HIGH SCHOOL MATHEMATICS

DIFFERENTIATION I

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The derivatives you need to know:

- $y = x^n \quad \rightarrow \quad \frac{dy}{dx} = nx^{n-1}$
- $y = kx^n \quad \rightarrow \quad \frac{dy}{dx} = nkx^{n-1}$

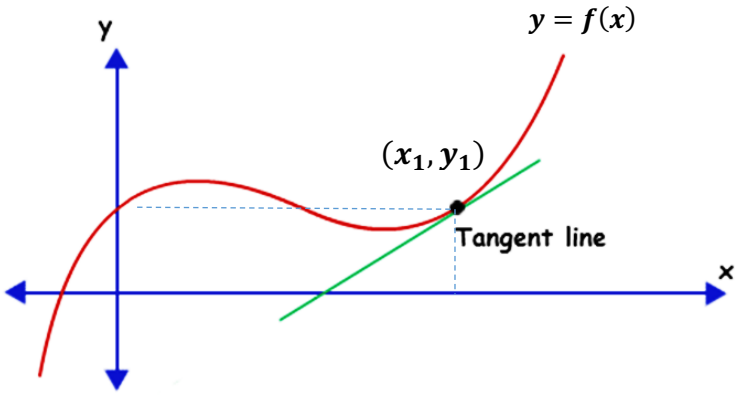
$f'(x)$ *is the first derivative of* $f(x)$

$[f(x) \pm g(x)]' = f'(x) \pm g'(x)$

$[kf(x)]' = k \times f'(x) \quad (k \text{ is a constant})$

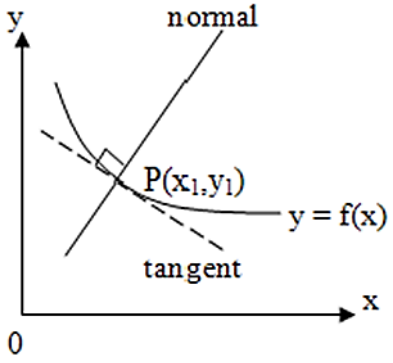
Tangent & Normal lines:

A **tangent** to a curve is a line that touches the curve at one point and has the same **gradient** with the curve at the point of contact.



$\frac{dy}{dx} @ (x_1, y_1) = m$

The gradient of the tangent line



Normal and tangent lines are perpendicular to each other,

$\therefore \; m_1 \times m_2 = -1$

The gradient of the tangent line

The gradient of the normal line

You can write either the equation of tangent line or normal line as you will have the gradient and also coordinates of the common point on these two lines.

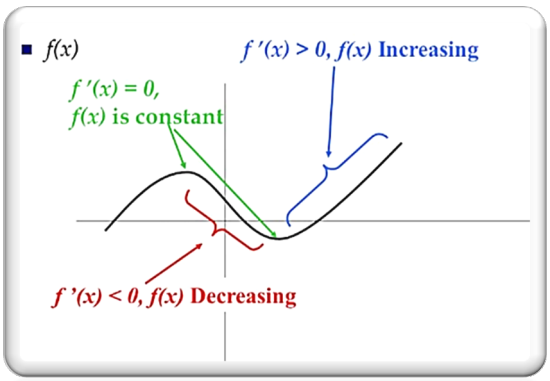
You may use the equation ; $y - y_1 = m(x - x_1)$

Increasing &Decreasing functions:

$\boldsymbol{f'(x) > 0}$ ⟹ ***The function is increasing***

$\boldsymbol{f'(x) < 0}$ ⟹ ***The function is decreasing***

$\boldsymbol{f'(x) = 0}$ ⟹ ***The function is stationary***



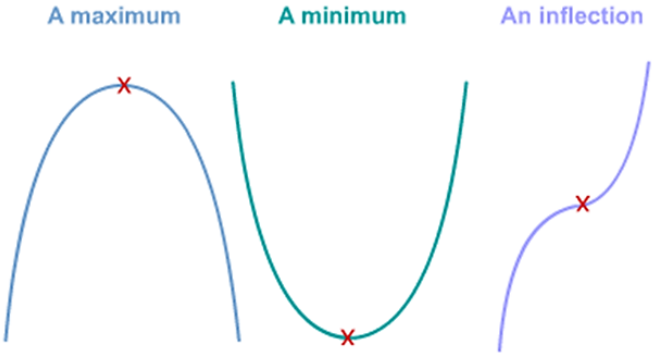
Stationary points (turning points):

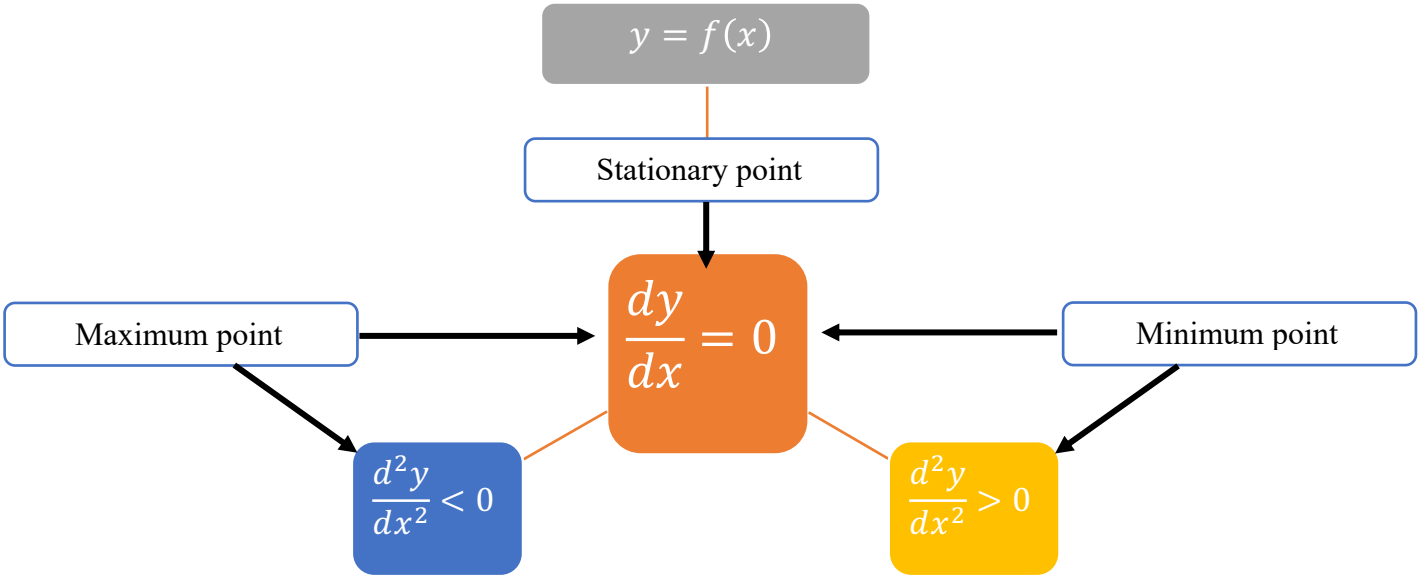
A stationary is a point on the graph of the function where the function's derivative is zero.

$$If\ (x_1, y_1)\ \textbf{is a stationary point then}\ , => \frac{dy}{dx} @ (x_1, y_1) = 0$$

Stationary point could be a minimum, maximum or a point of inflexion (inflection).

You will require to check / verify whether a point is minimum or maximum.





Maximum Point

If the point (x_1, y_1) is a maximum then;

$$\frac{dy}{dx} @ (x_1, y_1) = 0 \quad and \quad \frac{d^2y}{dx^2} < 0$$

Minimum Point

If the point (x_1, y_1) is a minimum then;

$$\frac{dy}{dx} @ (x_1, y_1) = 0 \quad and \quad \frac{d^2y}{dx^2} > 0$$