First Exam
Monday, September 10

This exam is closed book. Make sure your name is on all pages. Show all work, and show it in a logical and organized manner. Each entire problem is worth 25 points.

1. Classify each of the following differential equations as linear or nonlinear. In each case, say why.

   (a) $\dfrac{d^2y}{dx^2} + e^x y = x$
   (b) $y' + e^y = x$

   (c) $y'''' + 4y''' + 6y'' + 4y' + y = e^{-x}$
   (d) $\sin(y') + y = e^{-x}$

2. State the order of each of the equations in Problem 1.

3. Solve the following initial value problem.

$$y' + \frac{1}{t}y = 1, \qquad y(1) = \frac{1}{2}.$$

4. Sketch a direction field for the following differential equation. Also, solve the differential equation and discuss the relationship between the solution and the direction field you have sketched. Sketch a solution curve on the direction field you have drawn to illustrate your discussion.

$$\frac{dy}{dx} = -\frac{y}{x}$$