1. Complete **The Product Rule:** If f and g are differentiable, then

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

first times deriv. of second plus second times deriv. of first

2. Complete **The Quotient Rule:** If f and g are differentiable, then

$$\frac{d}{dx}\left[\frac{f(x)}{g(x)}\right] = \frac{g(x)\, f'(x) - f(x)\, g'(x)}{(g(x))^2}$$

Lo D-hi minus Hi D-low, square the bottom and off you go!

3. Find the derivatives for each function below. *Do not use the Product Rule or the Quotient Rule if you don't have to!* Do not simplify your answers.

(a) $f(x) = 5x^3e^x \;= (5x^3)(e^x)$

$f'(x) = 5x^3(e^x) - e^x(5 \cdot 3x^2)$

(b) $f(x) = \dfrac{2x^2 - 5}{4 - x}$

$$f'(x) = \frac{(4-x)(4x) - (2x^2-5)(-1)}{(4-x)^2}$$

(c) $f(x) = (1 - x^2)(e^x + x)$

$f'(x) = (1-x^2)(e^x+1) + (e^x+x)(-2x)$

(d) $g(x) = \dfrac{\sqrt{x}}{8}(1 - x\sqrt{x}) \;= \dfrac{x^{1/2}}{8} - \dfrac{x^{1/2}}{8} \cdot x^1 \cdot x^{1/2} = \dfrac{x^{1/2}}{8} - \dfrac{x^2}{8}$

$$g'(x) = \frac{\frac{1}{2}x^{-1/2}}{8} - \frac{1}{8}(2x)$$

(e) $h(x) = \dfrac{10x - x^{3/2}}{4x^2}$ (Avoid the quotient rule!) $= \frac{5}{2} x \cdot x^{-2} - \frac{1}{4} x^{3/2} x^{-4/2} = \frac{5}{2} x^{-1} - \frac{1}{4} x^{-1/2}$

$h'(x) = \frac{5}{2}(-x^{-2}) - \frac{1}{4}\left(-\frac{1}{2}\right)\left(x^{-3/2}\right)$

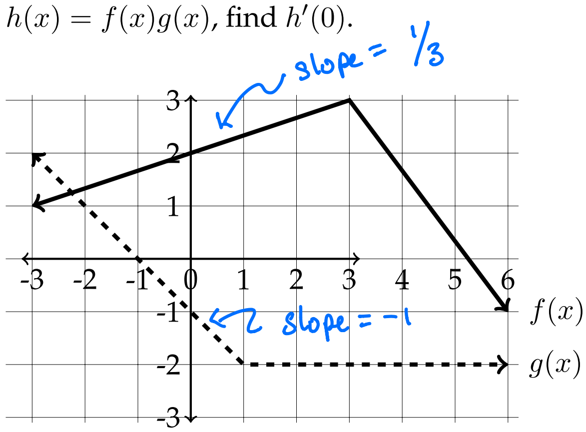
(f) $y = \dfrac{\sqrt[3]{x}}{2x+1} = \dfrac{x^{1/3}}{2x+1}$

$y' = \dfrac{(2x+1)(\frac{1}{3} x^{-4/3}) - (\sqrt[3]{x})(2)}{(2x+1)^2}$

(g) $v(t) = \dfrac{2te^t}{t^2+1}$

$v'(t) = \dfrac{(t^2+1)\frac{d}{dt}[2te^t] - 2te^t(2t)}{(t^2+1)^2} = \dfrac{(t^2+1)(2te^t + e^t(2)) - 2te^t(2t)}{(t^2+1)^2}$

4. The graphs of $f(x)$ (shown thick) and the graphs of $g(x)$ (shown dashed) are shown below. If $h(x) = f(x)g(x)$, find $h'(0)$.



$h'(0) = f(0)g'(0) + g(0)f'(0)$

$= 2(-1) + (-1)(\frac{1}{3})$

$= -2 - \frac{1}{3}$

$= -\frac{7}{3}$

5. Suppose that $f(5) = 1$, $f'(5) = 6$, $g(5) = -3$ and $g'(5) = 2$. Find the following values.

(a) $(f-g)'(5) = \frac{d}{dx}\left(f(x) - g(x)\right)\Big|_{x=5}$

$= f'(5) - g'(5)$

$= 6 - 2$

$= \boxed{4}$

(b) $(fg)'(5) = \frac{d}{dx}\left(f(x)g(x)\right)\Big|_{x=5}$

$= f(5)g'(5) + g(5)f'(5)$

$= 1(2) + (-3)(6)$

$= 2 - 18$

$= \boxed{-16.}$

(c) $(g/f)'(5) = \frac{d}{dx}\left(\frac{g(x)}{f(x)}\right)\Big|_{x=5}$

$= \dfrac{f(5)g'(5) - g(5)f'(5)}{(f(5))^2}$

$= \dfrac{1(2) - (-3)(6)}{1^2}$

$= 2 + 18 = \boxed{20}$