

## Additional Review Problems

1. An initial population of 50,000 inhabits a microcosm with carrying capacity of 100,000. Suppose that, after five years, the population increases to 60,000. Determine the intrinsic growth rate of the population.
2. Hydrocoden bitartrate is prescription drug used as a cough suppressant and pain reliever. Assume the drug is eliminated from the body by a natural decay process with half-life of 3.8 hours. The usual dose is 10 mg every 6 hours.
  - (a) Use a conservation principle to derive a differential equation satisfied by the amount  $Q(t)$  of the drug in the patient after a dose.
  - (b) Assume that the amount of the drug in the patient prior to the dose is  $Q_0$  and that the drug is absorbed immediately. Give a formula for computing  $Q(t)$ , where  $t$  measures the length of time after the dose.
3. Suppose that alcohol is introduced into a 2-liter beaker, which initially contains distilled water, at a rate of 0.1 liters per minute. Assume that the a well-mixed mixture is removed from the beaker at the same rate.
  - (a) Derive a differential equation for the concentration of alcohol in percent volume at any time  $t$ .
  - (b) How long will it take for the concentration of alcohol to reach 50%?
4. The rate at which a drug leaves the bloodstream and passes into the urine is proportional to the quantity of the drug in the blood at that time.
  - (a) Write and solve a differential equation for the quantity,  $Q$ , of the drug in the blood at time,  $t$ , in hours.
  - (b) Assume that 30% is left in the blood after 4 hours. How much of the drug is left in the patient's body after 6 hours if the patient is given 100 mg initially?