The Product Rule

<u>Example 1</u>: Find $f'(x)$ given that $f(x) = 2x^2 \left(3x^4 + 5\right)$.

What if we take the derivatives of each factor and multiply those together?

$$\frac{d}{dx}\left[f(x)g(x)\right] \neq \left[\frac{d}{dx}f(x)\right]\left[\frac{d}{dx}g(x)\right]$$

We can't simply multiply the derivatives of each factor together. Don't do this!!

The Product Rule

$$\frac{d}{dx}\left[f(x)g(x)\right] = \left[\frac{d}{dx}f(x)\right]g(x) + f(x)\left[\frac{d}{dx}g(x)\right]$$

<u>Example 1 (revisited)</u>: Use the product rule to find $f'(x)$ given that $f(x) = 2x^2 \left(3x^4 + 5\right)$.

Example 2: If $y = 3e^x \sin(x)$, find $y'\left(\frac{\pi}{2}\right)$.

DIY

1. Find the x-values at which $y = 2x^3 e^x$ has a horizontal tangent line.

2. Find the equation of the tangent line to $y = 4x \cos(x)$ at $x = \pi$.