LESSON 109

1. The initial population is 3,000.

2. The population decreases by a factor of 0.97 each year.

3. The population decreases by %3 each year.

4. The initial balance is \$2,000.
The balance increases by a factor of 1.04.
The function is $y = 2000(1.04)^t$.

5. When $t = 5$, $y = 2433.30580\ldots$.
The balance will be about \$2,433.

6. $x = \log_7 3$ Rewrite in logarithmic form.
$x = \frac{\ln 3}{\ln 7}$ Change-of-base formula
$x \approx 0.5646$ Use a calculator.

7. $e^x = 5$ Isolate the exponential.
$x = \ln 5$ Rewrite in logarithmic form.
$x \approx 1.6094$ Use a calculator.

8. $100 = 50(1.05)^t$
$(1.05)^t = 2$
$$t = \log_{1.05} 2 = \frac{\ln 2}{\ln 1.05} = 14.20669\ldots$$
It will take about 14 years.

9. a. $a = 50000, b = 0.95$
The function is $y = 50000(0.95)^t$.

b. $30000 = 50000(0.95)^t$
$(0.95)^t = 3/5$
$$t = \log_{0.95}(3/5) = \frac{\ln(3/5)}{\ln 0.95} = 9.95891\ldots$$
It will take about 10 years.

10. a. The initial amount taken is 200 milligrams.

b. When $t = 6$, $y = 35.59570\ldots$.
About 36 milligrams of the drug will remain.

c. $100 = 200(0.75)^t$
$(0.75)^t = 1/2$
$$t = \log_{0.75}(1/2) = \frac{\ln(1/2)}{\ln 0.75} = 2.40942\ldots$$
It will take about 2 hours.

d. $10 = 200(0.75)^t$
$(0.75)^t = 1/20$
$$t = \log_{0.75}(1/20) = \frac{\ln(1/20)}{\ln 0.75} = 10.41334\ldots$$
It will take about 10 hours.

11. a. The initial amount present is 100 grams.

b. When $t = 30$, $y = 22.31301\ldots$.
About 22 grams of the substance will remain.

c. $10 = 100e^{-t/20}$
$e^{-t/20} = 1/10$
$-t/20 = \ln(1/10)$
$t = -20\ln(1/10) = 46.05170\ldots$
It will take about 46 years.

d. $50 = 100e^{-t/20}$
$e^{-t/20} = 1/2$
$-t/20 = \ln(1/2)$
$t = -20\ln(1/2) = 13.86294\ldots$
It will take about 14 years.

12. a. $a = 5000, b = 1.03$
The function is $y = 5000(1.03)^t$.

b. When $t = 10$, $y = 6719.58189\ldots$.
The balance will be about \$6,720.

c. $15000 = 5000(1.03)^t$
$(1.03)^t = 3$
$$t = \log_{1.03} 3 = \frac{\ln 3}{\ln 1.03} = 37.16700\ldots$$
It will take about 37 years.

13. a. $a = 100, b = 083$
The function is $y = 100(0.83)^t$.

13. b. When $t = 6$, $y = 32.69403\ldots$.
About 33 mg will be in the body.

c. $50 = 100(0.83)^t$
$(0.83)^t = 1/2$
$$t = \log_{0.83}(1/2) = \frac{\ln(1/2)}{\ln 0.83} = 3.72000\ldots$$
It will take about 4 hours.

14. a. See the third example in Lesson 98.
$a = 100, b = 2$, exponent $= t/3$
The function is $y = 100(2)^{t/3}$.

b. When $t = 12$, $y = 1600$.
There will be , 1600 bacteria.

c. $100000 = 100(2)^{t/3}$
$(2)^{t/3} = 1000$
$t/3 = \log_2 1000$
$$t = 3\log_2 1000 = \frac{3\ln 1000}{\ln 2} = 29.89735\ldots$$
It will take about 30 hours.