Written Assignment #9:  
Applications of Linear Equations  
Due 5:00pm Tuesday, October 28, 2003

You are encouraged to collaborate with your colleagues. For credit, however, your final write-up must be done individually. Show all your work and make your presentation comprehensible.

1. The motion of a damped spring-mass system is called “quasi-periodic”. This means that the time it takes for the mass to complete one cycle (one up-swing followed by one down-swing) is constant, but the amplitude of the motion can change with each cycle. The “quasi-period” is the length of time for the mass to complete one cycle. Suppose a mass of 400g is attached to a spring with a spring-constant of 3600 g/sec$^2$ and that the observed quasi-period is 3 seconds. What is the damping constant for the spring?

2. Consider an RC circuit (a circuit with a resistor, capacitor and voltage source) with resistance of 10 ohms and a capacitor of 500 microfarads. Suppose that the circuit is hooked up to a battery, which produces a constant voltage (i.e. $V(t) = V_0$ is a constant). Show that the amount of charge stored in the capacitor tends to a finite limit as $t \to \infty$, while the current in the circuit tends to 0 as $t \to \infty$. Assuming that the initial charge on the capacitor is 0, show that regardless of what $V_0$ is, the time for the capacitor to reach 90% of its limiting charge is always the same.