Board –CBSE	Class –10th	Topic – Co-ordinate geometry

- The abscissa and ordinate of a given point are the distances of the point from the y-axis, and x-axis respectively.

- The coordinates of any point on the x-axis are of the form $(x, 0)$.
  The coordinates of any point on the y-axis are of the form $(0, y)$

- Distance of a point $P(x,\ y)$ from the origin $O(0, 0)$ is given by $OP = \sqrt{x^2 + y^2}$
  Example: $P(-\ 6, 7)$ and $O(0, 0)$ is given then the distance between them i.e. OP is calculated as follows:

  $$OP = \sqrt{(x_2 - 0)^2 + (y_2 - 0)^2}$$

  $$OP = \sqrt{x^2 + y^2}$$

  $$OP = \sqrt{6^2 + 7^2}$$

  $$OP = \sqrt{85}$$

- The coordinates of the point which divides the join of points $P(x_1,\ y_1)$, and $Q(x_2,\ y_2)$ internally in the ratio $m: n$ are $\frac{mx_2+nx_1}{m+n}, \frac{my_2+ny_1}{m+n}$

- Example: Find the coordinates of the point which is divided the line segment joining $(-\ 1,\ 3)$, and $(4,\ -\ 7)$ internally in the ratio 3: 4.
  Solution: Let the endpoints of AB be $A\ (-\ 1,\ 3)$, and $B\ (4,\ -\ 7)$.
  $(x_1 = -\ 1,\ y_1 = 3)$, and $(x_2 = 4,\ y_2 = -\ 7)$
  Also, $m = 3$, and $n = 4$
  Let $P(x,\ y)$ be the required point, then by section formula, we have,

$x = \frac{mx_2+nx_1}{m+n}, \; y = \frac{my_2+ny_1}{m+n}$

$\Rightarrow x = \frac{3\times4+4\times(-1)}{7}, \; y = \frac{3\times(-7)+4\times3}{7}$

$\Rightarrow x = \frac{12-4}{7}, \; y = \frac{-21+12}{7}$

$\Rightarrow x = \frac{8}{7}, \; y = \; -\frac{9}{7}$

Hence, the required point is $P\left(\frac{8}{7}, \; \frac{-9}{7}\right)$

The coordinates of the mid-point of the line segment joining the points $P\left(x_1, \; y_1\right)$ and $Q\left(x_2, \; y_2\right)$ are $\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$.

Example: $P(4, 8)$ and $Q(6, 10)$

$Midpoint \; = \frac{4+6}{2}, \frac{8+10}{2}$

So midpoint of PQ is $M(5, \; 9)$.

- The coordinates of the centroid of the triangle formed by the points $A\left(x_1, \; y_1\right)$, $B\left(x_2, \; y_2\right)$, and $C\left(x_3, \; y_3\right)$ are $\left(\frac{x_1+x_2+x_3}{3}, \frac{y_1+y_2+y_3}{3}\right)$

  For Example: Find the centroid of a triangle whose vertices are

  $(1, \; 4), \; (-\; 1, \; \; -\; 1), \; (3, \; \; -\; 2)$

  Solution: We know that the coordinates of the centroid of a triangle whose angular points are $\left(x_1, \; y_1\right)$, $\left(x_2, \; y_2\right)$, and $\left(x_3, \; y_3\right)$ are $\left(\frac{x_1+x_2+x_3}{3}, \frac{y_1+y_2+y_3}{3}\right)$

  So, the coordinates of the centroid of a triangle whose vertices are

  $(1, \; 4), (-\; 1, \; \; -\; 1)$, and $(3, \; \; -\; 2)$ are $\left(\frac{1-1+3}{3}\right), \left(\frac{4-1-2}{3}\right) = \left(1, \frac{1}{3}\right)$

- The area of the triangle formed by the points $A(x_1, y_1)$, $B(x_2, y_2)$ and $C(x_3, y_3)$ is

  $\frac{1}{2}\left|x_1(y_2 - y_3) + x_2(y_3 - y_1) + x_3(y_1 - y_2)\right|$ Or, $\frac{1}{2}\left|(x_1y_2 + x_2y_3 + x_3y_1) - (x_1y_3 + x_2y_1 + x_3y_2\right.$

  If points $A(x_1, y_1)$, $B(x_2, y_2)$ and $C(x_3, y_3)$ are collinear, then

  $x_1(y_2 - y_3) + x_2(y_3 - y_1) + x_3(y_1 - y_2) = 0$