2.3 Notes and Examples

Name: Block: Seat:

Product and Quotient Rules and Higher Order Derivatives

Slightly Less Basic Derivative Rules

1. The Product Rule: $\frac{d}{dx}[f(x) \cdot g(x)] =$
2. The Quotient Rule: $\frac{d}{dx}\left[\frac{f(x)}{g(x)}\right] =$
3. The Chain Rule : $\frac{d}{dx}[f(g(x))] =$
   More on this next time....

1. Now use your words....
   (a) $\frac{d}{dx}[f(x) \cdot g(x)] =$ The ______________ of the 1^{st} function ______________ the 2^{nd} ______PLUS______ the derivative of the ______________ times the ______________

   (b) $\frac{d}{dx}\left[\frac{f(x)}{g(x)}\right] =$ The ______________ of the 1^{st} function ______________ the 2^{nd} ______MINUS______ the derivative of the ___________ times the ___________ ALL DIVIDED BY ___________ SQUARED.

2. If $h(x) = (3x - 2x^2)(5 + 4x)$, find $h'(x)$

	f	g
Function		
Derivative		

$h'(x) =$

3. If $y = \frac{5x-2}{x^2+1}$, find y'

	f	g
Function		
Derivative		

$y' =$

4. If $y = 3x^2 \sin x$, find y'

5. If $y = 2x \cos x - 2 \sin x$, find y'

6. $\dfrac{d}{dx}\left[\dfrac{3 - \frac{1}{x}}{x+5}\right] =$

7. Given $g(2) = 3$, $g'(2) = -4$, $h(2) = -1$, $h'(x) = 5$, answer the following:
   (a) If $f(x) = g(x)h(x)$, find $f'(2)$

   (b) If $q(x) = \dfrac{g(x)}{h(x)}$, find $q'(2)$

8. $f(x) = \dfrac{x^2}{x^2+1}$. Find the point(s) at which the graph of f has a horizontal tangent line.

9. Now we can do the rest of the trig functions!

   (a) $\dfrac{d}{dx}(\tan x) = \dfrac{d}{dx}\left[\dfrac{\sin x}{\cos x}\right] =$

   (b) $\dfrac{d}{dx}(\sec x) = \dfrac{d}{dx}\left[\dfrac{1}{\cos x}\right] =$

10. "If all you have is a hammer, then everything looks like a nail." These all these are easier WITHOUT using the quotient rule:

    (a) $\dfrac{d}{dx}\left[\dfrac{x^2+3x}{6}\right] =$

    (b) $\dfrac{d}{dx}\left[\dfrac{5x^4}{8}\right] =$

    (c) $\dfrac{d}{dx}\left[\dfrac{-3(3x-2x^2)}{7x}\right] =$

    (d) $\dfrac{d}{dx}\left[\dfrac{9}{5x^2}\right] =$

Higher Order Derivatives Recall from last time:

(a) Position function:

(b) Velocity function:

(c) Acceleration function:

Taking a derivative of a derivative can just keep going and going...

Notation of Higher Order derivatives:

If f is a n-times differentiable function, we write:

1. First derivative:
2. Second derivative:
3. Third derivative:
4. Fourth derivative:
5. n^{th} derivative:

11. Because the moon has no atmosphere, a falling object on the moon encounters no air resistance. In 1971, Apollo 15 astronaut David Scott demonstrated that a feather and a hammer fall at the same rate on the moon (`https://youtu.be/oYEgdZ3iEKA`). The position function for each of these falling objects is given by: $s(t) = -0.8128t^2 + 2$, where $s(t)$ is measured in meters, and t is the time in seconds. What is the acceleration due to gravity on the moon? How many times greater is the Earth's acceleration due to gravity?