# Table of Derivatives and Properties

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|---|---|---|
| $f'(x) \equiv \lim_{h\to 0} \frac{f(x+h)-f(x)}{h}$ | $\frac{d}{dx}[c] = 0$ | $\frac{d}{dx}[cf(x)] = cf'(x)$ |
| $\frac{d}{dx}[f(x) \pm g(x)] = f'(x) \pm g'(x)$ | $\frac{d}{dx}[u(x)v(x)] = u'(x)v(x) + u(x)v'(x)$ | $\frac{d}{dx}\left[\frac{u(x)}{v(x)}\right] = \frac{u'(x)v(x) - u(x)v'(x)}{[v(x)]^2}$ |
| $\frac{d}{dx} f(u(x)) = \frac{df}{du}\frac{du}{dx} = f'(u(x))u'(x)$ | $\frac{d}{dx} u(x)^n = nu(x)^{n-1}u'(x)$ | $\frac{d}{dx} e^{u(x)} = u'(x)e^{u(x)}$ |
| $\frac{d}{dx}\ln(u(x)) = \frac{u'(x)}{u(x)}$ | $\frac{d}{dx} a^{u(x)} = u'(x)a^{u(x)}\ln(a)$ | $\frac{d}{dx}\log_a(u(x)) = \frac{u'(x)}{u(x)\ln(a)}$ |
| $\frac{d}{dx}\sin(u(x)) = u'(x)\cos(u(x))$ | $\frac{d}{dx}\cos(u(x)) = -u'(x)\sin(u(x))$ | $\frac{d}{dx}\tan(u(x)) = u'(x)\sec^2(u(x))$ |
| $\frac{d}{dx}\cot(u(x)) = -u'(x)\csc^2(u(x))$ | $\frac{d}{dx}\sec(u(x)) = u'(x)\sec(u(x))\tan(u(x))$ | $\frac{d}{dx}\csc(u(x)) = -u'(x)\csc(u(x))\cot(u(x))$ |
| $\frac{d}{dx}\sin^{-1}(u(x)) = \frac{u'(x)}{\sqrt{1-[u(x)]^2}}$ | $\frac{d}{dx}\cos^{-1}(u(x)) = -\frac{u'(x)}{\sqrt{1-[u(x)]^2}}$ | $\frac{d}{dx}\tan^{-1}(u(x)) = \frac{u'(x)}{1+[u(x)]^2}$ |
| $\frac{d}{dx}\cot^{-1}(u(x)) = -\frac{u'(x)}{1+[u(x)]^2}$ | $\frac{d}{dx}\sec^{-1}(u(x)) = \frac{u'(x)}{u(x)\sqrt{[u(x)]^2-1}}$ | $\frac{d}{dx}\csc^{-1}(u(x)) = -\frac{u'(x)}{u(x)\sqrt{[u(x)]^2-1}}$ |
| $\frac{d}{dx}\sinh(u(x)) = u'(x)\cosh(u(x))$ | $\frac{d}{dx}\cosh(u(x)) = u'(x)\sinh(u(x))$ | $\frac{d}{dx}\tanh(u(x)) = u'(x)\operatorname{sech}^2(u(x))$ |
| $\frac{d}{dx}\coth(u(x)) = -u'(x)\operatorname{csch}^2(u(x))$ | $\frac{d}{dx}\operatorname{sech}(u(x)) = -u'(x)\operatorname{sech}(u(x))\tanh(u(x))$ | $\frac{d}{dx}\operatorname{csch}(u(x)) = -u'(x)\operatorname{csch}(u(x))\coth(u(x))$ |
| $\frac{d}{dx}\sinh^{-1}(u(x)) = \frac{u'(x)}{\sqrt{1+[u(x)]^2}}$ | $\frac{d}{dx}\tanh^{-1}(u(x)) = \frac{u'(x)}{1-[u(x)]^2}$ | |

Higher Order Product Rules

$$\frac{d^2}{dx^2}[u(x)v(x)] = u''(x)v(x) + 2u'(x)v'(x) + u(x)v''(x)$$

$$\frac{d^3}{dx^3}[u(x)v(x)] = u'''(x)v(x) + 3u''(x)v'(x) + 3u'(x)v''(x) + u(x)v'''(x)$$