MA205 - Integral Calculus
Lesson 41: Modeling with Differential Equations

1. After winning \$2000 in a drawing, you (wisely) have decided to invest it. You shopped around and found an interest rate of 5.5%, compounded continuously. If $V(t)$ represents the value of your investment in t years, the initial value problem

$$\frac{dV}{dt} = (0.055)(2000)e^{0.055t}$$
$$V(0) = 2000$$

   describes the rate of growth of your investment.

   Independent variable:
   Dependent variable:
   Order of the DE:
   Linearity:
   Homogeneity:

2. Determine whether $y = e^{3x}$ is a solution to the first order Initial Value Problem $y' = 3y$, $y(0) = 1$.

3. Determine whether $x = t^2 e^{-t}$ is a solution to the differential equation $x'' + 2x' + x = 0$.

4. A population of ladybugs grows at a rate proportional to the size of the population. Write down a differential equation which describes this behavior. Be sure to define your variables.

5. Suppose a radioactive substance decays at a rate of 4 times the amount of the substance remaining at any time t. If there are 30 grams of the substance present initially, write down a differential equation that describes the behavior.

6. Newton's Law of Cooling states that the rate of cooling of an object is proportional to the temperature difference between the object and its surroundings, provided the difference is not too large.

   Your mother has made a turkey for Thanksgiving Day. She takes it out of the oven when the turkey has reached 185°F and places it on the kitchen counter. Write down a differential equation that expresses Newton's Law of Cooling in this situation. [Note: Always start by *defining your variables!*]