8-7

1. Plan

Objectives
1 To evaluate exponential functions
2 To graph exponential functions

Examples
1 Evaluating an Exponential Function
2 Real-World Problem Solving
3 Graphs of Exponential Functions
4 Real-World Problem Solving

Professional Development

Math Background

Exponential functions can model many naturally occurring phenomena, such as the growth of a colony of bacteria and the decay of radioactive polonium.

More Math Background: p. 428D

Lesson Planning and Resources

See p. 428E for a list of the resources that support this lesson.

PowerPoint

Bell Ringer Practice

Check Skills You'll Need
For intervention, direct students to:

Slope-Intercept Form
Lesson 6-2: Example 4
Extra Skills and Word Problem Practice, Ch. 6

Zero and Negative Exponents
Lesson 8-1: Example 1
Extra Skills and Word Problem Practice, Ch. 8

Exponential Functions

What You'll Learn
- To evaluate exponential functions
- To graph exponential functions

. . . And Why
To use an exponential model for a population of rabbits, as in Example 2

Check Skills You'll Need

GO for Help Lessons 6-2 and 8-1

Graph each function. 1–3. See back of book.

1. $y = 3x$ **2.** $y = 4x$ **3.** $y = -2x$

Simplify each expression.

4. 3^2 9 **5.** 5^{-3} $\frac{1}{125}$ **6.** $2 \cdot 3^4$ 162
7. $2 \cdot 3^{-2}$ $\frac{2}{9}$ **8.** $3 \cdot 2^{-1}$ $\frac{3}{2}$ **9.** $10 \cdot 3^2$ 90

New Vocabulary • exponential function

1 Evaluating Exponential Functions

The rules you wrote in Lesson 8-6 to describe geometric sequences, such as $A(n) = 3 \cdot 4^{n-1}$, are examples of exponential functions.

Key Concepts

Definition **Exponential Function**

An **exponential function** is a function in the form $y = a \cdot b^x$, where a is a nonzero constant, b is greater than 0 and not equal to 1, and x is a real number.

Examples $y = 0.5 \cdot 2^x$ $f(x) = -2 \cdot 0.5^x$

You can evaluate an exponential function for given values of the domain to find the corresponding values of the range.

Online active math

For: Exponential Functions Activity
Use: Interactive Textbook, 8-7

1 EXAMPLE Evaluating an Exponential Function

Evaluate each exponential function.

a. $y = 5^x$ for $x = 2, 3, 4$

x	5^x	y
2	$5^2 = 25$	25
3	$5^3 = 125$	125
4	$5^4 = 625$	625

b. $t(n) = 4 \cdot 3^n$ for the domain $\{-3, 6\}$

n	$4 \cdot 3^n$	$t(n)$
-3	$4 \cdot 3^{-3} = 4 \cdot \frac{1}{27} = \frac{4}{27}$	$\frac{4}{27}$
6	$4 \cdot 3^6 = 4 \cdot 729 = 2916$	2916

Quick Check

1 Evaluate each exponential function for the domain $\{-2, 0, 3\}$.

a. $y = 4^x$ $\frac{1}{16}$, 1, 64 **b.** $f(x) = 10 \cdot 5^x$ $\frac{2}{5}$, 10, 1250 **c.** $g(x) = -2 \cdot 3^x$ $-\frac{2}{9}$, −2, −54

Differentiated Instruction Solutions for All Learners

Special Needs L1
Have students search for examples of exponential functions in, for example, newspapers and magazines and science texts. Ask volunteers to present and describe their findings, including graphs and functions.
learning style: verbal

Below Level L2
Ask students what $f(x)$ and x represent in the function $f(x) = 1.5^x$ in Example 4. Help them to see what effect the value of the base, 1.5, has on the graph of the function.
learning style: visual

Real-World Connection

Rabbits were brought to Australia in 1860. Their numbers increased exponentially.

You can evaluate exponential functions to solve real-world problems.

2 EXAMPLE **Real-World Problem Solving**

Gridded Response Suppose 20 rabbits are taken to an island. The rabbit population then triples every half year. The function $f(x) = 20 \cdot 3^x$, where x is the number of half-year periods, models this situation. How many rabbits would there be after 2 years?

1	6	2	0
.	/	/	.
	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

$f(x) = 20 \cdot 3^x$

$= 20 \cdot 3^4$ **In 2 years, there are 4 half years. Evaluate the function for $x = 4$.**

$= 20 \cdot 81$ **Simplify powers.**

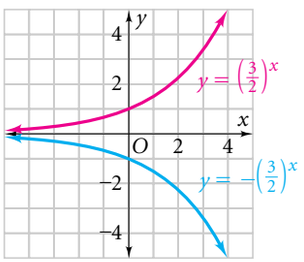
$= 1620$ **Simplify.**

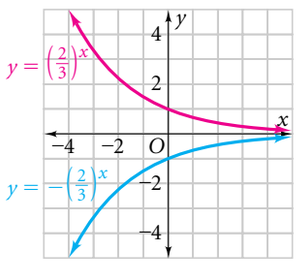
After two years, there would be 1620 rabbits.

Quick Check 2 Suppose 10 animals are taken to an island, and then the population of these animals quadruples every year. Use the function $f(x) = 10 \cdot 4^x$. How many animals would there be after 6 years? **40,960 animals**

2 Graphing Exponential Functions

Here are two graphs that show what exponential functions generally look like.



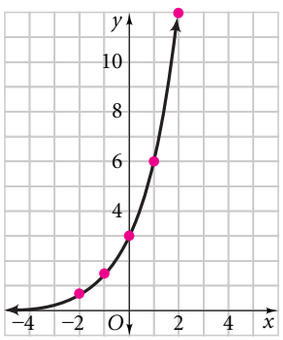


To graph an exponential function, make a table of values. Plot the points. Then join the points to form a smooth curve.

3 EXAMPLE **Graphs of Exponential Functions**

Graph $y = 3 \cdot 2^x$.

x	$3 \cdot 2^x$	(x, y)
-2	$3 \cdot 2^{-2} = \frac{3}{2^2} = \frac{3}{4}$	$\left(-2, \frac{3}{4}\right)$
-1	$3 \cdot 2^{-1} = \frac{3}{2^1} = 1\frac{1}{2}$	$\left(-1, 1\frac{1}{2}\right)$
0	$3 \cdot 2^0 = 3 \cdot 1 = 3$	$(0, 3)$
1	$3 \cdot 2^1 = 3 \cdot 2 = 6$	$(1, 6)$
2	$3 \cdot 2^2 = 3 \cdot 4 = 12$	$(2, 12)$



Test-Taking Tip

Organize your work. Use a column to show your work when evaluating a function.

Quick Check 3 Graph each exponential function. **a.** $y = 0.5 \cdot 2^x$ **b.** $y = -0.5 \cdot 2^x$ **a–b. See margin p. 470.**

2. Teach

Guided Instruction

PowerPoint Additional Examples

1 Evaluate each exponential function.
a. $y = 3^x$ for $x = 2, 3, 4$ **9, 27, 81**
b. $p(q) = 3 \cdot 4^x$ for the domain $\{-2, 3\}$ $\frac{3}{16}$, **192**

2 Suppose two mice live in a barn. If the number of mice quadruples every 3 months, how many mice will be in the barn after 2 years? **131,072**

PowerPoint Additional Examples

3 Graph $y = 2 \cdot 3^x$. **See back of book.**

4 The function $f(x) = 1.25^x$ models the increase in size of an image being copied over and over at 125% on a photocopier. Graph the function. **See back of book.**

Resources
- Daily Notetaking Guide 8-7 L3
- Daily Notetaking Guide 8-7—Adapted Instruction L1

Closure

Ask students to explain why *$y = x^4$ is not an exponential function.* **The exponent, not the base, must be a variable.** Have students explain how the graphs of $y = x^4$ and $y = 4^x$ differ. **The graph of $y = x^4$ is a u-shape in which the y-values increase on both sides of the y-axis as you move away from the y-axis. The graph of $y = 4^x$ is a smooth curve in which the y-values increase quickly as you move to the right side of the y-axis and decrease slowly as you move to the left of the y-axis.**

Advanced Learners L4
Lead students in a discussion of the graph of $y = a^x$, when a is greater than or equal to 1 and when a is between 0 and 1.
learning style: visual

English Language Learners ELL
Be sure students understand the term *exponential function*. Ask them to write a function that describes y as a function of x, and then a function for y as an exponential function of x. Discuss how the functions differ.
learning style: verbal

3. Practice

Assignment Guide

1 A B 1-11, 25-34, 36-42

2 A B 12-24, 35, 43

C Challenge 44-50

Test Prep 51-55

Mixed Review 56-65

Homework Quick Check

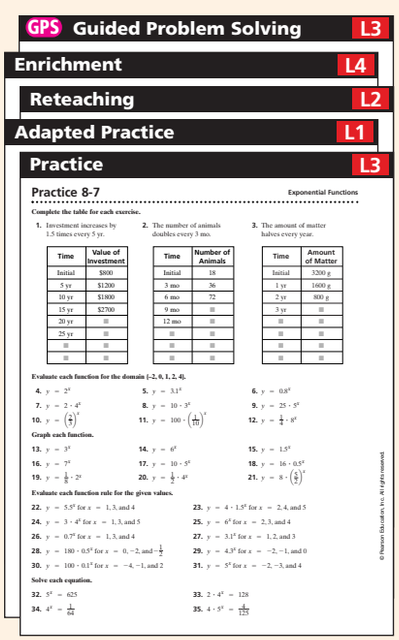
To check students' understanding of key skills and concepts, go over Exercises 6, 24, 34, 38, 42.

Careers

Exercises 9–11 A financial planner helps people plan how to manage and invest their money to pay for present and future needs. Investments may be used to earn money for a business venture, to buy property, to save for retirement, or to pay for any large purchase.

Differentiated Instruction Resources

- GPS Guided Problem Solving L3
- Enrichment L4
- Reteaching L2
- Adapted Practice L1
- Practice L3



Practice 8-7 Exponential Functions

Complete the table for each exercise.

1. Investment increases by 1.5 times every 5 yr.

Time	Value of Investment
Initial	$800
5 yr	$1200
10 yr	$1800
15 yr	$2700
20 yr	■
25 yr	■
■	■
■	■

2. The number of animals doubles every 3 mo.

Time	Number of Animals
Initial	18
3 mo	36
6 mo	72
9 mo	■
12 mo	■
■	■
■	■
■	■

3. The amount of matter halves every year.

Time	Amount of Matter
Initial	3200 g
1 yr	1600 g
2 yr	800 g
3 yr	■
■	■
■	■
■	■
■	■

Evaluate each function for the domain {-2, 0, 1, 2, 4}.

4. $y = 2^x$
5. $y = 3.1^x$
6. $y = 0.8^x$
7. $y = 2 \cdot 4^x$
8. $y = 10 \cdot 3^x$
9. $y = 25 \cdot 5^x$
10. $y = \left(\frac{1}{2}\right)^x$
11. $y = 100 \cdot \left(\frac{1}{10}\right)^x$
12. $y = \frac{1}{4} \cdot 8^x$

Graph each function.

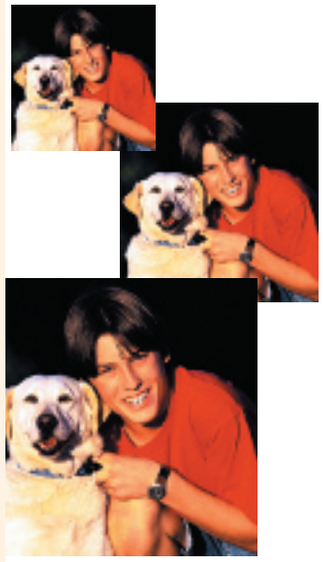
13. $y = 3^x$
14. $y = 6^x$
15. $y = 1.5^x$
16. $y = 7^x$
17. $y = 10 \cdot 5^x$
18. $y = 16 \cdot 0.5^x$
19. $y = \frac{1}{8} \cdot 2^x$
20. $y = \frac{1}{2} \cdot 4^x$
21. $y = 8 \cdot \left(\frac{1}{4}\right)^x$

Evaluate each function rule for the given values.

22. $y = 5.5^x$ for $x = 1, 3,$ and 4
23. $y = 4 \cdot 1.5^x$ for $x = 2, 4,$ and 5
24. $y = 3 \cdot 4^x$ for $x = 1, 3,$ and 5
25. $y = 6^x$ for $x = 2, 3,$ and 4
26. $y = 0.7^x$ for $x = 1, 3,$ and 4
27. $y = 3.1^x$ for $x = 1, 2,$ and 3
28. $y = 180 \cdot 0.5^x$ for $x = 0, -2,$ and $-\frac{1}{2}$
29. $y = 4.3^x$ for $x = -2, -1,$ and 0
30. $y = 100 \cdot 0.1^x$ for $x = -4, -1,$ and 2
31. $y = 5^x$ for $x = -2, -3,$ and 4

Solve each equation.

32. $5^x = 625$
33. $2 \cdot 4^x = 128$
34. $4^x = \frac{1}{64}$
35. $4 \cdot 5^x = \frac{4}{125}$

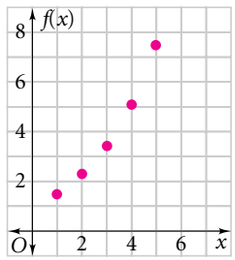


You can graph exponential functions to model real-world situations.

4 EXAMPLE **Real-World Problem Solving**

Photocopying Many photocopiers allow you to choose how large you want an image to be. The function $f(x) = 1.5^x$ models the new size of an image being copied over and over at 150%, where x is the number of enlargements. Graph the function.

x	1.5^x	$(x, f(x))$
1	$1.5^1 = 1.5$	(1, 1.5)
2	$1.5^2 = 2.25 \approx 2.3$	(2, 2.3)
3	$1.5^3 = 3.375 \approx 3.4$	(3, 3.4)
4	$1.5^4 = 5.0625 \approx 5.1$	(4, 5.1)
5	$1.5^5 = 7.59375 \approx 7.6$	(5, 7.6)



Quick Check

4 **a.** You can also make images that are smaller than the original on a photocopier. The function $f(x) = 0.9^x$ models the new size of an image being copied over and over at 90%. Graph the function. **See margin.**

b. Critical Thinking Explain why the function in Example 4 models discrete data. **It is not possible to have a fractional number of enlargements.**

EXERCISES

For more exercises, see *Extra Skill and Word Problem Practice.*

Practice and Problem Solving

A Practice by Example

Example 1 (page 468)

GO for Help

Evaluate each function rule for the given value.

1. $f(x) = 6^x$ for $x = 3$ **216**
2. $g(t) = 2 \cdot 3^t$ for $t = -2$ $\frac{2}{9}$
3. $y = 20 \cdot (0.5)^x$ for $x = 3$ **2.5**
4. $h(w) = 0.5 \cdot 4^w$ for $w = 3$ **32**
5. $y = 50 \cdot (0.3)^x$ for $x = 2$ **4.5**
6. $f(x) = 1.8 \cdot 2^x$ for $x = 6$ **115.2**
7. $y = 100 \cdot \left(\frac{1}{2}\right)^x$ for $x = -4$ **1600**
8. $y = 9 \cdot \left(\frac{5}{2}\right)^x$ for $x = -3$ **0.576**

Example 2 (page 469)

9. **Finance** Suppose an investment of $10,000 doubles in value every 13 years. How much is the investment worth after 52 years? After 65 years? **See left.**
10. **Finance** Suppose an investment of $500 doubles in value every 15 years. How much is the investment worth after 30 years? After 45 years? **See left.**
11. **Finance** Suppose an investment of $2000 doubles in value every 8 years. How much is the investment worth after 24 years? After 32 years? **$16,000, $32,000**

9. **$160,000; $320,000**
10. **$2000; $4000**

Example 3 (page 469)

Match each table with the function that models the data.

12. $y = 3x$ **A**

A.

x	y
1	3
2	6
3	9
4	12

13. $y = x^3$ **C**

B.

x	y
1	3
2	9
3	27
4	81

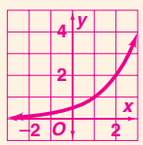
14. $y = 3^x$ **B**

C.

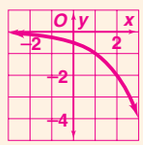
x	y
1	1
2	8
3	27
4	64

page 469 Quick Check

3a.

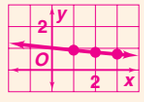


b.



Quick Check

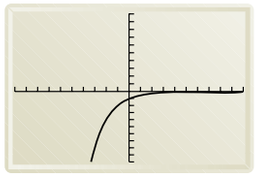
4a.



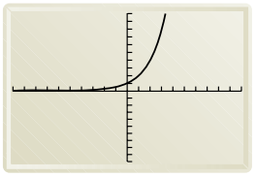
Match each function rule with the graph of the function.

15. $y = 2^x$ **B** **16.** $y = -(2^x)$ **D** **17.** $y = \left(\frac{1}{2}\right)^x$ **C** **18.** $y = -\left(\frac{1}{2}\right)^x$ **A**

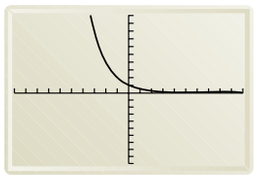
A.



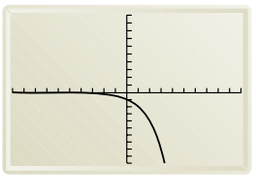
B.



C.



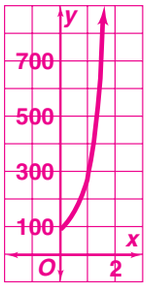
D.



Graph each function. **19–22.** **See margin.**

19. $y = 10 \cdot 2^x$ **20.** $y = 0.1 \cdot 2^x$ **21.** $y = \frac{1}{4} \cdot 2^x$ **22.** $y = 4^x$

24.



Example 4 (page 470)

23. Photocopying Suppose you are photocopying an image, reducing it to 85% its original size. The function $y = 0.85^x$ models the size of an image after x number of times it is reduced. Graph the function. **See margin.**

24. Science A population of 100 insects triples in size every month. The function $y = 100 \cdot 3^x$ models the population after x months. Graph the function. **See left above.**

B Apply Your Skills

Evaluate each function for the domain {−2, −1, 0, 1, 2, 3}. As the values of the domain increase, do the values of the range *increase* or *decrease*? 25–32. See left.

25. $f(x) = 5^x$ **26.** $y = 2.5^x$ **27.** $h(x) = 0.1^x$ **28.** $f(x) = 5 \cdot 4^x$

29. $y = 0.5^x$ **30.** $y = \left(\frac{2}{3}\right)^x$ **31.** $g(x) = 4 \cdot 10^x$ **32.** $y = 100 \cdot 0.3^x$

33. Multiple Choice The population of Texas in 2000 was about 20.852 million people. The function $p(n) = 20.852(1.02071)^n$ estimates the population where $n = 0$ corresponds to the year 2000. Which is a reasonable estimate in millions of the population of Texas in 2020? **B**

(A) 21.284 (B) 31.420 (C) 41.740 (D) 49.842

34. Biology GPS A certain species of bacteria in a laboratory culture begins with 75 cells and doubles in number every 20 min.

a. Copy, complete, and extend the table to find when there will be more than 5,000 bacteria cells. **See back of book.**

Time (min)	Number of 20-min Time Periods	Pattern	Number of Bacteria Cells
Initial	0	75	75
20	1	$75 \cdot 2$	$75 \cdot 2^{\square} = \square$
40	$\square$	$75 \cdot 2 \cdot 2$	$75 \cdot 2^{\square} = \square$
60	$\square$	$\square$	$75 \cdot 2^{\square} = \square$
$\square$	$\square$	$\square$	$\square$

b. Write a function rule to model the situation.
$y = 75 \cdot 2^x$, where x is the number of 20-min time periods

25. 0.04, 0.2, 1, 5, 25, 125; increase

26. 0.16, 0.4, 1, 2.5, 6.25, 15.625; increase

27. 100, 10, 1, 0.1, 0.01, 0.001; decrease

28. 0.3125, 1.25, 5, 20, 80, 320; increase

29. 4, 2, 1, 0.5, 0.25, 0.125; decrease

30. $\frac{9}{4}, \frac{3}{2}, 1, \frac{2}{3}, \frac{4}{9}, \frac{8}{27}$; decrease

31. 0.04, 0.4, 4, 40, 400, 4000; increase

32. $1111.\overline{1}$, $333.\overline{3}$, 100, 30, 9, 2.7; decrease

Exercises 15–18 Suggest students review graphs from the lesson and make generalizations about their shapes before doing these exercises.

Technology Tip

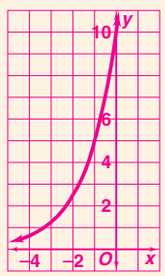
Exercise 34 Suggest that students write an equation for the problem. Let x equal the number of 20-min time periods. Let y equal the number of bacteria cells. Students can check their answer to the exercise by using the **TABLE** function on a graphing calculator.

Error Prevention!

Exercise 41 Some students may begin by multiplying 100 by 10 and then squaring the product. Remind them that the order of operations is: parentheses, exponents, multiplication and division, addition and subtraction.

pages 470–473 Exercises

19.



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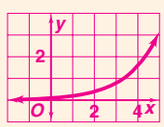

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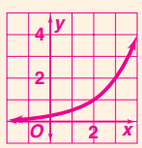

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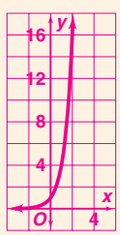
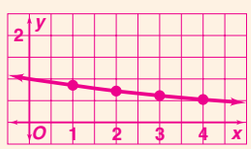


23.

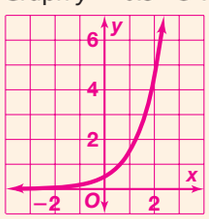


4. Assess & Reteach

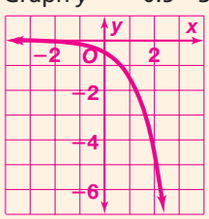
PowerPoint

Lesson Quiz

1. Evaluate each function rule for the given value.
   a. $y = 0.5^x$ for $x = 3$ **0.125**
   b. $f(x) = 4 \cdot 3^x$ for $x = -2$ $\frac{4}{9}$
2. Suppose an investment of $5000 doubles every 12 years.
   a. How much is the investment worth after 24 years? **$20,000**
   b. After 48 years? **$80,000**
3. Graph $y = 0.5 \cdot 3^x$.



4. Graph $y = -0.5 \cdot 3^x$.



Alternative Assessment

Write $y = 3x$ on a transparency and project it with an overhead projector. Give students three seconds to look at the equation and write on their own paper whether the equation is *exponential* or *not exponential*. Repeat with various functions. Cover each function as you proceed. Include exponential, linear, quadratic, and absolute value functions. At the end of the activity, uncover the whole list of functions. Have students compare their answers with those of classmates and determine which are correct.

Test Prep

Resources
For additional practice with a variety of test item formats:
- Standardized Test Prep, p. xxx
- Test-Taking Strategies, p. xxx
- Test-Taking Strategies with Transparencies

GO Online Homework Help
Visit: PHSchool.com
Web Code: ate-0807

35. a. Graph $y = 2^x$, $y = 4^x$, and $y = (0.25)^x$. **See margin.**
b. What point is on each graph? **(0, 1)**
c. Does the graph of an exponential function intersect the x-axis? Explain.
d. Critical Thinking How does the graph of an exponential function change as the base increases or decreases? **c–d. See left.**

35c. No; there is no value of x for which $y = 0$.

d. If the base is >1, the graph gets steeper as the base increases. If the base is <1, the graph gets steeper as the base decreases.

36. Ecology In 50 days, a water hyacinth can generate 1000 offspring (the number of plants is multiplied by 1000). **a. 1,000,000,000 plants**
a. How many hyacinth plants could there be after 150 days?
b. How many hyacinth plants could there be after 200 days? **1,000,000,000,000 plants**

37. a. Make a table of values for the domain $\{1, 2, 3, 4, 5\}$ of the function $y = (-2)^x$. **See left.**
b. What pattern do you see in the outputs? **See left.**
c. Critical Thinking Is $y = (-2)^x$ an exponential function? Justify your answer. **No; in $y = a \cdot b^x$, $b > 0$. $-2 < 0$, so it is not exponential.**

37a.

x	y
1	−2
2	4
3	−8
4	16
5	−32

b. Every other value is negative. The absolute value of one term is double the previous term.

Challenge

Which function is greater at the given value? **38.** $y = x^5$ **39.** $f(t) = 200 \cdot t^2$

38. $y = 5^x$ or $y = x^5$ at $x = 3$

39. $f(t) = 10 \cdot 2^t$ or $f(t) = 200 \cdot t^2$ at $t = 7$

40. $y = 3^x$ or $y = x^3$ at $x = 4$
$y = 3^x$

41. $f(x) = 2^x$ or $f(x) = 100x^2$ at $x = 10$
$f(x) = 100x^2$

42. Writing Analyze the range of the function $f(x) = 500 \cdot 1^x$ using the domain $\{1, 2, 3, 4, 5\}$. Explain why the definition of *exponential function* includes the restriction that $b \neq 1$. **{500}; $b = 1$ produces a linear graph.**

43. a. Graphing Calculator Graph the functions $y = x^2$ and $y = 2^x$.
b. What happens to the graphs between $x = 1$ and $x = 3$? **a–b. See margin.**
c. Critical Thinking How do you think the graph of $y = 6^x$ would compare to the graphs of $y = x^2$ and $y = 2^x$?
The graph of $y = 6^x$ is steeper than $y = x^2$ and $y = 2^x$.

Solve each equation.

44. $3^x = 9$ **2**

45. $3^x = \frac{1}{27}$ **−3**

46. $2^x = 64$ **6**

47. $3 \cdot 2^x = 24$ **3**

48. $2 \cdot 3^x = 162$ **4**

49. $5 \cdot 2^x - 152 = 8$ **5**

50. Suppose (0, 4) and (2, 36) are on the graph of an exponential function.
a. Use (0, 4) in the general form of an exponential function $y = a \cdot b^x$ to find the value of the constant a. **4**
b. Use your answer from part (a) along with (2, 36) to find the value of the constant b. **3**
c. Write a rule for the function. **$y = 4 \cdot 3^x$**
d. Evaluate the function for $x = -2$ and $x = 4$. **$\frac{4}{9}$, 324**

Test Prep

Multiple Choice

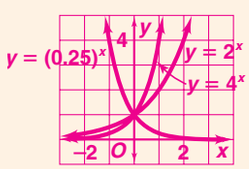
51. For the function $y = -3^x$, what is the value of y when $x = -2$? **B**
A. −9 **B.** $-\frac{1}{9}$ **C.** $\frac{1}{9}$ **D.** 9

52. Which function contains the points (1, 3) and (3, 6.75)? **G**
F. $y = 1.675x + 1.325$ **G.** $y = 2 \cdot 1.5^x$
H. $y = 1.5 \cdot 2^x$ **J.** $y = 1.325x + 1.675$

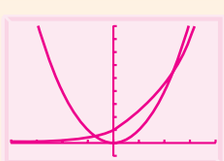
53. Which function has the same y-intercept as $y = 2^x$? **A**
A. $y = x + 1$ **B.** $y = 2x$ **C.** $y = x$ **D.** $y = 2(x + 1)$

pages 470–473 Exercises

35a.



43a.



b. Between $x = 1$ and $x = 3$, the graph of $y = x^2$ rises faster than the graph of $y = 2^x$. The graphs intersect at $x = 2$.

54. A population of 6000 doubles in size every 10 years. Which equation relates the size of the population y to the number of 10-year periods x? **H**

F. $y = 6000 \cdot 10^x$ **G.** $y = 10 \cdot 2^x$
H. $y = 6000 \cdot 2^x$ **J.** $y = 2 \cdot 100^x$

Short Response

55. Between what two integer values of x do the graphs of $y = 20(0.5)^x$ and $y = 0.5 \cdot 4^x$ intersect? Show your work. **See margin.**

Mixed Review

Lesson 8-6

GO for Help

Find each common ratio. Then find the next three terms in each sequence. **56–59. See left.**

56. 2, 10, 50, 250, . . .

57. 7, −21, 63, −189, . . .

58. −0.2, −0.4, −0.8, −1.6, . . .

59. 27, −9, 3, −1, . . .

60. 450, 45, 4.5, 0.45, . . .
0.1; 0.045, 0.0045, 0.00045

61. 7168, 1792, 448, 112, . . .
0.25; 28, 7, 1.75

Lesson 6-6

Write an equation for the line that passes through the given point and is parallel to the given line.

62. $y = 5x + 1; (0, 0)$ **$y = 5x$**

63. $y = 3x - 2; (0, 1)$ **$y = 3x + 1$**

64. $y = -2x + 5; (4, 0)$ **$y = -2x + 8$**

65. $y = 0.4x + 5; (2, -3)$ **$y = 0.4x - 3.8$**

56. 5; 1250, 6250, 31,250

57. −3; 567, −1701, 5103

58. 2; −3.2, −6.4, −12.8

59. $-\frac{1}{3}; \frac{1}{3}, -\frac{1}{9}, \frac{1}{27}$

Checkpoint Quiz 2 — Lessons 8-5 through 8-7

Simplify each expression.

1. $\left(\frac{3^2}{3^{-1}}\right)^4$ **3^{12}**

2. $\left(\frac{x^2}{y^3}\right)^{-5}$ **$\frac{y^{15}}{x^{10}}$**

3. $\left(\frac{10m^{-3}}{25n^{-6}}\right)^2$ **$\frac{4n^{12}}{25m^6}$**

4. $\left(\frac{6^2t^{-3}}{6^2r^0t^2}\right)^2$ **$\frac{1}{t^{10}}$**

Determine whether each sequence is *arithmetic* or *geometric*.

5. 22, 11, 5.5, 2.75, . . .
geometric

6. 5, 10, 20, 40, 80, . . .
geometric

7. 5, 10, 15, 20, 25, . . .
arithmetic

8. Use the sequence −100, 20, −4, ...

a. What is the first term? **−100**

b. What is the common ratio? **$-\frac{1}{5}$ or −0.2**

c. Write a rule for the sequence. **$A(n) = -100 \cdot (-0.2)^{n-1}$**

d. Use your rule to find the fifth and seventh terms in the sequence.
−0.16; −0.0064

9. Physics On the first swing, a pendulum swings through an arc of length 40 cm. On each successive swing, the length of the arc is 85% of the length of the previous swing.

a. Write a rule to model this situation. **$A(n) = 40 \cdot (0.85)^{n-1}$**

b. Find the length of the arc on the fifth swing. Round your answer to the nearest millimeter. **209 mm**

Real-World Connection

About 108 million vehicles cross the George Washington Bridge between New York and New Jersey in a year.

10. Commuting Refer to the information at the left.

a. Write the number of vehicles that crossed the George Washington Bridge in scientific notation. **1.08×10^8**

b. The Port Authority collected about $249 million in tolls from this bridge. Write this number in scientific notation. **2.49×10^8**

c. What was the average toll per vehicle? **about $2.31**

Online lesson quiz, PHSchool.com, Web Code: ata-0807

55. [2]

x	$y = 20 \cdot 0.5^x$	$y = 0.5 \cdot 4^x$
0	20	0.5
1	10	2
2	5	8

The graphs intersect between $x = 1$ and $x = 2$ (OR equivalent explanation).

[1] answer with no work shown

Checkpoint Quiz

Use this Checkpoint Quiz to check students' understanding of the skills and concepts of Lessons 8-5 through 8-7.

Resources
Grab & Go
- Checkpoint Quiz 2