

# Warm Up:

What is the product rule?

$$(\text{first})(\text{second})' + (\text{second})(\text{first})'$$

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## Quotient Rule

$$y = \frac{f(x)}{g(x)}$$

$$\frac{dy}{dx} = \frac{g(x)f'(x) - f(x)g'(x)}{g^2(x)}$$

" low d high - hi d low "  
low low

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$$\textcircled{2} \text{ (e)} \quad f(x) = \tan(x)$$

$$f(x) = \frac{\sin(x)}{\cos(x)}$$

$$f'(x) = \frac{\cos(x)\cos(x) - \sin(x)(-\sin(x))}{\cos^2(x)}$$

$$= \frac{\cos^2(x) + \sin^2(x)}{\cos^2(x)}$$

$$= \frac{1}{\cos^2(x)}$$

$$= \sec^2(x)$$

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$$\textcircled{2} \text{ (d)} \quad f(x) = \frac{1 + \ln x}{x}, \quad x \neq 0$$

$$f'(x) = \frac{(x)\left(\frac{1}{x}\right) - (1 + \ln x)(1)}{x^2}$$

$$= \frac{1 - 1 - \ln x}{x^2}$$

$$= \frac{-\ln x}{x^2}$$

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$$\textcircled{4} \quad y = \frac{x + \sin x}{3}$$

$$y = \frac{x}{3} + \frac{\sin x}{3}$$

$$y = \frac{1}{3}x + \frac{1}{3}\sin x$$

$$\boxed{\frac{dy}{dx} = \frac{1}{3} + \frac{1}{3}\cos x}$$

$$y = \frac{x + \sin x}{3}$$

$$\frac{dy}{dx} = \frac{(3)(1 + \cos x) - (x + \sin x)(0)}{9}$$

$$\frac{dy}{dx} = \frac{3 + 3\cos x}{9}$$

$$\frac{dy}{dx} = \frac{1 + \cos x}{3}$$

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$$\textcircled{5} \text{ (h)} \quad g(x) = \ln \left( \frac{x^2 - 1}{x^2 + 1} \right)$$

$$g'(x) = \left( \frac{x^2 + 1}{x^2 - 1} \right) \left[ \frac{(x^2 + 1)(2x) - (x^2 - 1)(2x)}{(x^2 + 1)^2} \right]$$

$$= \frac{2x [(x^2 + 1) - (x^2 - 1)]}{(x^2 - 1)(x^2 + 1)}$$

$$= \frac{2x (\cancel{x^2 + 1} - \cancel{x^2} + 1)}{(x^2 - 1)(x^2 + 1)}$$

$$= \boxed{\frac{4x}{(x^2 - 1)(x^2 + 1)}}$$

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$$\begin{aligned}
 (i) \quad y &= \frac{e^{2x}}{1-3x} \\
 \frac{dy}{dx} &= \frac{(1-3x)(e^{2x})(2) - (e^{2x})(-3)}{(1-3x)^2} \\
 &= \frac{2e^{2x}(1-3x) + 3e^{2x}}{(1-3x)^2} \\
 &= \frac{2e^{2x} - 6xe^{2x} + 3e^{2x}}{(1-3x)^2} \\
 &= \frac{5e^{2x} - 6xe^{2x}}{(1-3x)^2} \\
 &= \boxed{\frac{e^{2x}(5-6x)}{(1-3x)^2}}
 \end{aligned}$$

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$$\begin{aligned}
 (5) (k) \quad y &= 2 \tan(3x) \\
 \frac{dy}{dx} &= 2 \sec^2(3x) (3) \\
 &= 6 \sec^2(3x)
 \end{aligned}$$

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$$y = ax^n$$

$$\frac{dy}{dx} = anx^{n-1}$$

$$y = e^u$$

$$\frac{dy}{dx} = e^u du$$

$$y = \ln u$$

$$\frac{dy}{dx} = \frac{1}{u} \cdot du$$

$$y = \sin u$$

$$\frac{dy}{dx} = \cos u \cdot du$$

$$y = \cos u$$

$$\frac{dy}{dx} = -\sin u \cdot du$$

$$y = \tan u$$

$$\frac{dy}{dx} = \sec^2 u \cdot du$$

$$y = \cot u$$

$$\frac{dy}{dx} = -\csc^2 u \cdot du$$

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