

4.6 WS

KEY

1. The number of bacteria $N(t)$ present in a culture at time t hours is given by $N(t) = 2200(2)^t$. Find the number of bacteria present when:

- a. $t = 0$ hours
b. $t = 3$ hours

a. 2200 bacteria

b. 17,600 bacteria

2. A city had a population of 22,600 in 2007 and a population of 24,200 in 2012.

- a. Find the exponential growth function for the city. Use $t = 0$ to represent 2007.
b. Use the growth function to predict the population of the city in 2022. Round to the nearest hundred.

$$a. N(t) = 22,600 e^{kt}$$

$$24,200 = 22,600 e^{5k}$$

$$\ln \left[\frac{24,200}{22,600} \right] = \frac{5k}{5}$$

$$k = 0.01368$$

$$N(t) = 22,600 e^{0.0137t}$$

$$b. N(t) = 22,600 e^{0.0137t}$$

$$N(t) = 27,755$$

$$N(t) = 27,800$$

3. Find the decay function for the amount of polonium (^{210}Po) that remains in a sample after t days.

$$N(t) = N_0 e^{kt}$$

$$N(138) = 0.5N_0$$

$$.5N_0 = N_0 e^{138k}$$

$$.5 = e^{138k}$$

$$\frac{\ln .5}{138} = \frac{138k}{138}$$

$$k = -0.005023$$

$$N(t) = N_0 e^{-0.0050t}$$

4. Geologists have determined that Crater Lake in Oregon was formed by a volcanic eruption. Chemical analysis of wood chip assumed to be from a tree that died during the eruption has shown that it contains approximately 45% of its original carbon-14. Estimate how long ago the volcanic eruption occurred.

$$.45 = 0.5^{t/5730}$$

$$\ln .45 = \frac{t}{5730} \ln 0.5$$

$$5730 \left[\frac{\ln .45}{\ln 0.5} \right] = \frac{t}{5730} (5730)$$

$$t = 6600.9$$

about 6601 years old

5. Find the balance if \$4500 is invested at an annual interest rate of 2.5%, compounded annually, for
- 5 years
 - 12 years

$$a. A = P \left(1 + \frac{r}{n}\right)^{nt}$$

$$A = 4500 \left(1 + \frac{.025}{1}\right)^{1(5)}$$

$$A = \$5091.34$$

$$b. A = 4500 \left(1 + \frac{.025}{1}\right)^{12}$$

$$A = \$6052.00$$

6. How long will it take \$1000 to triple if it is invested at an annual interest rate of 5.5% compounded continuously? Round to the nearest year.

$$A = 3000$$

$$3000 = 1000 e^{.055t}$$

$$3 = e^{.055t}$$

$$\frac{\ln 3}{.055} = \frac{.055t}{.055}$$

$$t = 19.97$$

about 20 years

Solve the following equations. Be sure to check your answers.

7. $\ln(x-1) = 3$

$$e^3 = x-1$$

$$x = e^3 + 1$$

$$x = 21.09$$

8. $-2 = \log(2) - \log(x+3)$

$$-2 = \log\left(\frac{2}{x+3}\right)$$

$$\frac{1}{100} = \frac{2}{x+3}$$

$$x+3 = 200$$

$$x = 197$$

9. $4\ln(2x+3) = 11$

$$\ln(2x+3) = \frac{11}{4}$$

$$e^{11/4} = 2x+3$$

$$\frac{e^{11/4} - 3}{2} = \frac{2x}{2}$$

$$x = \frac{e^{11/4} - 3}{2}$$

$$x = 6.32$$

10. $\log_2(x+5) - \log_2(x-2) = 3$

$$\log_2\left(\frac{x+5}{x-2}\right) = 3$$

$$\frac{x+5}{x-2} = 8$$

$$x+5 = 8x-16$$

$$21 = 7x$$

$$x = 3$$

11. $4^{x-3} = \frac{1}{16}$

$$(x-3)\log 4 = \log\left(\frac{1}{16}\right)$$

$$x-3 = \frac{\log(1/16)}{\log 4}$$

$$x = \left[\frac{\log(1/16)}{\log 4}\right] + 3$$

$$x = 1$$

12. $2e^{0.5x} = 45$

$$e^{0.5x} = 22.5$$

$$0.5x \ln e = \ln 22.5$$

$$0.5x = \ln 22.5$$

$$x = \frac{\ln 22.5}{0.5}$$

$$x = 6.23$$