Week 2 **Math 0290** *Differential Equations* - RUBIN - Winter/Spring '09

DUE DATE: Since there is **NO CLASS on Monday, January 19th**, the homework problems from this handout are due at the end of the quiz on **Wednesday, January 21st**. BONUS PROBLEMS are due at the same time but should be turned in in a separate packet from the regular homework.

TOPICS:

Section 2.3: Models of Motion - In this section, we will focus on 1-d motion, with or without air resistance. In the case that there is air resistance, velocity will approach some finite limit, called the *terminal velocity*, as $t \to \infty$.

homework: pg. 44-46, # 3, 4, 8, 9, 10.

Section 2.4: Linear Equations - Despite the general name of the section, we will consider specifically first order linear equations. The key concepts here are how to define an integrating factor and how to use it to solve a first order linear ODE. We will not discuss the book's "alternate solution method" in class, although you are welcome to use it if you prefer it.

homework: pg. 55-56, # 2, 6, 13, 15, 19. ALSO: For #15, plot the solution in Matlab using ezplot. Then write an M-file to plot the solution to the same problem with the initial conditions $y(0) = 1, y(0) = 3$, and $y(0) = 5$ (you will have to find the particular solutions first), all on the same plot, over the interval $[-5, 5]$, together with axis labels and a legend, as in Figure 2.11 in your Matlab supplement text. Turn in a printout of your ezplot results, a printout of your M-file plot, and a printout of your M-file.

Section 2.5: Mixing Problems - The key equation for this section is the *balance law*, rate of change = rate in - rate out. Be sure to keep *units* in mind when you set up your ODE for mixing problems. For example, if you have grams/second on the left hand side of the balance law, then your rate in and rate out terms should each be in grams/second as well.

homework: pg. 61-62, # 1, 6, 7.

BONUS PROBLEMS:

1. pg. 45-6, #14.
2. Suppose that two friends sit down with identical cups of coffee, each at temperature θ_0, in a room of temperature T. Suppose that one person immediately adds cream, with temperature $\theta_c < T$, to her coffee, while the other adds cream after 5 minutes. Assume that the ratio of cream to coffee is 1:9. At the moment just after the second person adds the cream, which beverage is cooler? Be sure to justify your answer mathematically!
3. From *Linear Algebra and Differential Equations*, by Charles Cullen: One morning it began to snow steadily. At noon a snowplow started to clear a straight, level section of road. It took one hour to clear the first mile and two hours to clear the second mile. When did it start to snow? **Hint:** Assume that the plow moves a constant volume of snow per unit time.