Differentiation Rules

Note: k represents a constant and $\frac{d}{dx}\left[f(x)\right]=f'(x)$ → the *derivative*

Constant Rule

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

Constant Multiple Rule

$$\frac{d}{dx}\left[kx\right]=k$$

Sum and Difference Rule

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

Power Rule

$$\frac{d}{dx}\left[x^{n}\right]=n\cdot x^{n-1}$$

Product Rule

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

Quotient Rule

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

Chain Rule

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

Exponential Rules

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

$$\frac{d}{dx}[k^{x}]=(\ln k)\cdot k^{x}$$

Logarithmic Rules

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

$$\frac{d}{dx}\left[\log_{k} x\right]=\frac{1}{x\cdot \ln k}$$

Trig Function Rules

$$\frac{d}{dx}\left[\sin x\right]=\cos x$$

$$\frac{d}{dx}\left[\cos x\right]=-\sin x$$

$$\frac{d}{dx}\left[\tan x\right]=\sec^{2} x$$

$$\frac{d}{dx}\left[\csc x\right]=-\csc x\cdot \cot x$$

$$\frac{d}{dx}\left[\sec x\right]=\sec x\cdot \tan x$$

$$\frac{d}{dx}\left[\cot x\right]=-\csc^{2} x$$

Inverse Trig Function Rules

$$\frac{d}{dx}\left[\arcsin x\right]=\frac{1}{\sqrt{1-x^{2}}}$$

$$\frac{d}{dx}\left[\arccos x\right]=\frac{-1}{\sqrt{1-x^{2}}}$$

$$\frac{d}{dx}\left[\arctan x\right]=\frac{1}{1+x^{2}}$$

Integration Rules on Reverse →

Integration Rules

Note: a, b, C and k represent constants, $\int f(x)dx = F(x)$ → the *antiderivative*

And *The Fundamental Theorem of Calculus*: $\int_a^b f(x)\,dx = F(b) - F(a)$

General Rules

$$\int kf(x)\,dx = k\int f(x)\,dx$$

$$\int f(x) \pm g(x)\,dx = \int f(x)\,dx \pm \int g(x)\,dx$$

Power Rules

$$\int dx = x + C$$

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

Inverse Rule

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

Exponential Rules

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

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

Logarithmic Rules

$$\int \ln x\ dx = x \cdot (\ln|x| - 1) + C$$

$$\int \log_k x\ dx = \frac{x}{\ln k} \cdot (\ln|x| - 1) + C$$

U-Substitution (Reverse Chain Rule)

$$\int f[u(x)] \cdot u'(x)\ dx = F[u(x)]$$

Integration by Parts

$$\int u(x) \cdot v'(x)\ dx = u(x) \cdot v(x) - \int v(x)u'(x)dx$$

$$\int u \cdot dv = u \cdot v - \int v \cdot du$$

Trigonometric Rules

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

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

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

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

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

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

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

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

$$\int \frac{1}{\sqrt{a^2 - x^2}}dx = \arcsin\frac{x}{a} + C$$

$$\int \frac{1}{a^2 + x^2}dx = \frac{1}{a}\arctan\frac{x}{a} + C$$

Differentiation Rules on Reverse →