Coordinate Geometry

1. Distance between any two points $P(x_1, y_1)$ and $Q(x_2, y_2)$

$$PQ = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

2. Distance between a point $P(x, y)$ and origin $O(0, 0)$

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

3. Coordinates of point P, dividing the line-segment joining the points $A(x_1, y_1)$ and $B(x_2, y_2)$ ***internally*** in the ratio m:n are given by *section formula*

$$P \equiv \left(\frac{mx_2 + nx_1}{m + n}, \frac{my_2 + ny_1}{m + n} \right) \tag{1}$$

Special Case

(a) The mid-point of the line-segment joining the points $A(x_1, y_1)$ and $B(x_2, y_2)$ divides the line-segment in the ratio $1 : 1$. Hence, putting $m = 1$ and $n = 1$ in equation (1)

$$P \equiv \left(\frac{x_1 + x_2}{m + n}, \frac{y_1 + y_2}{m + n} \right) \tag{2}$$

4. Coordinates of point P, dividing the line-segment joining the points $A(x_1, y_1)$ and $B(x_2, y_2)$ ***externally*** in the ratio $m : n$ are given by

$$P \equiv \left(\frac{mx_2 + nx_1}{m + n}, \frac{my_2 + ny_1}{m + n} \right)$$

5. $A(x_1, y_1)$, $B(x_2, y_2)$ and $C(x_3, y_3)$ are the coordinates of the vertices of a $\triangle ABC$ and $G(x, y)$ is the centroid of the triangle

$$G \equiv \left(\frac{x_1 + x_2 + x_3}{3}, \frac{y_1 + y_2 + y_3}{3} \right)$$