Math 2280-001

Week 1 concepts and homework, due Friday January 16 (at the start of class).

All of the indicated problems are good for seeing if you can work with the underlying concepts. The underlined problems are to be handed in. The quiz at the start of class on Friday will be drawn from all of these concepts and from these or related problems.

*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**, 21, 22, **24** (except make the building 800 feet high rather than 400 feet high) **26** (except make the initial velocity 50 $\frac{m}{s}$ instead of 100 $\frac{m}{s}$), 31, 32, 33, **40.** Note: **40** is postponed until next week.

week 1.1) Solve the following initial value problems as a way to review important integration techniques from Calculus: substitution and integration by parts.

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

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

c) $\frac{dy}{dx} = \frac{2\,x}{\sqrt{x^2+9}}, y(0) = 3$.

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.

1.3: **2**, 3, 5, **6**, 10. For **2**, you may just xerox the book's slope fields. Alternately you may choose to google 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. For **6** you may use the output below. I should have time to demonstrate this in class on Wednesday. (There is also a Matlab version of dfield, which can be googled, downloaded and use inside Matlab.)

week 1.2
Consider the differential equation

$$y'(x) = x - y + 1.$$

a) Show that the functions $y(x) = x + C\,e^{-x}$ solve this differential equation.
b) Find the value of C in the general solution above, so that $y(x)$ solves the initial value problem

$$y'(x) = x - y + 1$$
$$y(-1) = 2.$$

Identify the graph of this solution on your slope field from text problem **1.3.6**. You may do that by sketching the graph onto the dfield plot below, making sure to identify the inital point.
c) Add the diagonal asymptote for this graph, and write its equation. Notice that the diagonal asymptote is itself the graph of one of the solution functions. The slope field picture has been created using the JAVA applet "dfield", at the URL

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