

## Derivatives

### Basic Properties/Formulas/Rules

$$\frac{d}{dx}(cf(x)) = cf'(x), c \text{ is any constant.} \quad (f(x) \pm g(x))' = f'(x) \pm g'(x)$$

$$\frac{d}{dx}(x^n) = nx^{n-1}, n \text{ is any number.} \quad \frac{d}{dx}(c) = 0, c \text{ is any constant.}$$

$$(f \cdot g)' = f'g + fg' \quad \text{-- (Product Rule)} \quad \left(\frac{f}{g}\right)' = \frac{f'g - fg'}{g^2} \quad \text{-- (Quotient Rule)}$$

$$\frac{d}{dx}(f(g(x))) = f'(g(x))g'(x) \quad \text{(Chain Rule)}$$

$$\frac{d}{dx}(e^{g(x)}) = g'(x)e^{g(x)} \quad \frac{d}{dx}(\ln g(x)) = \frac{g'(x)}{g(x)}$$

### Common Derivatives

#### Polynomials

$$\frac{d}{dx}(c) = 0 \quad \frac{d}{dx}(x) = 1 \quad \frac{d}{dx}(cx) = c \quad \frac{d}{dx}(x^n) = nx^{n-1} \quad \frac{d}{dx}(cx^n) = ncx^{n-1}$$

#### Trig Functions

$$\begin{array}{lll} \frac{d}{dx}(\sin x) = \cos x & \frac{d}{dx}(\cos x) = -\sin x & \frac{d}{dx}(\tan x) = \sec^2 x \\ \frac{d}{dx}(\sec x) = \sec x \tan x & \frac{d}{dx}(\csc x) = -\csc x \cot x & \frac{d}{dx}(\cot x) = -\csc^2 x \end{array}$$

#### Inverse Trig Functions

$$\begin{array}{lll} \frac{d}{dx}(\sin^{-1} x) = \frac{1}{\sqrt{1-x^2}} & \frac{d}{dx}(\cos^{-1} x) = -\frac{1}{\sqrt{1-x^2}} & \frac{d}{dx}(\tan^{-1} x) = \frac{1}{1+x^2} \\ \frac{d}{dx}(\sec^{-1} x) = \frac{1}{|x|\sqrt{x^2-1}} & \frac{d}{dx}(\csc^{-1} x) = -\frac{1}{|x|\sqrt{x^2-1}} & \frac{d}{dx}(\cot^{-1} x) = -\frac{1}{1+x^2} \end{array}$$

#### Exponential/Logarithm Functions

$$\begin{array}{lll} \frac{d}{dx}(a^x) = a^x \ln(a) & \frac{d}{dx}(e^x) = e^x & \\ \frac{d}{dx}(\ln(x)) = \frac{1}{x}, x > 0 & \frac{d}{dx}(\ln|x|) = \frac{1}{x}, x \neq 0 & \frac{d}{dx}(\log_a(x)) = \frac{1}{x \ln a}, x > 0 \end{array}$$

#### Hyperbolic Trig Functions

$$\begin{array}{lll} \frac{d}{dx}(\sinh x) = \cosh x & \frac{d}{dx}(\cosh x) = \sinh x & \frac{d}{dx}(\tanh x) = \operatorname{sech}^2 x \\ \frac{d}{dx}(\operatorname{sech} x) = -\operatorname{sech} x \tanh x & \frac{d}{dx}(\operatorname{csch} x) = -\operatorname{csch} x \coth x & \frac{d}{dx}(\coth x) = -\operatorname{csch}^2 x \end{array}$$