Math 2250-004
Homework 1, due Wednesday January 17 at the start of class.

Problems that are not underlined may be helpful for seeing if you can work with the underlying concepts; only the underlined problems need to be handed in, and some of those will be graded.

*1.1 Check whether a given function solves a **differential equation**. If solutions to a first order DE are given with a "free" constant C, find which C value solves a given **initial value problem**; translate geometric or modeling properties described in words into differential equations satisfied by the solution functions. Combine the above ideas to solve more complicated problems.*

1.1: 1, **4**, 5, **6**, 9, **15**, **19**, **27**, 29, **30**, 32, **33**, **34**.

1.2 Differential equations $y'(x) = f(x)$ which can be solved by direct antidifferentiation $y(x) = \int f(x)dx + C$: Solve such DE's using Calculus techniques. Solve for particle velocity and postion, given a formula for the acceleration function. Solve for position if velocity is described graphically. Applications.

1.2: 1, **2**, 5, **6**, **7**, **9**, 10, 13, 15, **16**, **18**, 19, 22, **24** (except make the building 600 feet high rather than 400 feet high) **26** , 31, 32, **33.**

w1.1) Solve the following initial value problems as a way to review important integration techniques from Calculus: substitution and integration by parts.

a) $\frac{dy}{dx} = 3\sin\left(\frac{x}{2}\right), y(0) = 2$.

b) $y'(x) = 3x\,e^{-2x}$, $y(0) = 0$.

c) $\frac{dy}{dx} = \frac{6x}{\sqrt{x^2+4}}$, $y(0) = 6$.

1.3 Slope fields and solution curves: understand how the graph of the solution to a first order DE IVP is related to the underlying slope field; the existence-uniqueness theorem for solutions to IVPs.

1.3: 2, 3, 5, **6,** 10, ***11***,12, ***13***, ***14***, 17, 18 , ***24***. For **6**, you may just xerox or trace over the book's slope fields. Alternately you may choose to google and download the applet "dfield", which has dialog boxes that you use, in order to have the software draw these slope fields for you. Then you can take screen shots and print them out. Use "dfield" for 24, see link below. If you find different software that does a good job with direction fields, that's also fine.)

w1.2) Consider the initial value problem

$$y'(x) = 2xy^2$$
$$y(1) = 1.$$

a) Use the existence-uniqueness theorem to show that there some open interval containing $x_0 = 1$ on which this initial value problem has a unique solution.

b) The differential equation in this problem is separable, so you can actually find a solution to the initial value problem above. Do so.

c) What is the largest interval on which the solution to **b** is defined as a differentiable function? Explain.

d) Use the *dfield* Java tool at the URL below, to plot the part of the initial value problem solution graph that is contained in the rectangle $-2 < x < 2, -2 < y < 4$. The URL where you can download the program (which you can always find by searching for "dfield") is

http://math.rice.edu/~dfield/dfpp.html

1.4: *2,3,**4**,**9**,**12**,13,19,**20**,21: solving DE's and IVP's for separable differential equations*