

# Calculus Cheat Sheet

$$\lim_{h \rightarrow 0} \frac{\sin h}{h} = 1.$$

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

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

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

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

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

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

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

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

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

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

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

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

$$\frac{d \operatorname{arccot}(x)}{dx} = -\frac{1}{1+x^2}.$$

$$\frac{d \operatorname{arcsec}(x)}{dx} = \frac{1}{|x| \sqrt{x^2-1}}.$$

$$\frac{d \operatorname{arccsc}(x)}{dx} = -\frac{1}{|x| \sqrt{x^2-1}}.$$

$$\frac{d \sinh(x)}{dx} = \cosh(x).$$

$$\frac{d \cosh(x)}{dx} = \sinh(x).$$

$$\frac{d \tanh(x)}{dx} = \operatorname{sech}^2(x).$$

$$\frac{d \coth(x)}{dx} = -\operatorname{csch}^2(x).$$

$$\frac{d \operatorname{sech}(x)}{dx} = -\tanh(x) \operatorname{sech}(x).$$

$$\frac{d \operatorname{csch}(x)}{dx} = -\coth(x) \operatorname{csch}(x).$$

$$\frac{\mathrm{d} \operatorname{arcsinh}(x)}{\mathrm{d} x} = \frac{1}{\sqrt{x^2 + 1}}.$$

$$\frac{\mathrm{d} \operatorname{arccosh}(x)}{\mathrm{d} x} = \frac{1}{\sqrt{x^2 - 1}}.$$

$$\frac{\mathrm{d} \operatorname{arctanh}(x)}{\mathrm{d} x} = \frac{1}{1 - x^2}.$$

$$\frac{\mathrm{d} \operatorname{arccoth}(x)}{\mathrm{d} x} = \frac{1}{1 - x^2}.$$

$$\frac{\mathrm{d} \operatorname{arcsech}(x)}{\mathrm{d} x} = -\frac{1}{x\sqrt{1 - x^2}}.$$

$$\frac{\mathrm{d} \operatorname{arccsch}(x)}{\mathrm{d} x} = -\frac{1}{|x|\sqrt{1 + x^2}}.$$

$$x^n = \sum_{k=0}^{\infty} \binom{n}{k} a^{n-k} (x - a)^k, \quad |x - a| < |a|.$$

$$\ln(x) = \ln(a) + \sum_{n=1}^{\infty} (-1)^{n-1} \frac{(x - a)^n}{na^n}, \quad 0 < x \leq a.$$

$$a^x = \sum_{n=0}^{\infty} \frac{a^b (\ln(a))^n}{n!} (x - b)^n, \quad a \in \mathbb{R}_{>0}.$$

$$\sin(x) = \sum_{n=0}^{\infty} \frac{\sin\left(a + \frac{n\pi}{2}\right)}{n!} (x - a)^n.$$

$$\cos(x) = \sum_{n=0}^{\infty} \frac{\cos\left(a + \frac{n\pi}{2}\right)}{n!} (x - a)^n.$$

$$\int x^n \mathrm{d} x = \begin{cases} \frac{1}{n+1} x^{n+1} + C, & n \neq -1 \\ \ln|x| + C, & n = -1 \end{cases}.$$

$$\int \ln(x) \mathrm{d} x = x \ln(x) - x + C.$$

$$\int (\ln(x))^n \mathrm{d} x = x (\ln(x))^n - n \int (\ln(x))^{n-1} \mathrm{d} x, \quad n \in \mathbb{N}.$$

$$\int e^{nx} \mathrm{d} x = \frac{1}{n} e^{nx} + C, \quad n \neq 0.$$

$$\int \sin(x) \mathrm{d} x = -\cos(x) + C.$$

$$\int \sin^2(x) \mathrm{d} x = \frac{x}{2} - \frac{\sin(2x)}{4} + C.$$

$$\int \sin^n(x) \mathrm{d} x = -\frac{1}{n} \sin^{n-1}(x) \cos(x) + \frac{n-1}{n} \int \sin^{n-2}(x) \mathrm{d} x, \quad n \in \mathbb{N}_{>2}.$$

$$\int \cos(x) \mathrm{d} x = \sin(x) + C.$$

$$\int \cos^2(x) \mathrm{d} x = \frac{x}{2} + \frac{\sin(2x)}{4} + C.$$

$$\int \cos^n(x) \, dx = \frac{1}{n} \cos^{n-1}(x) \sin(x) + \frac{n-1}{n} \int \cos^{n-2}(x) \, dx, \quad n \in \mathbb{N}_{>2}.$$

$$\int \tan(x) \, dx = -\ln |\cos(x)| + C = \ln |\sec(x)| + C.$$

$$\int \tan^2(x) \, dx = \tan(x) - x + C.$$

$$\int \tan^n(x) \, dx = \frac{1}{n-1} \tan^{n-1}(x) - \int \tan^{n-2}(x) \, dx, \quad n \in \mathbb{N}_{>2}.$$

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

$$\int \cot^2(x) \, dx = -\cot(x) - x + C.$$

$$\int \cot^n(x) \, dx = -\frac{1}{n-1} \cot^{n-1}(x) - \int \cot^{n-2}(x) \, dx, \quad n \in \mathbb{N}_{>2}.$$

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

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

$$\int \sec^n(x) \, dx = \frac{1}{n-1} \tan(x) \sec^{n-2}(x) + \frac{n-2}{n-1} \int \sec^{n-2}(x) \, dx, \quad n \in \mathbb{N}_{>2}.$$

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

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

$$\int \csc^n(x) \, dx = -\frac{1}{n-1} \cot(x) \csc^{n-2}(x) + \frac{n-2}{n-1} \int \csc^{n-2}(x) \, dx, \quad n \in \mathbb{N}_{>2}.$$

$$\int \arcsin(x) \, dx = x \arcsin(x) + \sqrt{1-x^2} + C.$$

$$\int \arccos(x) \, dx = x \arccos(x) - \sqrt{1-x^2} + C.$$

$$\int \arctan(x) \, dx = x \arctan(x) - \frac{1}{2} \ln(1+x^2) + C.$$

$$\int \operatorname{arccot}(x) \, dx = x \operatorname{arccot}(x) + \frac{1}{2} \ln(1+x^2) + C.$$

$$\int \operatorname{arcsec}(x) \, dx = x \operatorname{arcsec}(x) - \operatorname{sgn}(x) \ln \left| x + \sqrt{x^2-1} \right| + C, \quad |x| \geq 1.$$

$$\int \operatorname{arccsc}(x) \, dx = x \operatorname{arccsc}(x) + \operatorname{sgn}(x) \ln \left| x + \sqrt{x^2-1} \right| + C, \quad |x| \geq 1.$$

$$\int \sinh(x) \, dx = \cosh(x) + C.$$

$$\int \sinh^2(x) \, dx = -\frac{x}{2} + \frac{\sinh(2x)}{4} + C.$$

$$\int \sinh^n(x) \, dx = \frac{1}{n} \sinh^{n-1}(x) \cosh(x) - \frac{n-1}{n} \int \sinh^{n-2}(x) \, dx, \quad n \in \mathbb{N}_{>2}.$$

$$\int \cosh(x) \, dx = \sinh(x) + C.$$

$$\int \cosh^2(x) \, dx = \frac{x}{2} + \frac{\sinh(2x)}{4} + C.$$

$$\int \cosh^n(x) \, dx = \frac{1}{n} \cosh^{n-1}(x) \sinh(x) + \frac{n-1}{n} \int \cosh^{n-2}(x) \, dx, \quad n \in \mathbb{N}_{>2}.$$

$$\int \tanh(x) \, dx = \ln(\cosh(x)) + C.$$

$$\int \tanh^2(x) \, dx = x - \tanh(x) + C.$$

$$\int \tanh^n(x) \, dx = \frac{1}{n-1} \tanh^{n-1}(x) - \int \tanh^{n-2}(x) \, dx, \quad n \in \mathbb{N}_{>2}.$$

$$\int \coth(x) \, dx = \ln |\sinh(x)| + C.$$

$$\int \coth^2(x) \, dx = x - \coth(x) + C.$$

$$\int \coth^n(x) \, dx = -\frac{1}{n-1} \coth^{n-1}(x) - \int \coth^{n-2}(x) \, dx, \quad n \in \mathbb{N}_{>2}.$$

$$\int \operatorname{sech}(x) \, dx = \operatorname{arctanh}(\sinh(x)) + C.$$

$$\int \operatorname{sech}^2(x) \, dx = \tanh(x) + C.$$

$$\int \operatorname{sech}^n(x) \, dx = \frac{1}{n-1} \tanh(x) \operatorname{sech}^{n-1}(x) + \frac{n-2}{n-1} \int \operatorname{sech}^{n-2}(x) \, dx, \quad n \in \mathbb{N}_{>2}.$$

$$\int \operatorname{csch}(x) \, dx = \ln \left| \tanh\left(\frac{x}{2}\right) \right| + C.$$

$$\int \operatorname{csch}^2(x) \, dx = -\coth(x) + C.$$

$$\int \operatorname{csch}^n(x) \, dx = -\frac{1}{n-1} \coth(x) \operatorname{csch}^{n-1}(x) + \frac{n-2}{n-1} \int \operatorname{csch}^{n-2}(x) \, dx, \quad n \in \mathbb{N}_{>2}.$$

$$\int \operatorname{arcsinh}(x) \, dx = x \operatorname{arcsinh}(x) - \sqrt{x^2 + 1} + C.$$

$$\int \operatorname{arccosh}(x) \, dx = x \operatorname{arccosh}(x) - \sqrt{x^2 - 1} + C, \quad (x) \geq 1.$$

$$\int \operatorname{arctanh}(x) \, dx = x \operatorname{arctanh}(x) + \frac{1}{2} \ln(1 - x^2) + C, \quad |x| < 1.$$

$$\int \operatorname{arccoth}(x) \, dx = x \operatorname{arccoth}(x) + \frac{1}{2} \ln(x^2 - 1) + C, \quad |x| > 1.$$

$$\int \operatorname{arcsech}(x) \, dx = x \operatorname{arcsech}(x) + \arctan\left(\frac{\sqrt{1-x^2}}{x}\right) + C, \quad 0 < x \leq 1.$$

$$\int \operatorname{arccsch}(x) \, dx = x \operatorname{arccsch}(x) + \ln \left| x + \sqrt{x^2 + 1} \right| + C, \quad x \neq 0.$$

$$\int \frac{1}{x^2 + a^2} \, dx = \frac{1}{a} \arctan\left(\frac{x}{a}\right) + C, \quad a \neq 0.$$

$$\int \frac{1}{x^2 - a^2} dx = \frac{1}{2a} \ln \left( \frac{x-a}{x+a} \right) + C, \quad a \neq 0.$$

$$\int \frac{1}{a^2 - x^2} dx = \frac{1}{2a} \ln \left( \frac{a-x}{a+x} \right) + C, \quad a \neq 0.$$

$$\int \frac{1}{ax + b} dx = \frac{1}{a} \ln |ax + b| + C, \quad a \neq 0.$$

$$\int (ax + b)^n dx = \frac{1}{a(n+1)} (ax + b)^{n+1} + C, \quad a \neq 0 \wedge n \neq -1.$$

$$\int \frac{x}{ax + b} dx = \frac{x}{a} - \frac{b}{a^2} \ln |ax + b| + C, \quad a \neq 0.$$

$$\int \frac{x}{(ax + b)^2} dx = \frac{1}{a^2} \ln |ax + b| + \frac{b}{a^2(ax + b)} + C, \quad a \neq 0.$$

$$\int x(ax + b)^n dx = \frac{a(n+1)x - b}{a^2(n+1)(n+2)} (ax + b)^{n+1} + C, \quad a \neq 0 \wedge n \notin \{-1, -2\}.$$

$$\int \sqrt{a^2 + x^2} dx = \frac{x}{2} \sqrt{a^2 + x^2} + \frac{a^2}{2} \ln \left( x + \sqrt{a^2 + x^2} \right) + C.$$

$$\int x \sqrt{a^2 + x^2} dx = \frac{1}{3} (a^2 + x^2)^{3/2} + C.$$

$$\int \frac{1}{\sqrt{a^2 + x^2}} dx = \operatorname{arcsinh} \left( \frac{x}{|a|} \right) + C = \ln \left( x + \sqrt{a^2 + x^2} \right) + C.$$

$$\int \frac{x}{\sqrt{a^2 + x^2}} dx = \sqrt{a^2 + x^2} + C.$$

$$\int \sqrt{x^2 - a^2} dx = \frac{x}{2} \sqrt{x^2 - a^2} - \frac{a^2}{2} \ln \left( x + \sqrt{x^2 - a^2} \right) + C, \quad x^2 > a^2.$$

$$\int x \sqrt{x^2 - a^2} dx = \frac{1}{3} (x^2 - a^2)^{3/2} + C, \quad x^2 > a^2.$$

$$\int \frac{1}{\sqrt{a^2 - x^2}} dx = \arcsin \left( \frac{x}{|a|} \right) + C, \quad a^2 > x^2.$$

$$\int \frac{x}{\sqrt{a^2 - x^2}} dx = -\sqrt{a^2 - x^2} + C, \quad a^2 > x^2.$$

$$\int \sqrt{a^2 - x^2} dx = \frac{x}{2} \sqrt{a^2 - x^2} + \frac{a^2}{2} \arcsin \left( \frac{x}{|a|} \right) + C, \quad a^2 \geq x^2.$$

$$\int x \sqrt{a^2 - x^2} dx = \frac{1}{3} (a^2 - x^2)^{3/2} + C, \quad a^2 \geq x^2.$$

$$\int \frac{1}{\sqrt{a^2 - x^2}} dx = \arcsin \left( \frac{x}{|a|} \right) + C, \quad a^2 \geq x^2.$$

$$\int \frac{x}{\sqrt{a^2 - x^2}} dx = \sqrt{a^2 - x^2} + C, \quad a^2 \geq x^2.$$

$$\int \sqrt{ax + b} dx = \frac{2}{3a} (ax + b)^{3/2} + C, \quad a \neq 0.$$

$$\int x^n \sqrt{ax + b} dx = \frac{2}{a(2n+3)} \left( x^n (ax + b)^{3/2} - bn \int x^{n-1} \sqrt{ax + b} dx \right), \quad a \neq 0 \wedge n \in \mathbb{N}.$$

$$\int \frac{1}{\sqrt{ax+b}} \, \mathrm{d}x = \frac{2\sqrt{ax+b}}{a} + C, \quad a \neq 0.$$

$$\int \frac{x^n}{\sqrt{ax+b}} \, \mathrm{d}x = \frac{2}{a} \left( x^n \sqrt{ax+b} - n \int x^{n-1} \sqrt{ax+b} \, \mathrm{d}x \right), \quad a \neq 0 \wedge n \in \mathbb{N},$$

$$= \frac{2}{a(2n+1)} \left( x^n \sqrt{ax+b} - bn \int \frac{x^{n-1}}{\sqrt{ax+b}} \, \mathrm{d}x \right).$$

$$\int_{-\infty}^{\infty} e^{-t^2} \, \mathrm{d}t = \sqrt{\pi}.$$

$$\int_0^{\infty} e^{-t^2} \, \mathrm{d}t = \frac{\sqrt{\pi}}{2}.$$