Basic Derivatives

$$\frac{d}{dx}\left(x^n\right)=nx^{n-1}$$

$$\frac{d}{dx}\left(\sin u\right)=\cos u\bullet u'$$

$$\frac{d}{dx}\left(\cos u\right)=-\sin u\bullet u'$$

$$\frac{d}{dx}\left(\tan u\right)=\sec^2 u\bullet u'$$

$$\frac{d}{dx}\left(\cot u\right)=-\csc^2 u\bullet u'$$

$$\frac{d}{dx}\left(\sec u\right)=\sec u\tan u\bullet u'$$

$$\frac{d}{dx}\left(\csc u\right)=-\csc u\cot u\bullet u'$$

$$\frac{d}{dx}\left(\ln u\right)=\frac{1}{u}\frac{du}{dx}$$

$$\frac{d}{dx}\left(e^u\right)=e^u\frac{du}{dx}$$

More Derivatives

$$\frac{d}{dx}\left(\sin^{-1} u\right)=\frac{1}{\sqrt{1-u^2}}\frac{du}{dx}$$

$$\frac{d}{dx}\left(\cos^{-1} u\right)=\frac{-1}{\sqrt{1-u^2}}\bullet u'$$

$$\frac{d}{dx}\left(\tan^{-1} u\right)=\frac{1}{1+u^2}\bullet u'$$

$$\frac{d}{dx}\left(\cot^{-1} u\right)=\frac{-1}{1+u^2}\bullet u'$$

$$\frac{d}{dx}\left(\sec^{-1} u\right)=\frac{1}{|u|\sqrt{u^2-1}}\bullet u'$$

$$\frac{d}{dx}\left(\csc^{-1} u\right)=\frac{-1}{|u|\sqrt{u^2-1}}\bullet u'$$

$$\frac{d}{dx}\left(a^u\right)=a^u\ln a\bullet u'$$

$$\frac{d}{dx}\left(\log_a u\right)=\frac{1}{u\ln a}\bullet u'$$

Basic Derivative Rules

Given c is a constant,

1. Constant Rule $\frac{d}{dx}[c] = 0$
2. Constant Multiple Rule $\frac{d}{dx}[cf(x)] = cf'(x)$
3. Sum Rule $\frac{d}{dx}[f(x) + g(x)] = f'(x) + g'(x)$
4. Difference Rule $\frac{d}{dx}[f(x) - g(x)] = f'(x) - g'(x)$
5. Product Rule $\frac{d}{dx}[f(x)g(x)] = f'(x)g(x) + f(x)g'(x)$
6. Quotient Rule $\frac{d}{dx}\left[\frac{f(x)}{g(x)}\right] = \frac{g(x)f'(x) - f(x)g'(x)}{[g(x)]^2}$
7. Chain Rule $\frac{d}{dx}[f(g(x))] = f'(g(x))g'(x)$

Derivatives of Trig Functions

1. $\frac{d}{dx}[\sin x] = \cos x$
2. $\frac{d}{dx}[\cos x] = -\sin x$
3. $\frac{d}{dx}[\tan x] = \sec^2 x$
4. $\frac{d}{dx}[\sec x] = \sec x \tan x$
5. $\frac{d}{dx}[\csc x] = -\csc x \cot x$
6. $\frac{d}{dx}[\cot x] = -\csc^2 x$

Derivatives of Inverse Trig Functions

1. $\frac{d}{dx}\left[\sin^{-1} x\right] = \frac{1}{\sqrt{1-x^2}}$
2. $\frac{d}{dx}\left[\cos^{-1} x\right] = \frac{-1}{\sqrt{1-x^2}}$
3. $\frac{d}{dx}\left[\tan^{-1} x\right] = \frac{1}{1+x^2}$
4. $\frac{d}{dx}\left[\sec^{-1} x\right] = \frac{1}{|x|\sqrt{x^2-1}}$
5. $\frac{d}{dx}\left[\csc^{-1} x\right] = \frac{-1}{|x|\sqrt{x^2-1}}$
6. $\frac{d}{dx}\left[\cot^{-1} x\right] = \frac{-1}{1+x^2}$

Derivatives of Exponential and Logarithmic Functions

1. $\lim_{x \to 0} (1+x)^{\frac{1}{x}} = e$

2. $\frac{d}{dx}[\log_a x] = \frac{1}{x \ln a}, (a > 0,\ a \neq 1)$

3. $\frac{d}{dx}[\ln x] = \frac{1}{x}$

4. $\frac{d}{dx}\left[\ln|x|\right] = \frac{1}{x}$

5. $\frac{d}{dx}\left[\log_a |x|\right] = \frac{1}{x \ln a}, (a > 0,\ a \neq 1)$

6. $\frac{d}{dx}\left[e^x\right] = e^x$

7. $\frac{d}{dx}\left[a^x\right] = a^x \ln a$

Derivatives

$$\frac{d}{dx}\left(x^n\right) = nx^{n-1}$$

$$\frac{d}{dx}(\sin x) = \cos x$$

$$\frac{d}{dx}(\cos x) = -\sin x$$

$$\frac{d}{dx}(\tan x) = \sec^2 x$$

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

$$\frac{d}{dx}(\sec x) = \tan x \sec x$$

$$\frac{d}{dx}(\csc x) = -\cot x \csc x$$

$$\frac{d}{dx}(ln\, u) = \frac{1}{u} du$$

$$\frac{d}{dx}\left(e^u\right) = e^u du$$

$$\frac{d}{dx}(log_a x) = \frac{1}{x\, ln\, a}$$

$$\frac{d}{dx}\left(a^u\right) = a^x (ln\, a)\, du$$

Differentiation Rules

Chain Rule

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

Product Rule

$$\frac{d}{dx}(uv) = u\frac{dv}{dx} + v\frac{du}{dx}$$

Quotient Rule

$$\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$$

Differentiation Rules

Chain Rule

$$\frac{d}{dx}\left[f(u)\right] = f'(u)\frac{du}{dx} \quad OR \quad \frac{dy}{dx} = \frac{dy}{du}\frac{du}{dx}$$

Product Rule

$$\frac{d}{dx}(uv) = u\frac{dv}{dx} + v\frac{du}{dx} \quad OR \quad uv' + vu'$$

Quotient Rule

$$\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2} \quad OR \quad \frac{vu' - uv'}{v^2}$$

Derivative of an Inverse

If f and its inverse g are differentiable, and the point (c, f(c)) exists on the function f meaning the point (f(c), c) exists on the function g, then

$$\frac{d}{dx}[g(x)] = \frac{1}{f'\left(f^{-1}(x)\right)} = \frac{1}{f'\left(f(c)\right)}$$