Name: Worksheet 10

There are three problem sets below. Each consists of one derivative practice problem (since your midterm is Friday, at this point you should know your derivative rules and be able to do these derivatives pretty quickly), and one other problem that should take a little more thought. Everyone should work through ALL of these problems (in approximately the first hour and 15 minutes of class), but each group will start on a different problem. For the last part of class, I will choose a group to present each problem on the board, so make sure you understand all the problems and are ready to present any of them!

1. (a) Derivative Practice! Differentiate the function $f(x) = sin^2(5x) + \sqrt{tan(e^x)}$. Do not simplify your answer.

   (b) Main Problem: The radius of a balloon is given by the formula $r(t) = \sqrt{t^2+1} - 1$. *(Imagine you are blowing it up, so after one second, the radius is* $r(1) = \sqrt{2} - 1$ *inches.)*

   i. Give a formula for the rate of change in the radius with respect to time.

   ii. Give a formula for the rate of change of the volume of the balloon with respect to time.

   iii. How fast is the volume changing when $t = 2$?

   iv. How fast is the volume changing when $r = 2$?

2. (a) Derivative Practice! Differentiate the function $f(x) = csc(5x^{-7} + 6e^{9x^2+1})$. Do not simplify your answer.

   (b) Main Problem: Assume $f(x)$ is a continuous function such that $f(0) = 1$ and $f(1) = 0$. Show that there must be a point where $f(x) = x$ (this is called a fixed point of f).

3. (a) Derivative Practice! Differentiate the function $f(x) = \dfrac{7 + ln(x)}{sec(x) + (3x+5)^{100}}$. Do not simplify your answer.

   (b) Main Problem: A giddily gleeful student, elated over passing a Calculus 180 examination, hurls a somewhat large calculus book directly upward from the ground. It moves according to the law $s(t) = 96t - 16t^2$ where t is the time in seconds after it is thrown and $s(t)$ is the height in feet above the ground at time t. Find:

   i. the velocity of the book after 1.5 seconds;

   ii. the maximum height the book reaches;

   iii. the average speed of the book during its upward rise;

   iv. the acceleration of the book at its maximum height;

   v. the rate of change of the acceleration of the book after 4 seconds;

   vi. the time it would take for the 6 ft. tall student to have the misfortune of being hit on the head by the book.