§2.3: Product and Quotient Rule
"I WILL…
… Apply a derivative using the Product and Quotient Rule"

I. Product Rule

A. $\frac{d}{dx}[f(x)g(x)] =$ ______________________________

B. Many times, there can be more than one derivative can be taken for a differentiable function. These derivatives imply continued continuity (like the first derivative):
   1. First Derivative: $y' =$ ________ $= \underline{\hspace{2cm}}$
   2. Second Derivative: $y'' =$ ________ $= \underline{\hspace{2cm}}$
   3. Third Derivative: $y''' =$ ________ $= \underline{\hspace{2cm}}$
   4. Fourth Derivative: $y^4 =$ ________ $= \underline{\hspace{2cm}}$
   5. nth Derivative: $y^{(n)} =$ ________ $= \underline{\hspace{2cm}}$

Ex 1: Solve the derivative of $f(x) = x^2(2x - 3)$	Your Turn: Solve the derivative for $f(x) = (-2x^4 + 5x^2 + 4)(-3x^2 + 2)$
Ex 2: Solve for the derivative of $f(x) = 3x^3 \sin x$	Your Turn: Solve for the derivative of $f(x) = 2x \sin x$ by using only the Product Rule

II. Acceleration

A. Acceleration can be defined as the second derivative of the position function or the first derivative of the velocity of the function

B. Rate of Change in Velocity

C. $f(t) = v'(t) = a''(t)$

Ex 3: The position of an object is defined by the equation, $y = \frac{1}{4}t^4 + t^2$. What is the acceleration of the object at $t = 2$?	Ex 4: Given $\frac{dy}{dx} = 5x^4 - 3x$, solve for $\frac{d^4y}{dx^4}$

Your Turn: Given $f''(x) = 6x + 27x^{-2}$, solve for $f^{(4)}(x)$

III. Quotient Rule

A. $\frac{d}{dx}\left[\frac{f(x)}{g(x)}\right] =$ ____________________

Ex 5: Solve for the derivative of $f(x) = \frac{x^2+2x}{x}$	Ex 6: Solve for the derivative of $f(x) = \frac{3-\left(\frac{1}{x}\right)}{x+5}$
Ex 7: Solve $\frac{d^2y}{dx^2}$ for $f(x) = \frac{x-1}{x+2}$	Your Turn: Solve for the derivative of $f(x) = \frac{6x+7}{7-2x}$

III. Trig Function Derivatives

A. $\frac{d}{dx}[\sin x] =$ ____________________

B. $\frac{d}{dx}[\cos x] =$ ____________________

C. $\frac{d}{dx}[\tan x] =$ ____________________

D. $\frac{d}{dx}[\csc x] =$ ____________________

E. $\frac{d}{dx}[\sec x] =$ ____________________

F. $\frac{d}{dx}[\cot x] =$ ____________________

Ex 8: Solve for the derivative of $f(x) = \sin x \tan x$

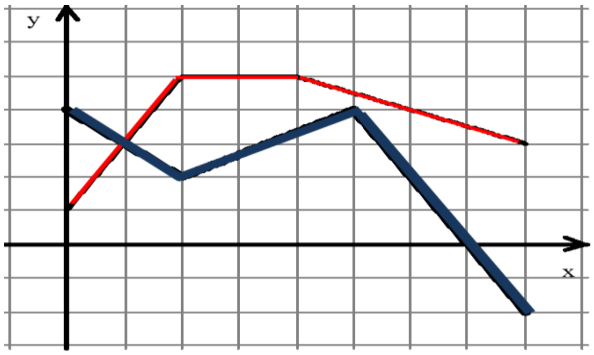
Ex 9: Solve for the derivative of $f(x) = \frac{\cos x}{1+\sin x}$

Your Turn: Solve for the derivative of $f(x) = \frac{\sec x}{x}$ by using the Quotient Rule

Ex 10: Using the table given $h(x) = f(x)g(x)$, solve for $h'(2)$

x	2	3
$f(x)$	1	-3
$f'(x)$	-2	1
$g(x)$	3	4
$g'(x)$	6	2

Ex 11: Use the graphs of f (red graph) and g (blue graph) to solve for $h'(7)$ if $h(x) = g(x)f(x)$, if they exist.



Your Turn: Using the table given $q(x) = \frac{f(x)}{g(x)}$, solve for $q'(3)$

x	2	3
$f(x)$	1	-3
$f'(x)$	-2	1
$g(x)$	3	4
$g'(x)$	6	2

AP 1) If $f''(x) = 3x^2 + 6x + 4$, solve for $f^{(4)}(x)$

(A) 0 (B) 6 (C) $2x + 6$ (D) $6x + 6$

Vocabulary	Connections and Process	Answer and Justifications

AP 2) Find the derivative of $x^2\, f(x)$.

(A) $x\,[x\, f'(x) + 2\, f(x)]$ (B) $2x\, f'(x)$ (C) $x\,[x\, f(x) + 2\, f'(x)]$ (D) $x^2 f'(x)$

Vocabulary	Connections and Process	Answer and Justifications

AP3) Find $\frac{dy}{d\theta}$ for $y = \csc\theta - \cot\theta$

(A) $-\csc\theta\cot\theta + \sec^2\theta$ (B) 0 (C) $-\cot^2\theta + \csc\theta\cot\theta$ (D) $\sec\theta\tan\theta - \sec^2\theta$

Vocabulary	Connections and Process	Answer and Justifications

Assignment: Page 125: 1-12 all, 13-17 odd, 25-31 odd, 39-43 odd, 47-51 odd, 63, 65, 67A, 73, 75, 91-97 odd