

Differentiation Rules

In all the rules below x is the independent variable and k and c are constant real numbers.

Basic Rules

- $\frac{d}{dx}k = 0$
- $\frac{d}{dx}x^n = nx^{n-1}$ (for $n \neq 0$)
- $\frac{d}{dx}e^x = e^x$
- $\frac{d}{dx}a^x = (\ln a) a^x$
- $\frac{d}{dx} \ln x = \frac{1}{x}$
- $\frac{d}{dx} \sin x = \cos x$
- $\frac{d}{dx} \cos x = -\sin x$

Rules for sums, products, and compositions of functions

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

Other Rules

- $\frac{d}{dx} kx = k$
- $\frac{d}{dx} e^{kx} = ke^{kx}$
- $\frac{d}{dx} \sin(kx) = k \cos(kx)$
- $\frac{d}{dx} \cos(kx) = -k \sin(kx)$