Basic Calculus I

Rules of Differentiation

Definition: The derivative of a function $f(x)$ at a point $x = a$ is denoted by the symbol $f'(a)$.

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

If the above limit(s) exist then the function $f(x)$ is differentiable at $x = a$.

Addition and Subtraction Rule

$$[f(x) + g(x)]' = f'(x) + g'(x)$$
$$[f(x) - g(x)]' = f'(x) - g'(x)$$

Constant Multiple Rule

$$[cf(x)]' = cf'(x)$$

Product Rule

$$[f(x) \cdot g(x)]' = f'(x)g(x) + f(x)g'(x)$$

Quotient Rule

$$\left[\frac{f(x)}{g(x)}\right]' = \frac{f'(x)g(x) - f(x)g'(x)}{(g(x))^2}$$

Reciprocal Rule

$$\left[\frac{1}{g(x)}\right]' = -\frac{g'(x)}{(g(x))^2}$$

Chain Rule

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

$f(x)$	$f'(x)$
C c is a **constant**	**0**
$mx + b$ m is slope, b is intercept	**m**
x^p	px^{p-1}
$\sin(x)$	$\cos(x)$
$\cos(x)$	$-\sin(x)$
$\tan(x)$	$\sec^2(x)$
$\frac{1}{x}$	$\frac{-1}{x^2}$
a^x a is a **positive constant**	$a^x \cdot \ln(a)$
e^x	e^x
$\ln(x)$	$\frac{1}{x}$