

1. You deposit 1000 at an annual rate of 4%, compounded continuously. Write and solve a differential equation to find your balance after  $t$  years.
2. Suppose that the instantaneous annual birth rate of the population of the state of Washington is 6% and the instantaneous annual death rate is 8%. Suppose also that people move into the state continuously and at the rate of 30,000 people per year, uniformly distributed throughout the year. Assume that the population of Washington state at the start of the year 2000 is 5 million.
  - a. Find a function that expresses the population of Washington in terms of the number of years since 2000.
  - b. Find the population in the year 2001.
  - c. What happens to the population as time goes on?
  - d. What initial population would result in the population remaining constant? Is this an example of stable or unstable equilibrium? Explain.
3. You make a downpayment of \$50,000 on a \$250,000 house and take out a 30 year mortgage for the balance at an annual rate of 10%. Assume that interest is compounded continuously and that you make payments continuously.
  - a. Find your monthly payment. Compare this with the amount you would pay each month if you paid only interest on the loan and did not reduce the principal.
  - b. How much do you pay for the house?
  - c. How much of your first monthly payment goes to reduce the principal of your loan? How much of your last monthly payment goes to reduce the principal of your loan?
4. A cup of coffee at  $80^\circ\text{C}$  is brought into a room that remains at a constant temperature of  $20^\circ\text{C}$ . One minute later the temperature of the coffee is  $79^\circ\text{C}$ .
  - a. How long does it take the temperature to cool to  $40^\circ\text{C}$ ?
  - b. At what rate (in  $\text{deg}/\text{min}$ ) is the coffee cooling when it is first brought into the room?
  - c. At what rate is the coffee cooling when its temperature is  $50^\circ\text{C}$ ?
5. A small country has \$10 billion in paper currency in circulation, and each day \$50 million comes into the country's banks. The government decides to introduce new currency by having the banks replace the old bills with new ones whenever new currency comes into the banks. How long will it take for new bills to make up 90% of the bills in circulation?