Chain Rule

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

Generalized Product Rule

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

example

$$\frac{d}{dx} e^{5x} = e^{5x} \cdot 5$$

$$5e^{5x}$$

Exponentials

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

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

Logarithmic Der.

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

$$\frac{d}{dx} \log_a(x) = \frac{1}{x \cdot \ln a}$$

Examples

- $\frac{d}{dx} e^{\sin(x)} = e^{\sin(x)} \cdot \cos(x)$ ✓

- $f(x) = \underbrace{x \cdot e^{3x}}_{f \; g}$

$f' = 1$

$g' = e^{3x} \cdot 3 = 3e^{3x}$

$f'(x) = f'g + fg'$

$1 \cdot e^{3x} + x \cdot 3e^{3x}$

$e^{3x}(1 + 3x)$

$f(x) = \ln 5x^4$

$f' = \frac{1}{5x^4} \cdot 20x^3$

$\frac{20x^3}{5x^4}$

$\frac{4}{x}$