1. (9.3 from reading homework)

   (a) Draw a rough sketch of a possible solution to the logistic differential equation $\frac{dP}{dt} = 5P\left(1 - \frac{P}{8}\right)$. **You do not need to solve this differential equation to draw a rough sketch.** Hint: Explained in https://www.khanacademy.org/math/ap-calculus-bc/bc-diff-equations/bc-logistic-models/e/logistic-differential-equation

2. (9.3 from WebAssign)

   (a) Find the solution of the differential equation that satisfies the given initial condition.

   $$\frac{dy}{dx} = \frac{x}{y}, \quad y(0) = -9$$

   (b) Find the solution of the differential equation that satisfies the given initial condition.

   $$xy' + y = y^2, \quad y(1) = -8$$

   (c) Consider the differential equation

   $$(x^2 + 15)y' = xy$$

   1. Find all constant solutions.
   2. Find all solutions.

   (d) The differential equation below models the temperature of a 86^o C cup of coffee in a 20^o C room, where it is known that the coffee cools at a rate of 1^o C per minute when its temperature is 70^o C. Solve the differential equation to find an expression for the temperature of the coffee at time t. (Let y be the temperature of the cup of coffee in ^oC, and let t be the time in minutes, with $t = 0$ corresponding to the time when the temperature was 86^o C.)

   $$\frac{dy}{dt} = -\frac{1}{50}(y - 20)$$

   (e) A tank contains 8000 L of brine with 14 kg of dissolved salt. Pure water enters the tank at a rate of 80 L/min. The solution is kept thoroughly mixed and drains from the tank at the same rate.

   1. How much salt is in the tank after t minutes?
   2. How much salt is in the tank after 20 minutes?

   (f) 1. Find the orthogonal trajectories of the family of curves

   $$y^2 = 8kx^3$$

   2. Sketch these orthogonal trajectories.