Alternative markings

$$f'(x) = \frac{df(x)}{dx} = \frac{\partial f(x)}{\partial x}$$

Definitions

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

Rules

1. Sum rule: $[f(x) + g(x)]' = f'(x) + g'(x)$
2. Constant multiple rule: $[cf(x)]' = cf'(x)$
3. Function multiplication rule: $[f(x) \cdot g(x)]' = f'(x) \cdot g(x) + f(x) \cdot g'(x)$
4. Chain rule: $\{f[g(x)]\}' = f'[g(x)]g'(x)$

Notable derivatives

Function	Derivative
$f(x) = c$ (where c is a constant)	$f'(x) = 0$
$f(x) = x^n$ (where n is any real number)	$f'(x) = nx^{n-1}$
$f(x) = e^x$	$f'(x) = e^x$
$f(x) = \ln(x)$	$f'(x) = \frac{1}{x}$
$f(x) = \sin(x)$	$f'(x) = \cos(x)$
$f(x) = \cos(x)$	$f'(x) = -\sin(x)$
$f(x) = \tan(x)$	$f'(x) = \sec^2(x)$

Practice

Prove the following using the rules and notable derivatives:

$$(x^3)' = 3 \cdot x^2$$
$$(4 \cdot x^3 + 13 \cdot x^2 + 12 \cdot x + 5)' = 12 \cdot x^2 + 26 \cdot x + 12$$
$$\sin'(\cos(x)) = -\cos(\cos(x)) \sin(x)$$
$$(\frac{1}{x})' = -\frac{1}{x^2}$$
$$\left[\frac{f(x)}{g(x)}\right]' = \left[f(x) \cdot \frac{1}{g(x)}\right]' = \frac{f'(x)g(x) - f(x)g'(x)}{g^2(x)}$$