The Product Rule

Standard 7f-Find the derivative of a product of two functions

It's very simple

Remember how the Quotient Rule works?

If you have two functions

f and g

$$\frac{d}{dx}\left(\frac{f}{g}\right)=\frac{f'\cdot g-g'\cdot f}{g^2}$$

The Product Rule is even easier to remember

$$\frac{d}{dx}\left(f\cdot g\right)=f'\cdot g+g'\cdot f$$

$$\frac{d}{dx}\left(f \cdot g\right) = f' \cdot g + g' \cdot f$$

Example: $f(x) = e^{3x}$ $\quad g(x) = 2x^3 - 3x^2 + 5$

$f'(x) = 3e^{3x}$ $\quad g'(x) = 6x^2 - 6x$

$$f \cdot g = \left(2x^3 - 3x^2 + 5\right)e^{3x}$$

$$\frac{d}{dx}\left(f \cdot g\right) = f' \cdot g + g' \cdot f$$

$$= 3e^{3x}\left(2x^3 - 3x^2 + 5\right) + \left(6x^2 - 6x\right)e^{3x}$$

$$= 3e^{3x}\left(2x^3 - 3x^2 + 5\right) + \left(6x^2 - 6x\right)e^{3x}$$

By the way, this can and should be simplified

↑

Because of course we will be doing sign patterns with derivatives like this eventually

$$= e^{3x}\left[3\left(2x^3 - 3x^2 + 5\right) + \left(6x^2 - 6x\right)\right]$$

$$= e^{3x}\left[\left(6x^3 - 9x^2 + 15\right) + \left(6x^2 - 6x\right)\right]$$

$$= e^{3x}\left[6x^3 - 3x^2 - 6x + 15\right]$$