C12 - 5.0 - Integration Formulas

$f(x) = F'(x)$ | CHAIN RULE | $+C$ | Check by Taking the Derivative

Basic Formulas

$$\int k\,dx = kx + C \quad (k:\ a\ constant) \qquad \int kf(x)dx = k\int f(x)dx \qquad \int \frac{1}{x}dx = \int x^{-1}dx = \ln|x| + C$$

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

$$\int_a^b (f(x) \pm g(x))dx = \int_a^b f(x)dx \pm \int_a^b g(x)dx$$

Exponential and Logarithmic Functions

$$\int e^x dx = \frac{e^x}{lne} + C = e^x + C$$

$$\int a^x\,dx = \frac{a^x}{lna} + C \quad (a > 0, a \neq 1)$$

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

$$\int cotx\,dx = \ln|sinx| + C$$

Trigonometric Functions

$$\int sinx\,dx = -cosx + C \qquad \int secx\,tanx\,dx = secx + C \qquad \int \sec^2 x\,dx = tanx + C$$

$$\int cosx\,dx = sinx + C \qquad \int cscx\,cotx\,dx = -cscx + C \qquad \int \csc^2 x\,dx = -cotx + C$$

$$\int tanx\,dx = \ln|secx| + C \qquad \int secx dx = \ln|secx + tanx| + C \qquad \int cscx\,dx = \ln|cscx - cotx| + C$$

Reverse Chain Rule

$$\int \frac{f'(x)}{f(x)}\,dx = ln|f(x)| + C$$

$$\int (ax+b)^n dx = \frac{(ax+b)^{n+1}}{n+1} \times \frac{1}{a} + c \qquad \int \frac{1}{bx}dx = \frac{lnbx}{b} + C$$

$$\int e^{kx}dx = \frac{e^{kx}}{k} + C \qquad \int a^{kx}\,dx = \frac{1}{k} \bullet \frac{a^{kx}}{lna} + C$$

$$\int sinkx\,dx = -\frac{coskx}{k} + C \qquad \int coskx\,dx = \frac{sinkx}{k} + C$$

Integral Properties

$$\int_a^a f(x)dx = 0$$

$$\int_a^b cf(x)dx = c\int_a^b f(x)dx$$

$$\int_a^b f(x)dx = -\int_b^a f(x)dx$$

$$\int_a^b f(x)\,dx = \int_a^b f(u)\,du$$

$$\int_a^c f(x)dx = \int_a^b f(x)dx + \int_b^c f(x)dx\ ;\ a \leq b \leq c$$

Integration by Substitution

$$\int f(g(x))g'(x)dx = \int f(u)du = F(x) + c$$

Integration by Parts

$$\int uv'dx = uv - \int u'vdx$$

Inverse Trigonometric Functions

$$\int \frac{1}{\sqrt{1-x^2}}dx = \sin^{-1} x + C \qquad \int \frac{1}{x^2+1}dx = \tan^{-1} x + C$$

$$\int -\frac{1}{\sqrt{1-x^2}}dx = \cos^{-1}|x| + C \qquad \int -\frac{1}{x^2+1}dx = \cot^{-1} x + C \qquad \int \frac{1}{x\sqrt{x^2-1}}dx = \sec^{-1}|x| + C$$

Advanced Integrals

$$\int \frac{1}{\sqrt{a^2-x^2}}dx = \sin^{-1}\left(\frac{x}{a}\right) + C \qquad \int \frac{1}{x\sqrt{x^2-a^2}}dx = \frac{1}{a} \bullet \sec^{-1}\left(\frac{x}{a}\right) + C \qquad \int \frac{1}{x^2+a^2}dx = \frac{1}{a} \bullet \tan^{-1}\left(\frac{x}{a}\right) + C$$

C12 - 2.0 - Derivative Laws $\frac{d}{dx} =$

$$y' = f'(x) = \frac{dy}{dx}$$

CHAIN RULE

Basic Derivatives

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

$$\frac{d}{dx}[cf(x)] = cf'(x)$$

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

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

Power Rule

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

Product Rule

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

Chain Rule

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

Quotient Rule

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

Exponential and Logarithmic Funct9ions

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

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

Inverse Derivatives

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

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

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

$$Note: \ln e = 1$$

Trigonometric Functions

$$\frac{d}{dx}sinx = cosx$$

$$\frac{d}{dx}secx = secxtanx$$

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

$$\frac{d}{dx}cosx = -sinx$$

$$\frac{d}{dx}cscx = -cscx\ cotx$$

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

Inverse Trigonometric Functions

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

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

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

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

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

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