

Answers for Lesson 8-1, pp. 433–435 Exercises

1. -1
2. $\frac{1}{16}$
3. $\frac{1}{25}$
4. $-\frac{1}{25}$
5. $\frac{1}{16}$
6. $-\frac{1}{81}$
7. $\frac{1}{64}$
8. $-\frac{1}{12}$
9. 1
10. $\frac{1}{78}$
11. $-\frac{1}{64}$
12. $-\frac{1}{64}$
13. -2
14. $3; 4$
15. $0; -3$
16. -5
17. $3a$
18. $\frac{5}{x^4}$
19. x^7
20. c
21. $\frac{1}{25p}$
22. $\frac{1}{a^4}$
23. $\frac{3}{x^2y}$
24. $\frac{7a}{3b^2w}$
25. $\frac{1}{x^5y^7}$
26. $\frac{y^7}{x^5}$
27. $4c^3$
28. $\frac{7st^3}{5}$
29. $\frac{6}{ac^3}$
30. $\frac{x^2}{8z^7}$
31. $\frac{y^7}{t^{11}}$
32. $\frac{14}{m^2t^5}$
33. $\frac{1}{25}$
34. $\frac{1}{9}$
35. $-\frac{1}{9}$
36. 1
37. $\frac{3}{25}$
38. $\frac{1}{100}$
39. $\frac{25}{81}$
40. $\frac{81}{25}$
41. $-\frac{25}{27}$
42. $\frac{1}{25}$
43. -27
44. $-\frac{27}{400}$
45. a. \$20.48; \$.32
b. No; the value of the allowance rapidly becomes very great.
46. neg.
47. pos.
48. pos.
49. neg.
50. neg.
51. 10^{-1}
52. 10^{-2}
53. 10^{-3}
54. 10^{-4}
55. 10^{-5}
56. 0.001
57. 0.000001
58. 0.7
59. 0.03
60. 0.0005

Answers for Lesson 8-1, pp. 433–435 Exercises (cont.)

61. a. $5^{-2}, 5^{-1}, 5^0, 5^1, 5^2$

b. 5^4

c. $\frac{a^n}{1}$

62. D

63. 45

64. 6

65. 40

66. $\frac{1}{4}$

67. $-\frac{1}{243}$

68. 16

69. $\frac{2}{9}$

70. $\frac{1}{8}$

71. $\frac{1}{16}$

72. -1

73.

a	4	$\frac{1}{3}$	6	$\frac{7}{8}$	2
a^{-1}	$\frac{1}{4}$	3	$\frac{1}{6}$	$\frac{8}{7}$	0.5

74. a. 1

b. They are reciprocals for $a \neq 0$; $\frac{1}{a^n} = a^{-n}$ and $\frac{1}{a^{-n}} = \frac{1}{\frac{1}{a^n}} = a^n$.

75. A, B, D

76. Check students' work.

77. No; $3x^{-2} \cdot 3x^2 = 9 \cdot x^0 = 9$. The product of reciprocals should be 1.

78. The student multiplied b by zero instead of raising b to the zero power, which would equal 1.

79. a. 1 correct, 0.4096; 2 correct, 0.1536;
3 correct, 0.0256; 4 correct, 0.0016

b. 0 or 1

80. about 4 students; about 16 students; about 29 students

81. $8 - 48m^2$

Answers for Lesson 8-1, pp. 433–435 Exercises (cont.)

82. 21

83. $\frac{141}{m^2}$

84. 2.9375

85. $\frac{4}{nr^7y^2}$

86. $-7\frac{1}{4}$

87. 1 and -1

Answers for Lesson 8-2, pp. 438–440 Exercises

1. No; $55 > 10$. 2. yes 3. No; $0.9 < 1$.
4. yes 5. yes 6. No; $46 > 10$.
7. 9.04×10^9 8. 2.0×10^{-2} 9. 9.3×10^6
10. 2.17×10^4 11. 3.25×10^{-3} 12. 8.003×10^6
13. 9.2×10^{-4} 14. 1.56×10^{-2} 15. 500
16. 0.05 17. 2040 18. 720,000
19. 0.897 20. 1.3 21. 0.0000274
22. 0.0048 23. $10^{-3}, 10^{-1}, 10^0, 10^1, 10^5$
24. $6 \times 10^{-10}, 8 \times 10^{-8}, 9 \times 10^{-7}, 7 \times 10^{-6}$
25. $0.52 \times 10^{-3}, 50.1 \times 10^{-3}, 4.8 \times 10^{-1}, 56 \times 10^{-2}$
26. $5300 \times 10^{-1}, 5.3 \times 10^5, 0.53 \times 10^7, 530 \times 10^8$
27. C, A, B 28. 5.6×10^{-2} 29. 2.4×10^{15}
30. 6.0×10^1 31. 3.18×10^{-3} 32. 2.46×10^{-3}
33. 3.4×10^5 34. 5400 35. 7×10^1
36. 1×10^1 37. 4.6×10^{-2} 38. 0.0005
39. 3×10^{-26}
40. Yes; it can be written as 1×10^5 .
41. 48 million = 48×10^6 . Write 48 in scientific notation; then add the powers of 10: $4.8 \times 10^1 \times 10^6 = 4.8 \times 10^7$.
48 millionths = 48×10^{-6} . So $4.8 \times 10^1 \times 10^{-6} = 4.8 \times 10^{-5}$.
42. about $\$2.70 \times 10^{12}$
43. 2.796×10^{10} instructions; 1.6776×10^{12} instructions

Answers for Lesson 8-2, pp. 438–440 Exercises (cont.)

44. B

45. a. 5×10^{14}

b. about 1.6×10^8 years

46. about 2.61×10^9 people

47. a. $6.08 \times 10^{10} \text{ km}^3$

b. $1.09 \times 10^{12} \text{ km}^3$

c. $9.17 \times 10^{14} \text{ km}^3$

48. $3.\bar{3} \times 10^{-3}$

Answers for Lesson 8-3, pp. 443–445 Exercises

- | | | |
|--------------------------------------|--------------------------|--------------------------|
| 1. 2^{10} | 2. $\frac{2^5}{5^8}$ | 3. 1 |
| 4. $(0.99)^3$ | 5. 6^9 | 6. 1 |
| 7. c^5 | 8. $3r^5$ | 9. $\frac{10}{t^7}$ |
| 10. $56x^6$ | 11. $3x^4$ | 12. $-4.8n^3$ |
| 13. b^3 | 14. -7 | 15. $-45a^4$ |
| 16. $\frac{y^3}{x}$ | 17. $45x^7y^6$ | 18. $12a^6c^8$ |
| 19. $x^{10}y^2$ | 20. a^8b | 21. $-\frac{240m^3}{r}$ |
| 22. 6×10^5 | 23. 6×10^9 | 24. 4×10^3 |
| 25. 3.4×10^{-5} | 26. 5.6×10^{-7} | 27. 1.5×10^{22} |
| 28. about 2.5578×10^{13} mi | | |
| 29. 1.08×10^{21} dollars | | |
| 30. about 3.84×10^5 km | | |
| 31. 9 | 32. -4 | 33. -3 |
| 34. 11 | 35. -5 | 36. 5 |
| 37. -4 | 38. 0 | 39. 2, -3 |
| 40. $6x^3 + 2x^2$ | 41. $4x^4$ | 42. $4y^5 + 8y^2$ |
| 43. $4c^4$ | 44. $-6x^6$ | 45. $12a^7$ |
| 46. x^{10} | 47. $3^4 \cdot 2^2$ | 48. 2.7×10^{-8} |
| 49. 8.0×10^5 | 50. 2.1×10^{-5} | 51. 1.2×10^{-4} |
| 52. 8.0×10^{-8} | 53. 1.5×10^8 | 54. about 1.01 g |

Answers for Lesson 8-3, pp. 443–445 Exercises (cont.)

55. a. $y^1y^7; y^2y^6; y^3y^5; y^4y^4$
b. Answers may vary. Sample: $y^{-1}y^9; y^{-2}y^{10}; y^{-3}y^{11}; y^{-4}y^{12}$
c. An infinite number; there are an infinite number of integer pairs with a sum of 8.
56. a. about 10^{-7} m
b. Longer; $1 < 4 < 7$ so $1 \times 10^{-7} < 4 \times 10^{-7} < 7 \times 10^{-7}$.
57. Answers may vary. Sample: The property of multiplying powers only applies when 2 terms have the same base.
58. about 5.85×10^3 m
59. 7.65×10^{14}
60. 4.0392×10^8
61. 7.039305×10^{-7}
62. $1.7882786 \times 10^{-12}$
63. about 6.7×10^{33} molecules
64. 1.428×10^{33} molecules
65. x^3
66. $\frac{1}{a}$
67. $5c^3$
68. $6a^3 + 10a^2$
69. $8m^5 + 56m^3$
70. $-8x^5 + 36x^4$
71. 81
72. 2^{2n+3}
73. $2^{x+y} \cdot 3^{x+2}$
74. $\frac{1}{a+b}$
75. $(t+3)^2$
76. 25
77. a. 1.833×10^{-9} km³
b. 1.833 m³
78. 700 times

Answers for Lesson 8-4, pp. 449–451 Exercises

1. c^{10}
2. c^{10}
3. n^{32}
4. q^{100}
5. c^{19}
6. d^{15}
7. $\frac{1}{t^{14}}$
8. x^7
9. $625y^4$
10. $1024m^5$
11. $49a^2$
12. $\frac{1}{12g^4}$
13. $36y^4$
14. $81n^{24}$
15. $\frac{1}{8y^{12}}$
16. 1
17. x^{16}
18. $8x^5y^3$
19. 1
20. $\frac{1}{c^{18}}$
21. $9a^6b^8$
22. $\frac{a^{32}}{32c^{26}}$
23. 1.6×10^{11}
24. 9×10^{10}
25. 8×10^{-30}
26. 8×10^{-9}
27. 4.9×10^9
28. 3.6×10^{25}
29. 6.25×10^{-18}
30. 4.2875×10^{-11}
31. $8.57375 \times 10^{-10} \text{ m}^3$
32. 3
33. -4
34. 4
35. -3
36. 0
37. 8
38. -2
39. 0
40. -3
41. The student who wrote $x^5 + x^5 = 2x^5$ is correct; x^5 times x^5 is x^{10} .
42. 1
43. $243x^3$
44. b^{17}
45. $30x^2$
46. $\frac{0.16}{x^4}$
47. $-8a^9b^6$
48. 9
49. 4.3×10^4
50. $-256x^4y^5$
51. a. $24x^2; 96x^2$
b. 4 times
c. $8x^3; 64x^3$
d. 8 times

Answers for Lesson 8-4, pp. 449–451 Exercises (cont.)

52. $(mn)^4$ 53. $(ab)^5$ 54. $(7xyz)^2$ 55. $\left(\frac{2x}{y}\right)^2$
56. Check students' work.
57. a. 10^6 b. 10^9 c. 10^9 d. 10^{18}
58. a. 2^{23} bits
b. 2^{30} bytes; 2^{33} bits
59. a. about $5.15 \times 10^{14} \text{ m}^2$
b. about $3.60 \times 10^{14} \text{ m}^2$
c. about $1.37 \times 10^{18} \text{ m}^3$
60. C
61. Add exponents for products of powers as in a^2a^4 . Multiply exponents for powers of powers, as in $(a^2)^4$.
62. 3 63. 6 64. 12
65. 3 66. 4 67. -5
68. x^{12} ; x^{81} ; no

Answers for Lesson 8-5, pp. 456–458 Exercises (cont.)

45. a^6

46. $\frac{t^6}{27}$

47. $\frac{1}{n^{28}}$

48. $\frac{9}{4k^{10}}$

49. 49

50. a. 9.74×10^7 households; 5.44×10^{11} local calls; 9.7×10^{10} long-distance calls

b. about 5585 local calls

c. about 996 long-distance calls

51. a. Answers may vary.

Sample: $\frac{c^4}{c^6}$ can be written as c^{4-6} or c^{-2} ; $c^{-2} = \frac{1}{c^2}$.

b. Check students' work.

52. $\frac{a^4}{4b^{10}}$

53. $\frac{a^5c^5}{b^3}$

54. $\frac{3}{4}$

55. 5

56. $\frac{r^5}{p^{25}q^5}$

57. 20,736

58. $\frac{y^6}{81}$

59. $\frac{3b^5}{5a}$

60. H

61. Answers may vary. Sample: You can raise the numerator and denominator to the power and then simplify or simplify and then raise to the power.

62. a. about \$12,988

b. about \$20,733

c. about 60%

63. a. The student treated $\frac{5^4}{5}$ as $\left(\frac{5}{5}\right)^4$.

b. 125

64. $\left(\frac{3}{5}\right)^5$

65. $\left(\frac{m}{n}\right)^7$

66. d^3

67. 10^{10}

68. $\left(\frac{3x}{2y}\right)^3$

69. $\left(\frac{2}{13m}\right)^2$

70. $\left(\frac{7m}{5n}\right)^2$

71. $\left(\frac{5c}{6}\right)^3$

Answers for Lesson 8-5, pp. 456–458 Exercises (cont.)

72. a. about 1.2×10^6 s
 b. about 13.9 days
73. a-b. Check students' work.
 c. No, the power may remain the same or be one less.
74. def. of neg. exponent
75. dividing powers with the same base, def. of neg. exponent
76. raising a quotient to a power
77. mult. powers with the same base
78. raising a power to a power, dividing powers with the same base, def. of neg. exponents

79. n^2

80. n^{4x}

81. x^4

82. $\frac{1}{n^2}$

83. a.

**Distance From the Sun
(kilometers)**

Planet	Maximum : Minimum
Mercury	$6.97 \times 10^7 : 4.59 \times 10^7 \approx 1.52$
Venus	$1.089 \times 10^8 : 1.075 \times 10^8 \approx 1.01$
Earth	$1.521 \times 10^8 : 1.471 \times 10^8 \approx 1.03$
Mars	$2.491 \times 10^8 : 2.067 \times 10^8 \approx 1.21$
Jupiter	$8.157 \times 10^8 : 7.409 \times 10^8 \approx 1.10$
Saturn	$1.507 \times 10^9 : 1.347 \times 10^9 \approx 1.12$
Uranus	$3.004 \times 10^9 : 2.735 \times 10^9 \approx 1.10$
Neptune	$4.537 \times 10^9 : 4.457 \times 10^9 \approx 1.02$
Pluto	$7.375 \times 10^9 : 4.425 \times 10^9 \approx 1.67$

- b. The closer the ratio is to 1, the more circular the orbit.
 c. Pluto, Venus

Answers for Lesson 8-6, pp. 463–465 Exercises (cont.)

36. a. 144% ; $\approx 173\%$; $\approx 207\%$

b. $M(z) = (1.2)^z$

37. arithmetic; 3, 1, -1

38. neither; -3 , -8 , -14

39. geometric; 1.125, 0.5625, 0.28125

40. arithmetic; 20, 22, 24

41. a. $A(n) = 36 \cdot (0.9)^{n-1}$

b. 6; $n = 1$ corresponds to the first swing, because $A(1) = 36$.

c. 21.3 cm

42. a. $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{16}$

b. 2^{-1} , 2^{-2} , 2^{-3} , 2^{-4}

c. $r = 2^{-n}$

d. 2^{-10} or $\frac{1}{2^{10}}$

43. No; if a term were 0, then all terms would be 0 because you multiply a term to get the next term.

44. a. 1 , $\frac{3}{4}$, $\frac{9}{16}$, $\frac{27}{64}$

b. $r = 1 \cdot \left(\frac{3}{4}\right)^{n-1}$

c. $\frac{243}{1024}$

d. 0 , $\frac{1}{4}$, $\frac{7}{16}$, $\frac{37}{64}$

e. $r = \left[1 - 1 \cdot \left(\frac{3}{4}\right)^{n-1}\right]$

f. $\frac{14,197}{16,384}$

45. x ; x^5 , x^6 , x^7

46. $3x$; $27x^4$, $81x^5$, $243x^6$

47. xy^2 ; x^5y^9 , x^6y^{11} , x^7y^{13}

48. ab ; $2a^4b^2$, $2a^5b^3$, $2a^6b^4$

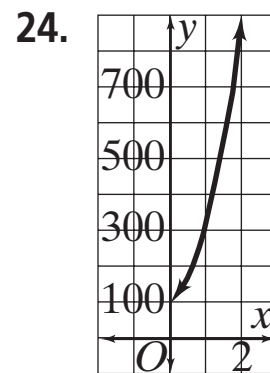
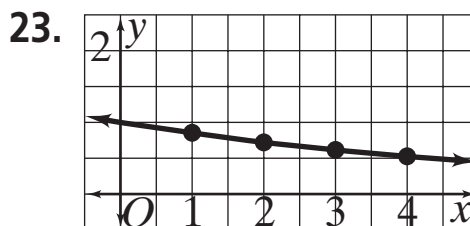
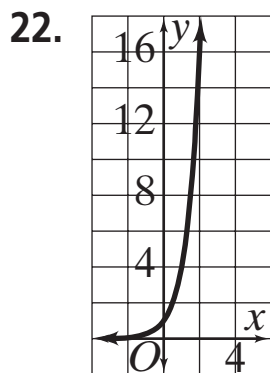
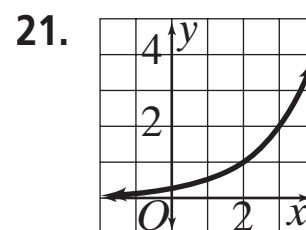
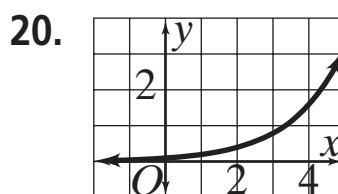
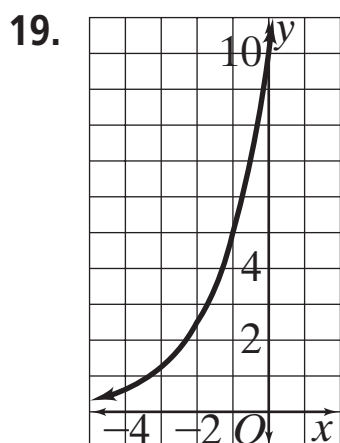
Answers for Lesson 8-6, pp. 463–465 Exercises (cont.)

49. 6×10^{-2} ; 2.592×10^2 , 1.5552×10^1 , 9.3312×10^{-1}

50. 5th

Answers for Lesson 8-7, pp. 470–472 Exercises

1. 216 2. $\frac{2}{9}$ 3. 2.5 4. 32
 5. 4.5 6. 115.2 7. 1600 8. 0.576
 9. \$160,000; \$320,000 10. \$2000; \$4000
 11. \$16,000, \$32,000
 12. A 13. C 14. B 15. B
 16. D 17. C 18. A



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

Answers for Lesson 8-7, pp. 470–472 Exercises (cont.)

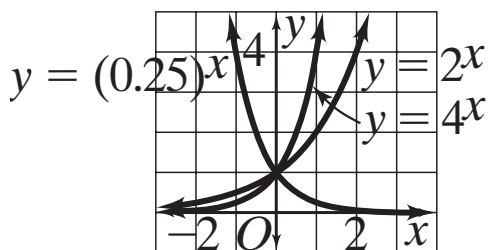
29. 4, 2, 1, 0.5, 0.25, 0.125; decrease
30. $\frac{9}{4}, \frac{3}{2}, 1, \frac{2}{3}, \frac{4}{9}, \frac{8}{27}$; decrease
31. 0.04, 0.4, 4, 40, 400, 4000; increase
32. $1111.\bar{1}, 333.\bar{3}, 100, 30, 9, 2.7$; decrease
33. B

34. a.

Time	Number of 20-min Time Periods	Pattern	Number of Bacteria Cells
Initial	0	75	75
20 min	1	$75 \cdot 2$	$75 \cdot 2^1 = 150$
40 min	2	$75 \cdot 2 \cdot 2$	$75 \cdot 2^2 = 300$
60 min	3	$75 \cdot 2 \cdot 2 \cdot 2$	$75 \cdot 2^3 = 600$
80 min	4	$75 \cdot 2 \cdot 2 \cdot 2 \cdot 2$	$75 \cdot 2^4 = 1200$
100 min	5	$75 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$	$75 \cdot 2^5 = 2400$
120 min	6	$75 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$	$75 \cdot 2^6 = 4800$
140 min	7	$75 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$	$75 \cdot 2^7 = 9600$

b. $y = 75 \cdot 2^x$, where x is the number of 20-min time periods

35. a.



- b. (0, 1)
- c. 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. a. 1,000,000,000 plants
- b. 1,000,000,000,000 plants

37. a.

x	y
1	-2
2	4
3	-8
4	16
5	-32

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

c. No; in $y = a \cdot b^x$, $b > 0$. $-2 < 0$, so it is not exponential.

38. $y = x^5$

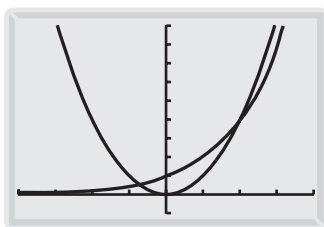
39. $f(t) = 200 \cdot t^2$

40. $y = 3^x$

41. $f(x) = 100x^2$

42. $\{500\}$; $b = 1$ produces a linear graph.

43. a.



$X_{\min} = -4$ $Y_{\min} = -1$

$X_{\max} = 4$ $Y_{\max} = 9$

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 $x = 2$.

c. The graph of $y = 6^x$ is steeper than $y = x^2$ and $y = 2^x$.

44. 2

45. -3

46. 6

47. 3

48. 4

49. 5

50. a. 4

b. 3

c. $y = 4 \cdot 3^x$

d. $\frac{4}{9}, 324$

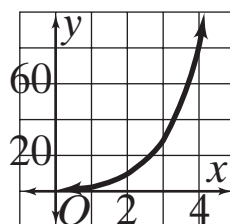
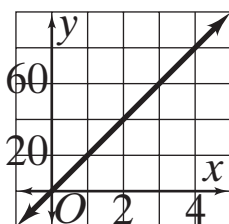
Answers for Lesson 8-8, pp. 479–482 Exercises

1. 20; 2
2. 200; 1.0875
3. 10,000; 1.01
4. 1; 1.5
5. a. 50,000
b. 0.03; 1.03
c. 1.03
d. 50,000; 1.03; x
e. about 104,689 people
6. 1.04
7. 1.05
8. 1.037
9. 1.0875
10. 1.005
11. 0.75%, 0.25%
12. 1%; $0.\overline{3}\%$
13. 1.125%; 0.375%
14. 1.9%; $0.6\overline{3}\%$
15. 1.5625%; $0.5208\overline{3}\%$
16. \$5352.90
17. \$16,661.35
18. \$634.87
19. \$28,338.18
20. a. 4 half-lives
b. 2.5 mCi
21. a. 3 half-lives
b. 3.125 mCi
22. 0.5
23. 0.1
24. $\frac{2}{3}$
25. 0.9
26. exp. growth
27. exp. decay
28. exp. growth
29. exp. decay
30. a. \$22,000; 0.8
b. $y = 22,000 \cdot (0.8)^x$
c. \$5767.17

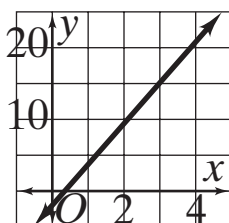
Answers for Lesson 8-8, pp. 479–482 Exercises (cont.)

31. $y = 130,000 \cdot (1.01)^x$; about 142,179 people
32. $y = 3,000,000 \cdot (0.985)^x$; about 2,579,191 people
33. $y = 2400 \cdot (1.07)^x$; \$4721.16
34. $y = 2400 \cdot (1.00583333)^x$; \$4823.19
35. a. $y = 584 \cdot (1.065)^x$; \$3862.79
 b. Check students' work.
36. Linear function; it is a straight line.
37. Neither; it is not just one straight line.
38. Exponential function; it is a curve with y -values that increase as x -values increase.
39. Neither; it decreases and then increases, unlike an exponential function.

40. linear function 41. exponential function



42. linear function



43. Answers may vary. Sample: \$600; even after 10 years, there is more money in the account with an initial deposit of \$600 (\$977.34) than there is in the account with an initial deposit of \$500 (\$907.01).

Answers for Lesson 8-8, pp. 479–482 Exercises (cont.)

- 44.** 6 half-lives
- 45.** 4 half-lives
- 46.** a. about 4 h
b. 3.75 mg
c. about 3.7 mg using the function and
 $15 \text{ mg} \times \frac{1}{4} = 3.75 \text{ mg}$ using the prediction
- 47.** a. $y = 6,284,000 \cdot (1.01)^x$
b. 7,667,674 people
- 48.** 94%
- 49.** 88%
- 50.** 96.5%
- 51.** 46.1%
- 52.** B
- 53.** a. \$220.00
b. \$3.96
c. \$223.96
d. \$193.96
e. 9 months
f. \$18.07
- 54.** Check students' work.
- 55.** 2003