Differentiation Formulas

$$\frac{d}{dx}k = 0$$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Integration Formulas

$$\int a\,dx = ax + C$$

$$\int x^n\,dx = \frac{x^{n+1}}{n+1} + C, n \neq -1$$

$$\int \frac{1}{x}\,dx = \ln|x| + C$$

$$\int e^x\,dx = e^x + C$$

$$\int a^x\,dx = \frac{a^x}{\ln a} + C$$

$$\int \ln x\,dx = x \ln x - x + C$$

$$\int \sin x\,dx = -\cos x + C$$

$$\int \cos x\,dx = \sin x + C$$

$$\int \tan x\,dx = -\ln|\cos x| + C$$

$$\int \cot x\,dx = \ln|\sin x| + C$$

$$\int \sec x\,dx = \ln|\sec x + \tan x| + C$$

$$\int \csc x\,dx = -\ln|\csc x + \cot x| + C$$

$$\int \sec^2 x\,dx = \tan x + C$$

$$\int \csc^2 x\,dx = -\cot x + C$$

$$\int \sec x \tan x\,dx = \sec x + C$$

$$\int \csc x \cot x\,dx = -\csc x + C$$

$$\int \frac{1}{\sqrt{a^2 - b^2 x^2}}\,dx = \frac{1}{b}\arcsin\left(\frac{bx}{a}\right) + C$$

$$\int \frac{1}{\sqrt{b^2 x^2 - a^2}}\,dx = \frac{1}{b}\operatorname{arcsec}\left(\frac{bx}{a}\right) + C$$

$$\int \frac{1}{a^2 + b^2 x^2}\,dx = \frac{1}{ab}\arctan\left(\frac{bx}{a}\right) + C$$

Integration by parts

Suppose u, v are functions of x, then

$$\int uv' = uv - \int vu'$$

Trig sub

Term	Replace x	Replace dx	New Term	Domain	Identity
$\sqrt{a^2 - x^2}$	$a \sin \theta$	$a \cos \theta d\theta$	$a \cos \theta$	$\theta \in \left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$	$1 - \sin^2 \theta = \cos^2 \theta$
$\sqrt{x^2 + a^2}$	$a \tan \theta$	$a \sec^2 \theta d\theta$	$a \sec \theta$	$\theta \in \left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$	$1 + \tan^2 \theta = \sec^2 \theta$
$\sqrt{x^2 - a^2}$	$a \sec \theta$	$a \sec \theta \tan \theta d\theta$	$a \tan \theta$	$\theta \in \left[0, \frac{\pi}{2}\right) \cup \left[\pi, \frac{3\pi}{2}\right)$	$\sec^2 \theta - 1 = \tan^2 \theta$