**HOMEWORK 1**
**DIFFERENTIAL EQUATIONS**
**DUE 2013-08-28**

**Show your work!**

(1) Find an example of a real-world problem modelled by .... Describe the real-world problem and the meaning of all variables involved. You may use any book or web-site, but you must give references for any resources you use.
   (a) ... an ordinary differential equation. Your answer may not involve population models, radioactive decay, mixing, springs, or LRC circuits.
   (b) ... a partial differential equation.

(2) Use calculus to find an exact solution to the problem: "If a penny is dropped from the top of Burnett Plaza, then how fast will it be going when it hits the ground?" You may make all simplifying assumptions from class, in particular, that the only force acting on the object is gravity. You will need to know that Burnett Plaza is 567 feet tall.

(3) If a penny is dropped from the top of Burnett Plaza, then its initial height is 567 ft, and its initial velocity is 0 ft/sec.
   (a) *Without* using calculus, how would you find the penny's *approximate* height and velocity 1 second later? (HINT: The approximate height is 567 ft + (0 ft/sec)(1 sec) = 567 ft.)
   (b) *Without* using calculus, how would you find the penny's *approximate* height and velocity 2 seconds later? (Use your answer to (a).)

(4) Suppose that we include in #2 the additional assumption that the penny experiences, in addition to the acceleration due to gravity, a *deceleration* due to air resistance whose magnitude is $Cv^2$, where $v$ is the velocity. (This is called *Newton drag*.) What is the new differential equation describing this situation?

$$\dot{v} = \boxed{\phantom{xxxxxxxxxx}}.$$

Specify your choice of positive direction, and be careful about signs.