1 Definition of a Derivative

$$\lim_{h\to 0}\frac{f(x+h)-f(x)}{h} \tag{1}$$

Derivative tells us the change of the function.
For instance if f(x) tells us the position of an object, then its derivative (written as $f'(x) or \frac{d}{dx}f(x)$) tells us the speed.

2 Derivative Properties

Sometimes memorizing these derivatives properties will help you in the later calculus.

Caution

Carefully read the direction of the problem as it may ask you to solve using the definition of a derivatives. Even with the correct answer it may hurt your score.

2.1 Constant Rule

$$\frac{d}{dx}c = 0 \tag{2}$$

where c is any real number
A derivative of any constant is equal to 0.

2.2 derivative of a single variable

$$\frac{d}{dx}x = 1 \tag{3}$$

where x is a variable to the first power

2.3 Power Rule

$$\frac{d}{dx}x^n = nx^{n-1} \tag{4}$$

where n is a real number

2.4 Product Rule

$$\frac{d}{dx}(f(x)\times g(x)) = (\frac{d}{dx}f(x))g(x) + f(x)(\frac{d}{dx}g(x)) \tag{5}$$

2.5 Quotient Rule

$$\frac{d}{dx}((f(x)\div g(x)) = \frac{(\frac{d}{dx}f(x))g(x) - f(x)\frac{d}{dx}g(x)}{(g(x)^2)} \tag{6}$$

3 Trigonometry Derivatives

- $\frac{d}{dx}sin(x) = cos(x)$
- $\frac{d}{dx}cos(x) = -sin(x)$
- $\frac{d}{dx}tan(x) = sec^2(x)$
- $\frac{d}{dx}sec(x) = sec(x)tan(x)$
- $\frac{d}{dx}csc(x) = -csc(x)cot(x)$
- $\frac{d}{dx}cot(x) = -csc^2(x)$
- **advice** trigonometry functions that start with the letter 'C' have a negative sign on its their derivative.

4 Application of Derivatives

- **Critical Points**: x=c is a critical point of a function if $f'(c) = 0$ or $f'(c) =$ DNE
- **Maximum Minimum**: since the derivatives tells us if the slope of the graph is increasing or decreasing we can find the use it to find the highest or/and lowest points