

# Derivative Formulas

## Basic Derivative Formulas

- $\frac{d}{dx}(x^n) = nx^{n-1}$
- $\frac{d}{dx}(\sqrt{x}) = \frac{1}{2\sqrt{x}}$
- $\frac{d}{dx}(x^{-1}) = -\frac{1}{x^2}$
- $\frac{d}{dx}(f(x)g(x)) = f'(x)g(x) + f(x)g'(x)$
- $\frac{d}{dx}\left(\frac{f(x)}{g(x)}\right) = \frac{f'(x)g(x) - f(x)g'(x)}{g^2(x)}$
- $\frac{d}{dx}(f(g(x))) = f'(g(x))g'(x)$
- $\frac{d}{dx}(f(g(h(x)))) = f'(g(h(x)))g'(h(x))h'(x)$
- $\frac{d}{dx}(\sqrt{f(x)}) = \frac{1}{2\sqrt{f(x)}}f'(x)$

## Derivatives of Trigonometric Functions

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

## Derivatives of Inverse Trigonometric Functions

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

## Derivatives of Exponential and Logarithmic Functions

- $\frac{d}{dx}(e^x) = e^x$
- $\frac{d}{dx}(a^x) = a^x \ln a \quad (a \neq 1, a > 0)$
- $\frac{d}{dx}(e^{f(x)}) = e^{f(x)} f'(x)$
- $\frac{d}{dx}(a^{f(x)}) = a^{f(x)} f'(x) \ln a$
- $\frac{d}{dx}(\ln x) = \frac{1}{x}$
- $\frac{d}{dx}(\log_a x) = \frac{1}{x \ln a}$
- $\frac{d}{dx}(\ln f(x)) = \frac{1}{f(x)} f'(x)$
- $\frac{d}{dx}(\log_a f(x)) = \frac{1}{f(x)} f'(x) \frac{1}{\ln a}$

## Derivatives of Inverse Functions

- $(f^{-1})'(x) = \frac{1}{f'(f^{-1}(x))}$

## Derivatives of Hyperbolic Functions

- $\frac{d}{dx}(\sinh x) = \cosh x$
- $\frac{d}{dx}(\cosh x) = \sinh x$