

# 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.

- Write a DE for the quantity,  $Q(t)$ , of hydrocodone bitartrate in the body at time  $t$ , in hours, since the drug was absorbed
- 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?
- Solve the DE and use the usual dose as the initial condition.
- Use the half-life to find the constant of proportionality.
- 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 present your work to the rest of the class. When you have completed that, write the DEs for the other scenarios.

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

OR

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

OR

- At 1pm there is a power failure, which is bad news for your electric heater. Assume it was  $68^\circ$  when the power went out in the house, and it is  $10^\circ$  outside. At 10PM it is  $57^\circ$ . 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. A state game commission releases 40 elk into a game refuge. After 5 years, the elk population is 104. The commission estimates that the environment can support no more than 4000 elk. Let  $t$  be the time in years since the elk were introduced into the refuge.

- Write the DE for the population,  $P(t)$ .
- Estimate the elk population after 15 years.
- Find the long-term limit of the population as  $t \rightarrow \infty$ .