Worksheet for Product, Quotient and Chain Rule

Product Rule $$y = f(x) * g(x)$$ $$\frac{dy}{dx} = f(x) * g'(x) + g(x) * f(x)$$ or $$y' = fg' + gf'$$ First times derivative of second plus second times derivative of first. Example: $y = \sqrt{x} \; x^2 + 6$ $$f = \sqrt{x} \qquad g(x) = x^2 + 6$$ $$f' = \frac{1}{2\sqrt{x}} \qquad g' = 2x$$ So, $y' = 2x\sqrt{x} + \dfrac{x^2 + 6}{2\sqrt{x}}$	**Practice:** For, $$y = x^{-7} \; x^2 - e^x$$ Find: f, g, f', and g' and y'
Quotient Rule $$y = \frac{f(x)}{g(x)}$$ $$\frac{dy}{dx} = \frac{g(x) * f'(x) - f(x) * g'(x)}{g(x)^2}$$ Or $$y' = \frac{gf' - fg'}{g^2}$$ Low d(High) – High d(Low) over Low squared.	**Example** $$y = \frac{5x^4}{e^x}$$ $$f = 5x^4 \qquad g = e^x$$ $$f' = 20x^3 \qquad g' = e^x$$ $$\frac{dy}{dx} = \frac{e^x 20x^3 - 5x^4 e^x}{e^x{}^2} = \frac{20e^x x^3 - 5e^x x^4}{e^{2x}} = \frac{20x^3 - 5x^4}{e^x}$$
Chain Rule $$y = f(g(x))$$ $$y' = f'(g(x)) * g'(x)$$ Derivative of the outside function times the derivative of what's inside.	**Example** $\qquad y = \sqrt{6x - 1}$ $$f(g) = \sqrt{g} \qquad\qquad g(x) = 6x - 1$$ $$\frac{df}{dg} = \frac{1}{2\sqrt{g}} \qquad\qquad \frac{dg}{dx} = 6$$ $$\frac{dy}{dx} = \frac{1}{2\sqrt{6x-1}} * 6 = \frac{3}{\sqrt{6x-1}}$$

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Practice…Find dy/dx.

$y = e^{6x-5}$	$y = (3x^2 - 7)^3$
$y = \dfrac{6x^2}{\sqrt{x}}$	$y = \ln x \ \ e^{-9x}$
$y = 3^x + x^3 + e^{-3} + \ln 3$	$y = 9 - 7x^{-3}$
$y = x^{-2}(e^{3x})$	$y = \dfrac{8x}{x^2 + 9x - 3}$
$y = \sqrt{14x^2 - 7x}$	$y = e^{-0.8x}\sqrt{2x-1}$