

## Reteaching 7-1

**OBJECTIVE:** Modeling exponential growth and decay

**MATERIALS:** None

- The general form of an exponential function is  $y = ab^x$ . This can model either growth or decay. When the value of  $b$  is greater than 1, the function models growth. When the value of  $b$  is between zero and 1, the function models decay.
- When you see words like *increase* or *appreciation*, think growth. When you see words like *decrease* and *depreciation*, think decay.

### Example

Carl's weight at 12 yr is 82 lb. Assume that his weight increases at a rate of 16% each year. Write an exponential function to model the increase. Calculate his weight after 5 yr.

**Step 1:** Find  $a$  and  $b$ .

$$a = 82$$

←  $a$  is the original amount.

$$b = 1 + 0.16$$

←  $b$  is the growth or decay factor. If you are modeling growth,  $b$  equals 1 plus the percent. If you are modeling decay,  $b$  equals 1 minus the percent. Carl's weight increases, so add.

$$= 1.16$$

**Step 2:** Write the exponential function.

$$y = ab^x$$

← Use the formula.

$$y = 82(1.16)^x$$

← Substitute.

**Step 3:** Calculate.

$$y = 82(1.16)^5$$

← Substitute 5 for  $x$ .

$$y = 172.228$$

← Use a calculator.

If the model is correct, Carl will weigh about 172 lb in 5 yr.

### Activity

Write an exponential function to model each situation. Find each amount after the specified time.

- A tree 3 ft tall grows 8% each year. How tall will the tree be at the end of 14 yr?
- The price of a new home is \$126,000. The value of the home appreciates 2% each year. How much will the home be worth in 10 yr?
- A motorcycle purchased for \$9,000 today will be worth 6% less each year. For what can you expect to sell the motorcycle at the end of 5 yr?

# Practice 7-1

## Mixed Exercises

Write an exponential function to model each situation. Find the value of the function after 8 yr.

1. A \$12,000 car depreciates 25% each year.
2. A \$22,000 truck depreciates 12% per year.
3. A population of 2785 brown bears increases 3% each year.
4. A \$45,000 investment increases at a rate of 9.8% per year.
5. The population of the animals you are studying is decreasing by 1.5% each year. There were about 2,000,000 of them world-wide this year.

Identify each function as modeling either exponential growth or exponential decay. What is the percent of increase or decrease for each function?

6.  $y = 72(1.6)^x$
  7.  $y = 24(0.8)^x$
  8.  $y = 2.02(2.01)^x$
  9.  $y = 0.9(0.92)^x$
- Evaluate and then graph each function for the domain  $\{0, 1, 2, 3, 4, 5\}$ .
10.  $y = 90(1.1)^x$
  11.  $y = 23,000(0.12)^x$
  12.  $y = 2.35(1.95)^x$
  13.  $y = 32(0.85)^x$

14. Suppose you have 1 g of a mixture that is losing 1% of its mass each hour by evaporation.
  - a. What is the decay factor of the mixture?
  - b. Write an equation to model the mass of the mixture.
  - c. Use the formula to predict the time when there will be 0.1 g left.
15. Suppose a new business borrows \$50,000 from you for start up funds. The business will repay the loan in one payment 5 yr from now. The interest rate is 12.5%, compounded yearly.
  - a. What is the growth factor of the loan?
  - b. Write an equation to model the growth of the loan.
  - c. Find the amount the business will owe you when the loan comes due.

16. Suppose someone says he will loan you \$100. He will charge you 10% interest per day. How much will you owe him at the end of 30 days?
  - a. How much would you earn with the first option?
  - b. Write a formula for your pay on any day with the second option.
  - c. How much would you earn on the 30th day with the second option? (Hint: Remember that the 30th day is the 29th doubling.)
17. Suppose the retired professor who lives next door offers you work for the next 30 days. He says he will pay you \$500 per day, or, if you prefer, he will pay you \$.01 the first day and will double your pay each day after that.