1. Differentiate $f(x) = 2x\left(x^2 + 1\right)$

Note: *"The derivative of a product **is not** the product of the derivatives"*....What could it be????? Hmmm...

Product Rule for Derivatives

If f and g are both differentiable, then

$$\frac{d}{dx}\left[f(x)g(x)\right] = f(x)\frac{d}{dx}\left[g(x)\right] + g(x)\frac{d}{dx}\left[f(x)\right] \quad \text{OR} \quad (fg)' = fg' + f'g$$

Prove it!

$$f'(x) = \lim_{h\to 0}\frac{f(x+h) - f(x)}{h}$$

$$f'(x) = \lim_{x\to a}\frac{f(x) - f(a)}{x - a}$$

2. *Differentiate:* $f(x) = \left(x^2 + 3x\right)\left(e^x + 1\right)$

3. *Differentiate:* $u = \sqrt{t}\left(t + ae^t\right)$

4. Find f' and f'' where $f(x) = x^{-2}e^{x}$

5. If $f(x) = x^{2}g(x)$ where $g(2) = 3$ and $g'(2) = 1$, find $f'(2)$.

Quotient Rule for Derivatives

$$\frac{d}{dx}\left[\frac{f(x)}{g(x)}\right]=\frac{g(x)\frac{d}{dx}\left[f(x)\right]-f(x)\frac{d}{dx}\left[g(x)\right]}{\left[g(x)\right]^2} \qquad \text{OR} \qquad \left(\frac{f}{g}\right)'=\frac{gf'-fg'}{g^2}$$

You can also remember this as $D\left[\frac{hi}{ho}\right]=\frac{hoDhi - hiDho}{ho^2}$

You can derive the quotient rule in a similar way to deriving the product rule: *(I'll show it if we have time...)*

$$f'(x)=\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$$

$$f'(x)=\lim_{x\to a}\frac{f(x)-f(a)}{x-a}$$

7. *Differentiate:* $f(x)=\frac{x^3-2x}{x^2+1}$

8. *Differentiate:* $y=\frac{-2}{a+\sqrt[3]{x^2}}$

9. *Differentiate:* $F(t)=\left(\frac{2}{t}-\frac{5}{t}\right)\left(t^2-3t\right)$

9. Find f and f' : $f(x)=\dfrac{x^2}{2-x}$

10. Find an equation of the tangent line to the curve $y=\dfrac{3x}{x+2}$ at the point $(1,1)$.