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 DE for the quantity, $Q(t)$, of hydrocodine 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. Solve the DE and use the usual dose as the initial condition.

d. Use the half-life to find the constant of proportionality.

e. How much of the 10mg dose is still in the body after 12 hours?

2. Next choose ONE of the following to work on with a partner. Write the DE, solve it, and answer any questions. Prepare to share your work with the rest of the class.

a. A 20° yam is put in a 200° oven. Assume that the temperature of the yam is 120° after 30 minutes. What will the temperature be after 50 minutes?

OR

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

OR

c. At 1pm there is a power failure, which is bad news for your electric heater. Assume it was 68° when the power went out in the house, and it is 10° outside. At 10PM it is 57°. If the outdoor temperature remains constant, what temperature will it be at 7am the next morning? Should you worry about your water pipes freezing?

3. When you have completed #2, write the DEs for the other two scenarios, and any initial and additional conditions.

4. 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.

6. 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 pure water flowing into it at 10 liters/min. The contents of the tank are kept thoroughly mixed, and the contents flow out at 10 liters/min. Salt is added to the tank at the rate of 0.1 kg/min. The tank contains 100 liters of water.