Name:________________________________

10.1 The Product Rule

Exercise 10.1.1 Use the Product Rule to differentiate the following functions.

a. $f(x) = x^2 \cdot \sin(x) - 1$

b. $T(t) = 2\sec(t)\tan(t)$

c. $k = \dfrac{e^t\sqrt{t}}{2}$

d. $y = 4x\cos(x) + 3^x - x^3$

e. $y = x^4x^7$

f. $\sqrt{x}\sqrt{x^{21}}$

Exercise 10.1.2 If $f(x) = xe^x$, find a formula for the n^{th} derivative of f, $f^{(n)}(x)$.

Exercise 10.1.3 If $f(x) = \sqrt{x}g(x)$, where $g(4) = 2$ and $g'(4) = 3$, find $f'(4)$.

10.2 The Quotient Rule

Exercise 10.2.1 Use the Quotient Rule to differentiate the following functions.

a. $g(x) = \dfrac{4\tan(x)}{x}$

b. $j(y) = \dfrac{\sqrt[3]{y^5}}{\cos(y)}$

c. $y = \dfrac{\sin(x)}{4\sec(x)}$

d. $f(t) = \dfrac{t^2}{e^t}$

e. $g(x) = \dfrac{x^6}{x^2}$

f. $k(m) = \dfrac{10}{2m}$

Exercise 10.2.2 Find the equation of the tangent line to $y = \dfrac{e^x}{1+x^2}$ at $\left(1, \dfrac{1}{2}e\right)$.

Exercise 10.2.3 Simplify the following functions so that you need NOT apply a product or quotient rule. Then take the derivatives of the simplified forms.

a. $y = \dfrac{4x^{12} - 5x^4 + 3x^2}{x^4}$

b. $h(x) = \dfrac{4 - x^6}{3x^{-2}}$

c. $z = (x + 4)(x - 4)$

d. $g(x) = \dfrac{-4\sin(x)}{\cos(x)}$

e. $z(x) = \sin^2(x) + \cos^2(x)$

f. $T(x) = \dfrac{\ln(x)}{\ln(x^2)}$

10.3 The Product and Quotient Rules with Trigonometric Functions

Exercise 10.3.1 Prove that $\frac{d}{dx}(\sec(x)) = \sec(x)\tan(x)$.

Exercise 10.3.2 Consider the function $f(x) = x^2 \frac{\sin(x)}{e^x} = \frac{x^2 \sin(x)}{e^x}$. Find $f'(x)$ by first applying the product rule and then the quotient rule using the first form of the function. Next find $f'(x)$ by first applying the quotient rule and then the product rule using the second form of the function. Finally, show that the two answers you came up with for $f'(x)$ are equivalent.