## Math 10350 – Example Set 05A Sections 3.1 & 3.2 Product Rule & Quotient Rule

**Product and Quotient Rule.** Let f(x) and g(x) be differentiable functions. Derive formulas for the derivatives of  $p(x) = f(x) \cdot g(x)$  and  $q(x) = \frac{f(x)}{g(x)}$ .

Product Rule: 
$$\frac{d}{dx}(f(x)g(x)) = \underbrace{f'(x)g(x) + g'(x)f(x)}_{f(x)} \qquad \begin{array}{c} \text{common notation:} \\ f'g+g'f\\gdf+fdg\\gdf+fdg\\\end{array}$$
Quotient Rule: 
$$\frac{d}{dx}\left(\frac{f(x)}{g(x)}\right) = \underbrace{f'(x)g(x) - g'(x)f(x)}_{f(x)} \qquad \begin{array}{c} \text{common notation:} \\ \frac{f'g-g'f}{g^2} \text{ or } \\ \frac{f'g-g'f}{g^2} \text{ or } \\ \frac{high-d-low minus low-d-high}{low squared} \end{array}$$

1. The stationary points in the domain of a function f(x) are the values of x such that f'(x) = 0. What can you say about the tangent line at stationary points? Find the stationary points of the following functions: Since the derivative is the slope of the tangent line, the tangent line at a stationary point is zero i.e. the line is horizontal. 1a.  $f(x) = (x^2 - 3)e^x$ .

**1b.**  $y = \frac{2x-1}{x^2+1}$ .

**2.** Let  $p(x) = (x^3 - 5x + 1)g(x)$  and  $q(x) = \frac{f(x)}{g(x) + 1}$ . Given that f(2) = 2, g(2) = 3, f'(2) = -1 and g'(2) = -4, find the following values:

**a.** The instantaneous rate of change of p(x) at x = 2.

**b.** The slope of the tangent line to the graph of y = q(x) when x = 2.

<b>1a.</b> $f(x) = (x^2 - 3)e^x$ .													
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product rule: f'gtg'f			• • •		• •	•	• •	•	•	•	•	• •	•
$f(x) = x^2 - 3$ $g(x) = e^x$					• •	•	• •						
$f'(x) = 2x$ $g'(x) = e^{-x}$			• • •		• •			٠					
$x_{1}^{2} = (2x)e^{x} + e^{x}(x_{2}^{2})$	ushen is	x'=0?			• •	٠	• •		٠	٠	0	• •	٠
$= 2xe^{x} + e^{x}x^{2} - 3e^{x}$		3=0	x-1=0	• •	• •	•	• •	•	•	•	•	• •	•
$e^{x}(2x+x^{2}-3)$	never x:	-3	x = 1										
$=e^{x}(x^{2}+2x-3)$					• •		• •	٠	٠		٠		
= C <sup>x</sup> (X+3)(x-1)	Stationary	points	· x=-3,1	L	• •	•		٠		•	٠		
1b. $y = \frac{2x-1}{x^2+1}$ . $\frac{1}{29}$ or $\frac{1}{10}$	gh w												
auotient rule: <u>f'g-g'f</u>				• •	• •	•	• •	•	٠	*		• •	•
f(x)= Zx-1 g(x)= x2+1		• • •		• •			• •	•		•	•		
f'(x) = 2 $g'(x) = 2x$						0		0					٠
(2)(x <sup>2+1</sup> )-(2x)(2×-1)							• •	0		٠		• •	
$y^{2}$ $(x^{2}+1)^{2}$	when is $y = -\frac{2x^2+2x+2}{2} = 0$	· <b>O</b> :	• • •	• •	• •		• •	٠			•		
(x <sup>2</sup> +1) <sup>2</sup> : - <u>2x<sup>2</sup> + 2 x + 2</u>	-2x2+2x+2 C		• • •	• •	• •	٠	• •		٠	٠	٠	• •	
				• •	• •	•	• •	•	•	•	•		
	use quadrat	ic tormul	1a				• •						
Stationary point: $x = \frac{1}{2}$ 2. Let $p(x) = (x^3 - 5x + 1)g(x)$ as find the following values:	and $q(x) = \frac{f(x)}{g(x) + x}$	$-\frac{1}{1}$ . Given	that $f(2) =$	= 2, g(2)	= 3, j	f'(2) =	 = -1	and	g'(2	:) =	—4,		
Stationary point: $x = \frac{1}{2}$ 2. Let $p(x) = (x^3 - 5x + 1)g(x)$ at find the following values: derivative a. The instantaneous rate of cha	and $q(x) = \frac{f(x)}{g(x) + \frac{1}{g(x)}}$	$\frac{1}{1}$ . Given = 2.	that $f(2) =$	= 2, g(2)	0 = 3, j	f'(2) =	 = -1	and	g'(2	!) =	-4,		
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