**First Exam**
*Tuesday, February 20, 2018*

This exam is closed book, but you may use calculators. 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 33 points, and 10 points are free.

1. Consider $y' + 3y = 9$.

   (a) Draw a direction field for this differential equation, labeling any horizontal asymptotes.

   (b) Does this differential equation have an equilibrium solution? If so, state whether it is stable or unstable, and state why.

   (c) On your direction field, sketch (approximately) the solution curve going through the point $t = 0$, $y = 1$.

2. Solve the following initial value problem:

$$ty' + (1 + t)y = 2, \quad y(1) = 1.$$

3. A falling object satisfies the initial value problem

$$\frac{dv}{dt} = 9.8 - \left(\frac{v}{10}\right), \quad v(0) = 0,$$

   where $v$ is the velocity in meters per second.

   (a) Find the time, in seconds, that must elapse for the object to reach 75% of its limiting velocity.

   (b) How far, in meters, does the object fall in that time?