# Straight Lines

- Distance between the points $P(x_1, y_1)$ and $Q(x_2, y_2)$ is $\boxed{PQ = \sqrt{(x_2-x_1)^2 + (y_2-y_1)^2}}$

- Coordinates of a point dividing the line segment joining the points $(x_1, y_1)$ and $(x_2, y_2)$ internally in the ratio $m:n$ are $\left[\dfrac{mx_2 + nx_1}{m+n}, \dfrac{my_2 + ny_1}{m+n}\right]$

- In particular, If $m = n$, the coordinates of the mid point of the line segment joining the points $(x_1, y_1)$ and $(x_2, y_2)$ are $\left[\dfrac{x_1 + x_2}{2}, \dfrac{y_1 + y_2}{2}\right]$

- **Area of triangle** $\boxed{\frac{1}{2}\left[x_1(y_2 - y_3) + x_2(y_3 - y_1) + x_3(y_1 - y_2)\right]}$ vertices are $(x_1, y_1)$, $(x_2, y_2)$ and $(x_3, y_3)$

**Note:** If the area of the triangle ABC is zero, then three points A, B and C lie on a line, i.e., they are collinear.

- **Slope of a line** $\boxed{m = \tan\theta}$ $(\theta \neq 90^\circ)$

**Note:** The slope of $x$-axis is zero and slope of $y$-axis is not defined.

- **Slope of the line through the points $(x_1, y_1)$ and $(x_2, y_2)$** $\boxed{m = \dfrac{y_2 - y_1}{x_2 - x_1}}$

- **If the line $l_1$ is parallel to $l_2$** $\boxed{m_1 = m_2}$ $\boxed{\tan\alpha = \tan\beta}$

- **If the line $l_1$ and $l_2$ are perpendicular** $\boxed{m_2 = \dfrac{-1}{m_1}}$ OR $\boxed{m_1 m_2 = -1}$

$$\tan\beta = \tan(\alpha + 90^\circ) = -\cot\alpha = -\frac{1}{\tan\alpha}$$

- **Acute angle $\theta$ between two lines with slopes $m_1$ and $m_2$** $\boxed{\tan\theta = \left|\dfrac{m_2 - m_1}{1 + m_1 m_2}\right|, \quad 1 + m_1 m_2 \neq 0}$

- **Collinearity of three points** Three points are collinear if and only if $\boxed{\text{slope of } AB = \text{slope of } BC}$

- **Point - slope form** $\boxed{y - y_1 = m(x - x_1)}$

- **Two - point form** $\boxed{y - y_1 = \dfrac{y_2 - y_1}{x_2 - x_1}(x - x_1)}$

- **Slope - intercept form** Case I $\boxed{y = mx + c}$ slope $m$ and $y$-intercept $c$ Case II $\boxed{y = m(x - d)}$ slope $m$ and $x$-intercept $d$

- **Intercept form** $\boxed{\dfrac{x}{a} + \dfrac{y}{b} = 1}$ $x$-intercept $a$ and $y$-intercept $b$

- **Normal form** $\boxed{x\cos\omega + y\sin\omega = p}$ Normal distance from the origin.

- **Distance of a point from a line** $\boxed{d = \dfrac{|Ax_1 + By_1 + C|}{\sqrt{A^2 + B^2}}}$ $Ax + By + C = 0$ from a point $(x_1, y_1)$

- **Distance between two parallel lines** $\boxed{d = \dfrac{|C_1 - C_2|}{\sqrt{A^2 + B^2}}}$ two parallel lines $Ax + By + C_1 = 0$ and $Ax + By + C_2 = 0$