Math 307 I, Spring 2012
Extra Credit Problem #2

This problem is due any time before the second midterm, which is on May 16th. Partial solutions will still be awarded points. There is no particular answer I'm looking for; the more correct work you do, the more extra credit you'll get. The points will be added to your second midterm score. I want you to explain all your reasoning, and show me how far you could get. You are encouraged to ask me for hints.

Everywhere around us there are oscillations and vibrations. Most of these systems, with sufficient simplifying assumptions, can be modeled with a differential equation of the type we've been studying in Chapter 3. Choose some oscillating system in your daily life, and try to do some or all of the following:

- Analyze the system from a physical perspective, and create a mathematical model. Be careful to state and justify any assumptions you are making. (For example, when discussing the spring system, we used Hooke's Law, which assumes that the force from the spring is proportional to the displacement of the block.)
- Derive a differential equation of motion for the system. It should look like those we've been discussing in Chapter 3.
- Try to determine the period of oscillation, and describe qualitatively its dependence on physical quantities. (For example, with the spring system we have $\omega_0 = \sqrt{k/m}$, which implies that smaller masses and stiffer springs make for faster vibrations.)
- What values of the parameters result in critical damping?
- Make up a word problem as in Section 3.7 or Section 3.8, and solve it.

Ideas for possible systems to look at: there are two described in the textbook - Section 3.7 Problem #27 and Section 3.7 Problem #31; swinging pendulums are a classic example; a violin string should be doable, with a little physics; the tides are a fascinating example. Be creative.