Mathematics 115 Name: _____
Professor Alan H. Stein
Due Wednesday, March 14, 2007 This problem set is worth 50 points.

Make sure that you check the course website for instructions, fill out the pledge form and hand it in with your paper. The instructions for problem sets and take-home examinations along with the pledge form are available from the *General Policies* portion of the web site. *No paper will be accepted without a signed pledge form.* Remember that your paper may be handed in before the deadline but that no late papers will be accepted regardless of the reason. The course website also includes an explanation of how your average will be calculated if you fail to complete this assignment.

Note that, since most of the calculations involved can be done routinely using either a calculator or a symbolic manipulation program such as Maple or Mathematica, it will obviously be necessary to show, through your work, exactly how you came up with your solutions.

1. (a) Using plain language and avoiding all use of mathematical notation, state the *Product Rule*.
   (b) Using plain language and avoiding all use of mathematical notation, state the *Quotient Rule*.
   (c) Using an appropriate blend of plain language and mathematical notation, state the *Chain Rule*.
   (d) Using plain language and avoiding all use of mathematical notation, write down a strategy for calculating derivatives that will always work for functions built up from basic, elementary functions.
2. Calculate $\frac{d}{dx}\left(x^3 \tan x - 5x + 3\right)$.
3. Calculate $\frac{d}{dx}\left(\frac{x^3}{\sin x}\right)$.
4. Calculate $\frac{d}{dx}\left(\sin x \cos(x^4)\right)$.
5. Calculate $\frac{d}{dx}\left(\sin x \cos^4 x\right)$.

(6-7): Suppose the distance travelled along a straight path by an object is given by the formula $s = t^3 + 5t + \sin t$ for $t \geq 0$, where t represents time, measured in seconds, and s measures distance, measured in feet.

6. Find the average speed of the object over the time period $\pi \leq t \leq 2\pi$.
7. Find the instantaneous speed of the object when $t = \pi$.
8. Find an equation for the line tangent to the graph of the function $y = \tan x$ at the point $(\pi/6, 1/\sqrt{3})$.

9. Consider a function $y = f(x)$ defined implicitly by the equation $x = \sec y$, $y \in [0, \pi/2) \cup (\pi/2, \pi]$. Find a formula for its derivative. *Extra Credit: Get the formula for its derivative in terms of x and state the common name for the function f.*

10. A 10 foot tall ladder is leaning against a vertical wall but the base of the ladder is slipping away at a rate of 2 feet per minute. How fast is the tip of the ladder slipping down when it is 7 feet from the floor?

11. *Extra Credit:* Find a positive real number δ such that $|\sqrt{x} - 5| < 0.01$ whenever $|x - 25| < \delta$.