

9-6 Study Guide and Intervention (continued)**Exponential Growth and Decay**

Exponential Growth Population increase and growth of bacteria colonies are examples of **exponential growth**. When a quantity increases by a fixed percent each time period, the amount of that quantity after t time periods is given by $y = a(1 + r)^t$, where a is the initial amount and r is the percent increase (or rate of growth) expressed as a decimal.

Another exponential growth model often used by scientists is $y = ae^{kt}$, where k is a constant.

Example

A computer engineer is hired for a salary of \$28,000. If she gets a 5% raise each year, after how many years will she be making \$50,000 or more?

Use the exponential growth model with $a = 28,000$, $y = 50,000$, and $r = 0.05$ and solve for t .

$$y = a(1 + r)^t \quad \text{Exponential growth formula}$$

$$50,000 = 28,000(1 + 0.05)^t \quad y = 50,000, a = 28,000, r = 0.05$$

$$\frac{50}{28} = (1.05)^t \quad \text{Divide each side by 28,000.}$$

$$\log\left(\frac{50}{28}\right) = \log(1.05)^t \quad \text{Property of Equality of Logarithms}$$

$$\log\left(\frac{50}{28}\right) = t \log 1.05 \quad \text{Power Property}$$

$$t = \frac{\log\left(\frac{50}{28}\right)}{\log 1.05} \quad \text{Divide each side by } \log 1.05.$$

$$t \approx 11.9 \text{ years} \quad \text{Use a calculator.}$$

If raises are given annually, she will be making over \$50,000 in 12 years.

Exercises

- BACTERIA GROWTH** A certain strain of bacteria grows from 40 to 326 in 120 minutes. Find k for the growth formula $y = ae^{kt}$, where t is in minutes.
- INVESTMENT** Carl plans to invest \$500 at 8.25% interest, compounded continuously. How long will it take for his money to triple?
- SCHOOL POPULATION** There are currently 850 students at the high school, which represents full capacity. The town plans an addition to house 400 more students. If the school population grows at 7.8% per year, in how many years will the new addition be full?
- EXERCISE** Hugo begins a walking program by walking $\frac{1}{2}$ mile per day for one week. Each week thereafter he increases his mileage by 10%. After how many weeks is he walking more than 5 miles per day?
- VOCABULARY GROWTH** When Emily was 18 months old, she had a 10-word vocabulary. By the time she was 5 years old (60 months), her vocabulary was 2500 words. If her vocabulary increased at a constant percent per month, what was that increase?