

Differentiation Rules

Basic Functions

1. Constants

$$\frac{d}{dx} [c] = 0$$

2. Powers

$$\frac{d}{dx} [x^n] = nx^{n-1}$$

3. Exponents

$$\frac{d}{dx} [e^x] = e^x \quad \left(\frac{d}{dx} [a^x] = \ln(a)a^x \right)$$

4. Logarithms

$$\frac{d}{dx} \ln(x) = \frac{1}{x} \quad \left(\frac{d}{dx} [\log_a(x)] = \frac{1}{\ln(a)x} \right)$$

Combinations of Functions

1. Constant Multiples

$$\frac{d}{dx} [kf(x)] = kf'(x)$$

2. Sums

$$\frac{d}{dx} [f(x) \pm g(x)] = f'(x) \pm g'(x)$$

3. Products

$$\frac{d}{dx} [f(x)g(x)] = f'(x)g(x) + f(x)g'(x)$$

4. Quotients

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

5. Compositions (Chain Rule)

$$\frac{d}{dx} [f(u(x))] = f'(u(x))u'(x)$$

$$\frac{d}{dx} [f(u(x))] = \frac{df}{du} \frac{du}{dx}$$