpendicular lines $X'X$ and $Y'Y$ intersecting at the point O (see Fig. 11).
3. Take a thread of a unit length representing the number 1 along OX . Fix one end of the thread to the nail at O and the other end at A as shown in the figure.
4. Set free the other end of the thread at A and rotate the thread through angles of 90° , 180° , 270° and 360° and mark the free end of the thread in different cases as A_1 , A_2 , A_3 and A_4 , respectively, as shown in the figure.

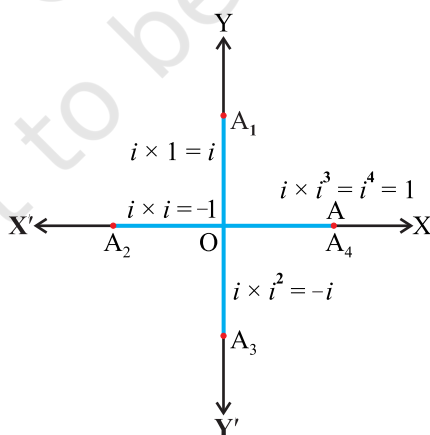


Fig. 11

DEMONSTRATION

1. In the argand plane, OA , OA_1 , OA_2 , OA_3 , OA_4 represent, respectively, $1, i, -1, -i, 1$.
2. $OA_1 = i = 1 \times i$, $OA_2 = -1 = i \times i = i^2$, $OA_3 = -i = i \times i \times i = i^3$ and so on. Each time, rotation of OA by 90° is equivalent to multiplication by i . Thus, i is referred to as the multiplying factor for a rotation of 90° .

OBSERVATION

1. On rotating OA through 90° , $OA_1 = 1 \times i = \underline{\hspace{2cm}}$.
2. On rotating OA through an angle of 180° , $OA_2 = 1 \times \underline{\hspace{1cm}} \times \underline{\hspace{1cm}} = \underline{\hspace{2cm}}$.
3. On rotation of OA through 270° (3 right angles), $OA_3 = 1 \times \underline{\hspace{1cm}} \times \underline{\hspace{1cm}} \times \underline{\hspace{1cm}} = \underline{\hspace{2cm}}$.
4. On rotating OA through 360° (4 right angles),

$$OA_4 = 1 \times \underline{\hspace{1cm}} \times \underline{\hspace{1cm}} \times \underline{\hspace{1cm}} \times \underline{\hspace{1cm}} = \underline{\hspace{2cm}}.$$

5. On rotating OA through n -right angles

$$OA_n = 1 \times \underline{\hspace{1cm}} \times \underline{\hspace{1cm}} \times \underline{\hspace{1cm}} \times \underline{\hspace{1cm}} \times \dots n \text{ times} = \underline{\hspace{2cm}}.$$

APPLICATION

This activity may be used to evaluate any integral power of i .

Activity 12

OBJECTIVE

To obtain a quadratic function with the help of linear functions graphically.

MATERIAL REQUIRED

Plywood sheet, pieces of wires.

METHOD OF CONSTRUCTION

1. Take two wires of equal length.
2. Fix them at O in a plane (on the plywood sheet) at right angle to each other to represent x -axis and y -axis (see Fig.12)
3. Take a piece of wire and fix it in such a way that it meets the x -axis at a distance of a units from O in the positive direction and meets y -axis at a distance of a units below O as shown in the figure. Mark these points as B and A, respectively.

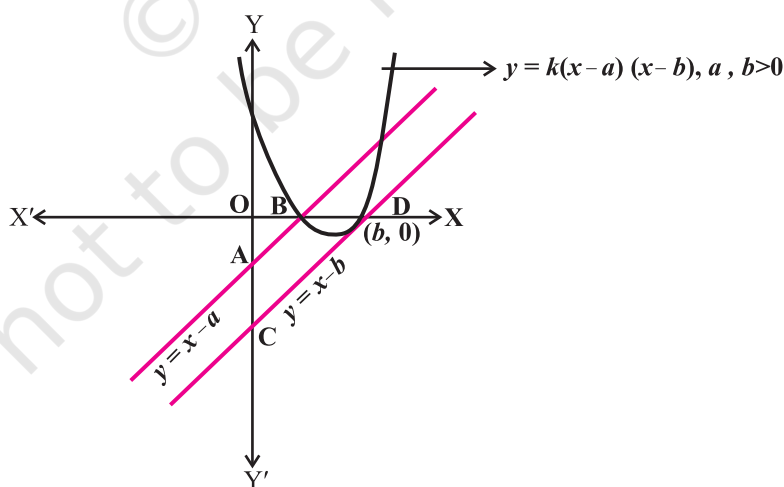


Fig. 12

- Similarly, take another wire and fix it in such a way that it meets the x -axis at a distance of b units from O in the positive direction and meets y -axis at a distance of b units below O as shown in the Fig.12. Mark these points as D and C, respectively.
- Take one more wire and fix it in such a way that it passes through the points where straight wires meet the x -axis and the wire takes the shape of a curve (parabola) as shown in the Fig.12.

DEMONSTRATION

- The wire through the points A and B represents the straight line given by $y = x - a$ intersecting the x and y -axis at $(a, 0)$ and $(0, -a)$, respectively.
- The wire through the points C and D represents the straight line given by $y = x - b$ intersecting x and y axis at $(b, 0)$ and $(0, -b)$, respectively.
- The wire through B and D represents a curve given by the function $y = k(x - a)(x - b) = k[x^2 - (a + b)x + ab]$, where k is an arbitrary constant.

OBSERVATION

- The line given by the linear function $y = x - a$ intersects the x -axis at the point _____ whose coordinates are _____.
- The line given by the linear function $y = x - b$ intersects the x -axis at the point _____ whose coordinates are _____.
- The curve passing through B and D is given by the function $y = \underline{\hspace{2cm}}$, which is a _____ function.

APPLICATION

This activity is useful in understanding the zeroes and the shape of graph of a quadratic polynomial.