

Basic Differentiation Rules

Let C and k be constants, f and g be differentiable functions.

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

$$\frac{d}{dx} [kx] = k$$

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

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

$$\frac{d}{dx} [x^n] = nx^{n-1} \quad \text{for any natural number } n$$

Special Derivative Rules

Chain Rule. Let g be differentiable and f be differentiable at $g(x)$.

Then

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

Product Rule. Let f and g be differentiable functions. Then

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

Quotient Rule. Let f and g be differentiable functions. Then

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

provided $g(x) \neq 0$.

Derivatives of Trig Functions

$$\frac{d}{dx} [\sin(x)] = \cos(x) \qquad \frac{d}{dx} [\csc(x)] = -\csc(x) \cot(x)$$

$$\frac{d}{dx} [\cos(x)] = -\sin(x) \qquad \frac{d}{dx} [\sec(x)] = \sec(x) \tan(x)$$

$$\frac{d}{dx} [\tan(x)] = \sec^2(x) \qquad \frac{d}{dx} [\cot(x)] = -\csc^2(x)$$