1. Solve the differential equation

$$(1+t^2)y' + y = 1.$$

2. Suppose that you are solving the equation $y' = -xy$ approximately, using Euler's method. If you start at the point (x_0, y_0), and take a step size of h, write down formulas for your new location, (x_1, y_1). Your formulas should be in terms of x_0, y_0, and h:

$x_1 =$ ____________________

$y_1 =$ ____________________

3. Solve the differential equation

$$-2ty' + (t+1)y = ty^3$$

4. Initially, a tank contains 6 gal of water containing 1 lb of salt. There is water flowing into the tank through two pipes: Water containing salt is entering the tank through the first pipe at rate of 2 gal/min. Several measurements indicate that the amount of salt contained in one gallon of the incoming water is $e^{-3t/2}$ lb at time t. One gallon of fresh water per minute is entering the tank through the second pipe. Finally, the well-stirred mixture is draining the tank at a rate of 3 gal/min. Determine the amount of salt at any time $t \geq 0$.

5. You're waving a flag in the air horizontally. Let $v(t)$ be the velocity of the flag (in meters/second) at time t, There is air resistance opposing the flag's motion, with a *magnitude* of $3\,|v|$, and you apply a force of $2\sin t$ (both measured in newtons). Find $v(t)$, if the starting velocity of the flag is 1 m/s.

6. A bird population $y(t)$ (measured in millions of birds) has the differential equation

$$y' = y\left(e^{-y} - \frac{1}{2}\right).$$

(a) Find the equilibrium solutions and classify each of them as stable, unstable, or semistable.

(b) Sketch the direction field.

(c) If the starting population is $y = 1$, find the limit of the population as $t \to \infty$.