1. Find the first derivative for the following functions. Do not simplify your answer.

a. $f(x) = \sqrt[4]{2 + \cot x}$,

b. $f(x) = \left(\frac{x+1}{2x-1}\right)^2 (3x - 1)$,

c. $f(x) = 2^x(3 - 2x^3)$,

2. Use the product or quotient rule to find $(\sec x)'$.

3. Find $\frac{d^{15}}{dx^{15}}(x \cos x)$ by working out some first few derivatives and find a pattern.

4. If $f'(x) = \frac{(x-1)}{(x^2+3)(x-2)}$, then

a. use the signs of f' to find the intervals where f is increasing or decreasing (do this by hand),

b. find the relative maximum and minimum for f by using answer from a) above,

c. find the place where f increases the most or decreases the most (you may use a tool to do this).

5. Given $f(x) = \sqrt{16 - x^2}$, find the largest rectangle that can fit under $y = f(x)$ and the first quadrant.

a. Set up the area function $A(x)$.

b. Find the derivative function for A.

c. Plot $y = A'(x)$

d. Use the plot of $y = A'(x)$ to find the maximum of $A(x)$.

6. The number N of bacteria in a culture after t days is modeled by

$$N = 200\left[1 - \frac{5}{(t^2+2)^2}\right].$$

a. Find $N'(t)$. (by hand)

b. Find $N'(0)$, $N'(10)$, $N'(30)$, $N'(40)$.

c. Plot $y = N'(t)$ and use the plot of $y = N'(t)$ to explain $N(t)$.

7. Given $f(x) = -(x-3)^2 + 4$. Find the shortest distance from $(0, 0)$ to $y = f(x)$.