

## Lesson 565 Differential Equations Applications


### Exponential Growth and Decay

Compounding  $n$  times per year, where  $P$  = principal,  $R$  = rate,  $T$  = years.

Future Value:  $FV = P(1 + r/n)^{nt}$

Compounding continuously

Future Value:  $FV = P \cdot e^{rt}$


 **Compound Interest** In Exercises 49–52, find the principal  $P$  that must be invested at rate  $r$ , compounded monthly, so that \$500,000 will be available for retirement in  $t$  years.

49.  $r = 7\frac{1}{2}\%$ ,  $t = 20$

50.  $r = 6\%$ ,  $t = 40$

51.  $r = 8\%$ ,  $t = 35$

52.  $r = 9\%$ ,  $t = 25$

 **Compound Interest** In Exercises 53–56, find the time necessary for \$1000 to double if it is invested at a rate of  $r$  compounded (a) annually, (b) monthly, (c) daily, and (d) continuously.

53.  $r = 7\%$

54.  $r = 6\%$

55.  $r = 8.5\%$

56.  $r = 5.5\%$

**Solve each exponential growth/decay problem.**

- 1) For a period of time, an island's population grows at a rate proportional to its population. If the growth rate is 3.8% per year and the current population is 1543, what will the population be 5.2 years from now?
- 2) During the exponential phase, E. coli bacteria in a culture increase in number at a rate proportional to the current population. If the growth rate is 1.9% per minute and the current population is 172.0 million, what will the population be 7.2 minutes from now?
- 3) Radioactive isotope Carbon-14 decays at a rate proportional to the amount present. If the decay rate is 12.10% per thousand years and the current mass is 135.2 mg, what will the mass be 2.2 thousand years from now?
- 4) A savings account balance is compounded continuously. If the interest rate is 3.1% per year and the current balance is \$1077.00, in how many years will the balance reach \$1486.73?
- 5) A cup of coffee cools at rate proportional to the difference between the constant room temperature of 20.0°C and the temperature of the coffee. If the temperature of the coffee was 86.1°C 3.0 minutes ago and the current temperature of the coffee is 79.9°C, what will the temperature of the coffee be 29.0 minutes from now?
- 6) During the exponential phase, E. coli bacteria in a culture increase in number at a rate proportional to the current population. If the population doubles in 20.4 minutes, in how many minutes will the population triple?