

ADVANCED DERIVATIVE RULES

Product Rule

- $[f(x) \cdot g(x)]' = f(x) \cdot g'(x) + g(x) \cdot f'(x)$
- 1st X Derivative of 2nd + 2nd X Derivative of 1st
- The derivative of $x^3 \ln x$ is $x^3 \cdot \frac{1}{x} + \ln x(3x^2)$, which would simplify to $x^2 + 3x^2 \ln x$

Quotient Rule

- $\left[\frac{f(x)}{g(x)}\right]' = \frac{g(x) \cdot f'(x) - f(x) \cdot g'(x)}{(g(x))^2}$
- Bottom X Deriv. of Top – Top X Deriv. of Bottom ALL OVER Bottom²
- The derivative of $\frac{3x}{\sin x}$ is $\frac{\sin x \cdot 3 - 3x \cdot \cos x}{(\sin x)^2}$, which a book would write as $\frac{3\sin x - 3x \cos x}{\sin^2 x}$

Chain Rule

- $[f(g(x))]' = f'(g(x)) \cdot g'(x)$
- Derivative of Outside X Derivative of Inside
- The derivative of $\sqrt{\sin x}$ or $(\sin x)^{\frac{1}{2}}$ is $\frac{1}{2}(\sin x)^{\frac{-1}{2}} \cdot \cos x$

Second Derivative

- $f''(x)$ just means the derivative of the derivative of $f(x)$
- The second derivative of $5x^3$ is the derivative of $15x^2$, which is **30x**