Derivative Table

Basic Properties of Differentiation

$$\frac{d}{dx}\left[af\left(x\right)\pm bg\left(x\right)\right]=a\frac{d}{dx}f\left(x\right)+b\frac{d}{dx}g\left(x\right)$$

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

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

$$\frac{d}{dx}\left[\frac{1}{f\left(x\right)}\right]=-\frac{\frac{d}{dx}\left[f\left(x\right)\right]}{f^{2}\left(x\right)}$$

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

Common Derivatives

Algebraic Functions

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

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

$$\frac{d}{dx}[ax] = a$$

$$\frac{d}{dx}\left(x^a\right) = ax^{a-1}$$

$$\frac{d}{dx}\left(a^x\right) = a^x \ln(a), \quad a > 0$$

$$\frac{d}{dx}\left(x^x\right) = x^x (1 + \ln x)$$

$$\frac{d}{dx}\left(e^x\right) = e^x$$

$$\frac{d}{dx}\left[y^n\right] = ny^{n-1}\left(\frac{dy}{dx}\right)$$

$$\frac{d}{dx}[\log_a y] = \frac{1}{\ln a} \cdot \frac{1}{y} \cdot \frac{dy}{dx}$$

$$\frac{d}{dx}\left(y^z\right) = zy^{z-1}\left(\frac{dy}{dx}\right) + (\ln y) \cdot y^z \left(\frac{dz}{dx}\right)$$

$$\frac{d}{dx}\left(\frac{1}{x}\right) = -\frac{1}{x^2}$$

$$\frac{d}{dx}\left(\frac{1}{x^2}\right) = -\frac{2}{x^3}$$

$$\frac{d}{dx}\left(\frac{1}{x^n}\right) = -\frac{n}{x^{n+1}}$$

$$\frac{d}{dx}\left(\sqrt{x}\right) = \frac{1}{2\cdot\sqrt{x}}, \quad x > 0$$

$$\frac{d}{dx}\left(\sqrt[3]{x}\right) = \frac{1}{3\cdot\sqrt[3]{x^2}}$$

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

$$\frac{d}{dx}\left(\frac{1}{\sqrt{x}}\right) = -\frac{1}{2\cdot\sqrt{x^3}}$$

$$\frac{d}{dx}\left(\frac{1}{\sqrt[3]{x}}\right) = -\frac{1}{3\cdot\sqrt[3]{x^4}}$$

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

Logarithms

$$\frac{d}{dx}\left(\ln x\right) = \frac{1}{x}, \quad x > 0$$

$$\frac{d}{dx}\left(x\cdot\ln x\right) = \ln x + 1$$

$$\frac{d}{dx}\left(\log_a x\right) = \frac{1}{x\ln a}, \quad a > 0 \text{ and } a \neq 1$$

$$\frac{d}{dx}\left(\frac{1}{\ln x}\right) = -\frac{1}{x\left(\ln x\right)^2}$$

$$\frac{d}{dx}\left(\frac{1}{x\ln x}\right) = -\left[\frac{\ln x + 1}{\left(x\ln x\right)^2}\right]$$

$$\frac{d}{dx}\left(\frac{1}{\log_a x}\right) = -\frac{1}{x\cdot\ln a\cdot\left(\log_a x\right)^2}$$

Trigonometric Functions

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

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

$$\frac{d}{dx}\tan x = \sec^2 x = \frac{1}{\cos^2 x}$$

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

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

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

Inverse Trigonometric Functions

$$\frac{d}{dx}\sin^{-1} x = \frac{1}{\sqrt{1-x^2}}, \quad |x|<1$$

$$\frac{d}{dx}\cos^{-1} x = -\frac{1}{\sqrt{1-x^2}}, \quad |x|<1$$

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

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

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

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

Hyperbolic Functions

$$\frac{d}{dx}\sinh x = \cosh x$$

$$\frac{d}{dx}\cosh x = \sinh x$$

$$\frac{d}{dx}\tanh x = 1 - \tanh^2 x = \operatorname{sech}^2 x$$

$$\frac{d}{dx}\coth x = 1 - \coth^2 x = -\operatorname{csch}^2 x$$

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

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

Inverse Hyperbolic Functions

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

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

$$\frac{d}{dx}\tanh^{-1} x = \frac{1}{1-x^2}, \quad |x| < 1$$

$$\frac{d}{dx}\coth^{-1} x = \frac{1}{1-x^2}, \quad |x| < 1$$

$$\frac{d}{dx}\operatorname{sech}^{-1} x = -\frac{1}{x\sqrt{1-x^2}}, \quad x > 0$$

$$\frac{d}{dx}\operatorname{csch}^{-1} x = -\frac{1}{x\sqrt{x^2+1}}, \quad x > 0$$

Inverses of Polynomials

$$\frac{d}{dx}\left(\frac{1}{x+1}\right)=-\frac{1}{\left(x+1\right)^{2}}$$

$$\frac{d}{dx}\left[\frac{1}{\left(x+1\right)^{2}}\right]=-\frac{2}{\left(x+1\right)^{3}}$$

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

Inverses of Square Roots of Polynomials

$$\frac{d}{dx}\left(\frac{1}{\sqrt{x+1}}\right)=-\frac{1}{2\cdot\sqrt{\left(x+1\right)^{3}}}$$

$$\frac{d}{dx}\left[\frac{1}{\sqrt[3]{x+1}}\right]=-\frac{1}{3\cdot\sqrt[3]{\left(x+1\right)^{4}}}$$

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