1 Distance Formula

The distance between two points $A(x_1, y_1)$ and $B(x_2, y_2)$ in a Cartesian plane is given by the formula:

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

Example: Find the distance between points $A(2, 3)$ and $B(5, 7)$.

$$AB = \sqrt{(5 - 2)^2 + (7 - 3)^2}$$

$$= \sqrt{3^2 + 4^2}$$

$$= \sqrt{9 + 16} = \sqrt{25} = 5$$

Thus, the distance between the points is 5 units.
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2 Section Formula

The section formula is used to find the coordinates of a point that divides a line segment joining two points in a given ratio.

Internal Division: If point $P(x, y)$ divides the line joining $A(x_1, y_1)$ and $B(x_2, y_2)$ in the ratio $m : n$, then:

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

External Division: If point $P(x, y)$ divides the line externally in the ratio $m : n$, then:

$$x = \frac{mx_2 - nx_1}{m - n}, \quad y = \frac{my_2 - ny_1}{m - n}$$

Example: Find the coordinates of the point that divides the line joining $A(2, 3)$ and $B(8, 5)$ in the ratio $2 : 3$.

$$x = \frac{2(8) + 3(2)}{2 + 3} = \frac{16 + 6}{5} = \frac{22}{5}$$

$$y = \frac{2(5) + 3(3)}{2 + 3} = \frac{10 + 9}{5} = \frac{19}{5}$$

Thus, the coordinates of the required point are $\left(\frac{22}{5}, \frac{19}{5}\right)$.
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3 Midpoint Formula

The midpoint $M(x, y)$ of a line segment joining two points $A(x_1, y_1)$ and $B(x_2, y_2)$ is given by the formula:

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

Example: Find the midpoint of the line segment joining $A(4, 6)$ and $B(8, 10)$.

$$M = \left(\frac{4 + 8}{2}, \frac{6 + 10}{2}\right)$$

$$= (6, 8)$$

Thus, the midpoint is $(6, 8)$.
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4 Centroid of a Triangle

The centroid of a triangle divides each median in the ratio $2:1$. If the coordinates of the vertices of a triangle are $A(x_1, y_1)$, $B(x_2, y_2)$, and $C(x_3, y_3)$, then the coordinates of the centroid G are given by:

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

Example: Find the centroid of the triangle whose vertices are $A(1, 2)$, $B(3, 4)$, and $C(5, 6)$.

$$G = \left(\frac{1 + 3 + 5}{3}, \frac{2 + 4 + 6}{3}\right)$$

$$= \left(\frac{9}{3}, \frac{12}{3}\right)$$

$$= (3, 4)$$

Thus, the centroid of the triangle is $(3, 4)$.
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5 Conclusion

- The **distance formula** is used to find the distance between two points in a coordinate plane.
- The **section formula** helps to determine the coordinates of a point dividing a line segment in a given ratio.
- The **midpoint formula** finds the middle point of a segment.
- The **centroid** of a triangle divides each median in the ratio $2:1$.

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