

EXPONENTIAL GROWTH When $a > 0$ and $b > 1$, the function $y = ab^x$ represents **exponential growth**. When a quantity grows exponentially, it increases by the same percent over equal time periods. To find the amount to which the quantity grows after t time periods, use the following model.

KEY CONCEPT

For Your Notebook

Exponential Growth Model

a is the **initial amount**. r is the **growth rate**.
 $y = a(1 + r)^t$
 $1 + r$ is the **growth factor**. t is the **time period**.

REWRITE EQUATIONS

Notice that you can rewrite $y = ab^x$ as $y = a(1 + r)^t$ by replacing b with $1 + r$ and x with t (for time).

Notice the relationship between the growth rate r and the growth factor $1 + r$. If the initial amount of a quantity is a units and the quantity is growing at a rate of r , then after one time period the new amount is:

$$\text{Initial amount} + \text{amount of increase} = a + r \cdot a = a(1 + r)$$

EXAMPLE 4



TAKS REASONING: Multi-Step Problem

ANOTHER WAY

For alternative methods for solving Example 4, turn to page 528 for the **Problem Solving Workshop**.

COLLECTOR CAR The owner of a 1953 Hudson Hornet convertible sold the car at an auction. The owner bought it in 1984 when its value was \$11,000. The value of the car increased at a rate of 6.9% per year.



- Write a function that models the value of the car over time.
- The auction took place in 2004. What was the approximate value of the car at the time of the auction? Round your answer to the nearest dollar.

Solution

- Let C be the value of the car (in dollars), and let t be the time (in years) since 1984. The initial value a is \$11,000, and the growth rate r is 0.069.

$$\begin{aligned} C &= a(1 + r)^t && \text{Write exponential growth model.} \\ &= 11,000(1 + 0.069)^t && \text{Substitute 11,000 for } a \text{ and 0.069 for } r. \\ &= 11,000(1.069)^t && \text{Simplify.} \end{aligned}$$

- To find the value of the car in 2004, 20 years after 1984, substitute 20 for t .

$$\begin{aligned} C &= 11,000(1.069)^{20} && \text{Substitute 20 for } t. \\ &\approx 41,778 && \text{Use a calculator.} \end{aligned}$$

► In 2004 the value of the car was about \$41,778.

AVOID ERRORS

The growth rate in this example is 6.9%, or 0.069. So, the growth factor is $1 + 0.069$, or 1.069, not 0.069.