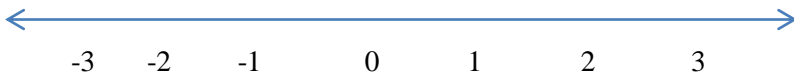


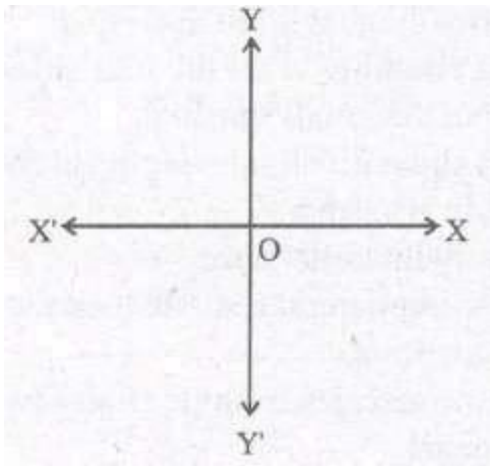
Unit – 3.2 Coordinate Geometry

- **Co-ordinate Geometry :-** Coordinates are an ordered set of numbers that define the position of a point.
- **Directed Line :-** A line in which there are positive, negative and zero values.



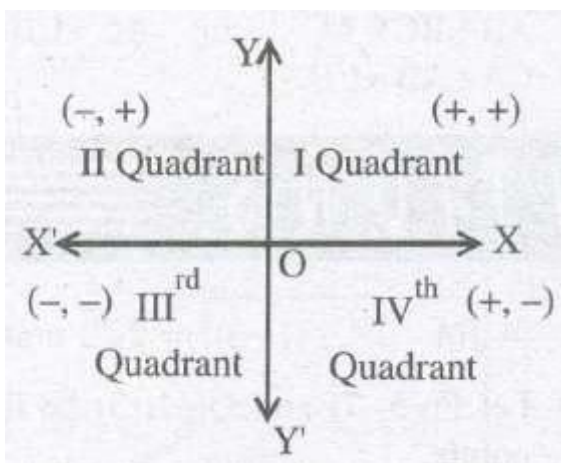
- **THE CARTESIAN CO-ORDINATE SYSTEM**

Let $X'OX$ and YOY' be two perpendicular straight lines meeting at fixed point O then $X'OX$ is called the x—axis and $Y'OY$ is called the axis of y or y axis. Point O is called the origin. x axis is known as **abscissa** and y—axis is known as **ordinate**.



NOTE : The x- axis and y— axis are mutually perpendicular to each other that is why, this system of coordinates is also called Rectangular cartesian coordinate system.

- **QUADRANTS**



The coordinate axes $X'OX$ and $Y'OY$ divide the plane into four parts, called quadrants, numbered I, II, III and IV anti-clockwise from OX.

NOTE : The coordinates of a point on the x-axis are of the form (x, 0), and of a point on the y-axis are of the form (0, y).

• DISTANCE FORMULA of Two Points

The distance between two points whose co—ordinates are P (x₁, y₁) and Q (x₂, y₂) given by the formula $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

DISTANCE OF ONE POINT

$$\sqrt{(x - 0)^2 + (y - 0)^2} = \sqrt{x^2 + y^2}$$

NOTE : Since, distance is always non-negative (Positive), we take only the positive square root.

• SECTION FORMULA

The coordinates of the point p (x, y) which divides the line segment joining the points A (x₁, y₁) and B (x₂, y₂)

internally in the ratio m₁ : m₂ are $x = \frac{m_1 x_2 + m_2 x_1}{m_1 + m_2}$

and $y = \frac{m_1 y_2 + m_2 y_1}{m_1 + m_2}$

A(x₁, y₁) P(x, y) B(x₂, y₂)

NOTE : If the ratio in which P (x, y) divides AB is K : 1, then the coordinates of the point P will be

$$\left(\frac{kx_2 + x_1}{k + 1}, \frac{ky_2 + y_1}{k + 1} \right)$$

COORDINATES OF MID-POINT

(Special case of section formula)

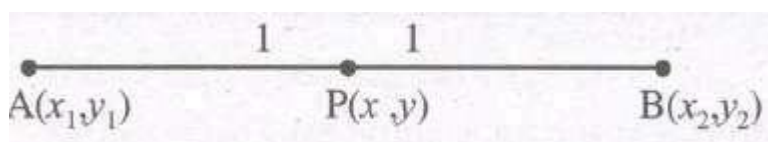
The mid-point of a line segment divides the line segment in the ratio 1 : 1

∴ The coordinates of the mid-point P of the join of the points A (x₁, y₁) and B (x₂, y₂) is

$$\left(\frac{x_1 + x_2}{1 + 1}, \frac{y_1 + y_2}{1 + 1} \right) =$$

$$\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$$

(using section- formula m₁ = 1, m₂ = 1)



• AREA OF A TRIANGLE

Area of $\triangle ABC$, formed by the points $A(x_1, y_1)$, $B(x_2, y_2)$, $C(x_3, y_3)$ is given by the numerical value of the expression

$$\frac{1}{2} [x_1(y_2 - y_3) + x_2(y_3 - y_1) + x_3(y_1 - y_2)]$$

NOTE:

- (1) Area cannot be negative so, we shall ignore negative sign if it occurs in a problem.
- (2) To find the area of quadrilateral we shall divide it into two triangles by joining two opposite vertices, find their areas and add them.
- (3) If the area of triangle is zero sq. units then the vertices of triangle are collinear.

REMARKS:

(I) Four points will form :

- (a) a **parallelogram** if its opposite sides are equal, but diagonals are unequal.
- (b) a **rectangle** if opposite sides are equal and two diagonals are also equal.
- (c) a **rhombus** if all the four sides are equal, but diagonals unequal,
- (d) a **square** if all sides are equal and diagonals are also equal.

(II) Three points will form:

- (a) an equilateral triangle if all the three sides are equal.
- (b) an isosceles triangle if any two sides are equal.
- (c) a right angled triangle if sum of square of any two sides is equal to square of the third side.
- (d) a triangle if sum of any two sides (distances) is greater than the third side (distance).

(III) Three points A, B and C are collinear or lie on a line if one of the following holds

- (i) $AB + BC = AC$
- (ii) $AC + CB = AB$
- (iii) $CA + AB = CB$.