MATH 279 Test 1 Review

You should be able to:

1. Identify the order and linearity of a differential equation, deterimine whether or not a given function is a solution to a given differential equation.

2. Use Thm 1 to find the largest interval on which a unique solution to an initial value problem is guaranteed. (*only for linear in standard form)

3. Recognize a first order linear DE and solve by integrating factor.

4. Recognize a first order separable DE and solve by separation of variables.

5. Solve a first order linear equation with a single discontinuity in either $p(t)$ *or* $g(t)$.

6. Describe the behavior of a solution as $t \to \infty$ either based on the algebraic solution or based on the direction field.

7. Set up and solve problems involving rates of change, and answer related questions. In each case it is wise to define the dependent variable and the initial condition(s) and note units at the very beginning.

   a) Simple exponential decay. DE: $y' = ky$, solution: $y = Ce^{kt}$.
   b) Exponential decay with additional amounts. DE: $y' = ky + a$. Note that the solution in part (a) does not apply here, the equation must be solved by one of the methods above.
   c) Mixing Problems: if $y(t)$ = number of (state units) of (what substance is mixed into solution) at time t, and $y(0)$ = number of (state units) of (what substance is mixed into solution) at $t = 0$, then $y' =$ rate (the y substance) enters tank – rate (the y substance) leaves the tank. Each rate is a product of concentration * flow, and each rate has units (y units) / (time units). The rate out is always (y) / (volume at any time) * (given flow rate)
   d) Falling Objects: $v' = -g - \frac{k}{m}v$ where $v(t)$ = velocity at time t, g is either 9.8 or 32, k is the coefficient of air resistance, and m is the mass of the object (or weight/ gravity if weight is given.)
   e) Moving objects where velocity is a function of distance. Write $\frac{dv}{dt} = \frac{dv}{dx}\frac{dx}{dt} = v\frac{dv}{dx}$ and solve the problem by integrating v as a function of x.

8. Use Euler's method to approximate the solution to an initial value problem for a given t value. (You will be given either the number of steps OR the value of h.)

Background skills: You need to be able to integrate the standard functions as well as integration by parts and use properties of exponential and log functions to simplify expressions.