

Basic Differentiation Formulas

In the table below, $u = f(x)$ and $v = g(x)$ represent differentiable functions of x

Derivative of a constant

$$\frac{dc}{dx} = 0$$

Derivative of constant multiple

$$\frac{d}{dx}(cu) = c \frac{du}{dx}$$

(We could also write $(cf)' = cf'$, and could use the "prime notion" in the other formulas as well)

Derivative of sum or difference

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

Product Rule

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

Quotient Rule

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

Chain Rule

$$\frac{dy}{dx} = \frac{dy}{du} \frac{du}{dx}$$

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

$$\frac{d}{dx} u^n = nu^{n-1} \frac{du}{dx}$$

$$\frac{d}{dx} a^x = (\ln a) a^x$$

$$\frac{d}{dx} a^u = (\ln a) a^u \frac{du}{dx}$$

(If $a = e$)

$$\frac{d}{dx} e^x = e^x$$

$$\frac{d}{dx} e^u = e^u \frac{du}{dx}$$

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

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

(If $a = e$)

$$\frac{d}{dx} \ln x = \frac{1}{x}$$

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

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

$$\frac{d}{dx} \sin u = \cos u \frac{du}{dx}$$

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

$$\frac{d}{dx} \cos u = -\sin u \frac{du}{dx}$$

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

$$\frac{d}{dx} \tan u = \sec^2 u \frac{du}{dx}$$

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

$$\frac{d}{dx} \cot u = -\csc^2 u \frac{du}{dx}$$

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

$$\frac{d}{dx} \sec u = \sec u \tan u \frac{du}{dx}$$

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

$$\frac{d}{dx} \csc u = -\csc u \cot u \frac{du}{dx}$$

$$\frac{d}{dx} \sin^{-1} x =$$

$$\frac{d}{dx} \sin^{-1} u =$$

$$\frac{d}{dx} \arcsin x = \frac{1}{\sqrt{1-x^2}}$$

$$\frac{d}{dx} \arcsin u = \frac{1}{\sqrt{1-u^2}} \frac{du}{dx}$$

$$\frac{d}{dx} \tan^{-1} x =$$

$$\frac{d}{dx} \tan^{-1} u =$$

$$\frac{d}{dx} \arctan x = \frac{1}{1+x^2}$$

$$\frac{d}{dx} \arctan u = \frac{1}{1+u^2} \frac{du}{dx}$$