The Derivative

Definition: The derivative is the slope of the tangent line to the curve at any point *x*. It can also be defined as the rate of change at any point *x*.

The function must be defined at the point *x*.

Examples of where the function is **not** defined include: Vertical Asymptotes (V. A.) and holes.

Examples of where the function is **not** differentiable are sharp corners, endpoints, vertical tangents.

1st Principles Definition of the Derivative

Lagrange Notation

$$y' = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$$

or

$$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$$

Leibniz Notation

$$\frac{dy}{dx} = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$$

Example 1: Determine y' if $y = \sqrt{x+1}$.

Example 2: Determine $\frac{dy}{dx}$ at $x = 3$ if $y = 2x^2 + 6x + 11$.