Rutgers University
Math 151

Sections 3.3, 3.5: Differentiation Rules - Worksheet

1. Calculate the derivatives of the following functions.

   (a) $f(x) = 5x^4 - 8\sqrt[5]{x} - e^4$.

   (b) $f(x) = 7x\cos(x)e^x$.

   (c) $f(x) = exe^e + 4\dfrac{\sqrt{x}}{\sin(x)}$.

   (d) $f(x) = \dfrac{3}{5 + x^4}$.

   (e) $f(x) = 3\sin(1)7^x - x^{4/3}$.

   (f) $f(x) = \dfrac{x^2}{xe^x - 1}$.

   (g) $f(x) = 2^x x^2$.

   (h) $f(x) = \dfrac{\cos(x)}{\sin(x) + 1}$.

   (i) $f(x) = \dfrac{x\cos(x)\sin(x)}{5^x}$.

2. (a) Find the points on the graph of $f(x) = 2\sec(x) + \tan(x)$, $-\dfrac{\pi}{2} < x < \frac{\pi}{2}$, where the tangent line is horizontal.

   (b) Find the points on the graph of $f(x) = \dfrac{1}{1 - 2x}$ where the tangent line passes through the origin.

   (c) [**Advanced**] Find the values of the constant a for which the tangent lines to the graph of $f(x) = x^3 + 3x^2 + 5x$ at $x = a$ and $x = a + 1$ are parallel.

3. Find the second derivative of the functions below.

   (a) $f(x) = x^3 e^x$.

   (b) $f(x) = \dfrac{3x + 5}{2x + 7}$.

   (c) $f(x) = \dfrac{7\cos(x)}{x}$.

4. Suppose that f is a differentiable function such that $y = -2x + 1$ is tangent to the graph of f at $x = 3$. Evaluate the following

   (a) $f(3)$.

   (b) $f'(3)$.

   (c) $\dfrac{d}{dx}\left(2f(x) - x^3\right)_{|x=3}$.

   (d) $\dfrac{d}{dx}\left(\dfrac{f(x)}{x}\right)_{|x=3}$.

   (e) [**Advanced**] $\dfrac{d}{dx}\left(e^x f(x)^2\right)_{|x=3}$.