Chapter 11 DEs Group Work Target Practice

1. Hydrocodone bitartrate is used as a cough suppressant. After the drug is fully absorbed, the quantity in the body **decreases at a rate proportional to the amount** left in the body. The half-life of hydrocodone bitartrate in the body is 3.8 hours, and the usual dose is 10 mg.

   a. Write a differential equation (DE) for the quantity, $Q(t)$, of hydrocodone bitartrate in the body at time t, in hours, since the drug was absorbed

   b. Find the equilibrium solution of the DE—the constant of proportionality is assumed to be nonzero. Based on the context, do you expect the equilibrium to be stable or unstable?

   c. Write the initial condition using the usual dose.

   d. Write a half-life condition using the half-life (the time taken to fall to half its usual dose).

      Notice that this is a separable DE and we could separate, integrate, and use the conditions to answer questions like how much of the 10mg dose is still in the body after 12 hours (but do not solve). I've done this in solutions.

2. Write the differential equations and any initial and additional conditions:

   a. A 20° yam (Celsius) is put in a 200° oven. Assume that the temperature of the yam is 120° after 30 minutes.

   b. A detective finds a deceased individual at 9am. The temperature of the body is measured at 90.3° (Fahrenheit). One hour later, the temperature is 89°. Assume the temperature of the room has been maintained at a constant 68°.

   c. At 1pm there is a power failure, which is bad news for your electric heater. Assume it was 68° (Fahrenheit) when the power went out in the house, and it is 10° outside. At 10PM it is 57°.

      Notice that these are all separable DEs (see solutions for the the separation, integration, and using the conditions).

3. Write a differential equation for the balance in an investment fund with time measured in years when the balance is losing value at a continuous rate of 6.5% per year, and payments are being made out of the fund at a continuous rate of \$50,000 per year.

4. Write a differential equation for $\frac{dS}{dt}$ in kg/min, where S is the salt in kg and t is in min: A tank containing salt mixed into water has salt added to the tank at the rate of 0.1 kg/min. The contents of the tank are kept thoroughly mixed, and the contents flow in and out at 10 liters/min. The tank contains 100 liters of water.