Chapter 7

7.1 Skill Practice **1.** order of magnitude **3.** 4^8 **5.** 3^4 **7.** $(-7)^9$ **9.** 2^{14} **11.** 3^{10} **13.** $(-5)^{12}$ **15.** $15^3 \cdot 29^3$ **17.** $132^6 \cdot 9^6$ **19.** x^6 **21.** z^6 **23.** x^{10} **25.** $(b-2)^{12}$ **27.** $25x^2$ **29.** $49x^2y^2$ **31.** $100x^{14}$ **33.** $96d^{22}$ **35.** $12p^{19}$ **37.** $108x^{29}$ **39.** *Sample answer:* The exponents should be added, not multiplied; $c^1 \cdot c^4 \cdot c^5 = c^{1+4+5} = c^{10}$. **43.** 2 **45.** 2 **47.** $-3267x^{12}y^{13}$ **49.** $1000r^{17}s^6t^{17}$

7.1 Problem Solving **53.** 10^{26} m

55. a.

Ounces of gold	10	100	1000	10,000	100,000
Number of atoms	10^{24}	10^{25}	10^{26}	10^{27}	10^{28}

b. $10^5 \cdot 10^{23}$; 10^{28} atoms **57.** 10^{27}

7.2 Skill Practice **1.** base, exponent **3.** 5^4 **5.** 3^4 **7.** $(-4)^3$ **9.** 10^6 **11.** $\frac{1}{3^5}$ **13.** $\frac{5^4}{4^4}$ **15.** 7^7 **17.** 3^8 **21.** y^7 **23.** $\frac{a^9}{y^9}$ **25.** $\frac{p^4}{q^4}$ **27.** $-\frac{64}{x^3}$ **29.** $\frac{64c^3}{d^6}$ **31.** $\frac{x^4}{9y^6}$ **33.** $\frac{9x^4}{4y^2}$ **35.** $\frac{3m^7}{8n^6}$ **39.** 8 **41.** 4 **43.** $54s^3t^3$ **45.** $\frac{27x^{11}y^5}{25}$ **47.** Identity property of multiplication; Multiply fractions; Quotient of powers property

7.2 Problem Solving

49. a.

Step	Number of new squares	Side length of new square
1	$4 = 4^1$	$\frac{1}{2} = \left(\frac{1}{2}\right)^1$
2	$16 = 4^2$	$\frac{1}{4} = \left(\frac{1}{2}\right)^2$
3	$64 = 4^3$	$\frac{1}{8} = \left(\frac{1}{2}\right)^3$
4	$256 = 4^4$	$\frac{1}{16} = \left(\frac{1}{2}\right)^4$

b. $\frac{4^4}{4^2}$; 16 times

51. about 31,710 yr **53.** 31^3 times greater

7.3 Skill Practice **1.** Product of powers property and definition of zero exponent; the expression simplifies using the product of powers property to 3^0, which by definition equals 1. **3.** $\frac{1}{64}$ **5.** $-\frac{1}{3}$ **7.** 1 **9.** 1 **11.** $\frac{49}{4}$ **13.** undefined **15.** $\frac{1}{32}$ **17.** $\frac{1}{32}$ **19.** 27 **21.** $\frac{1}{243}$ **23.** $\frac{8}{3}$ **25.** 16 **27.** 3^0 is not equivalent to 0, but to 1; $-6 \cdot 3^0 = -6 \cdot 1 = -6$. **29.** $\frac{2}{y^3}$ **31.** $\frac{1}{121h^2}$ **33.** $\frac{5}{m^3n^4}$ **35.** 1 **37.** $\frac{1}{x^5y^2}$ **39.** $\frac{y^8}{15x^{10}}$ **41.** $243d^3$ **43.** $\frac{3x^{12}y^5}{4}$

7.3 Problem Solving **51.** about 10^5 grains of rice **53.** about 10^{11} red blood cells

55. a.

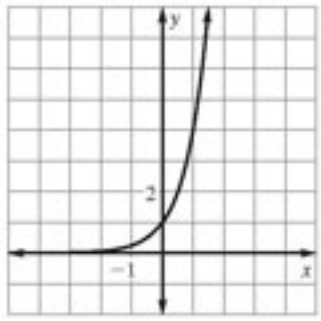
Number of folds	0	1	2	3
Fraction of original area	1	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{8}$

b. $\left(\frac{1}{2}\right)^x$ where x is the number of folds **57. a.** 112.5 watts **b.** $I = 9d^{-2}$ **c.** The intensity is divided by 4.

Extension **1.** 1000 **3.** $\frac{1}{729}$ **5.** $\frac{1}{3}$ **7.** 81 **9.** $\frac{1}{216}$ **11.** $-\frac{1}{4}$ **13.** For $0 < x < 1$, $x^{1/2} < x^{-1/2}$; for $x = 1$, $x^{1/2} = x^{-1/2}$; for $x > 1$, $x^{1/2} > x^{-1/2}$.

7.4 Skill Practice **1.** growth factor **3.** The graph would be a vertical stretch. *Sample answer:* Since the y-values of $y = 2 \cdot 5^x$ are double those of $y = 5^x$. **5.** $y = 125 \cdot 5^x$ **7.** $y = \frac{1}{9} \cdot 3^x$

9.



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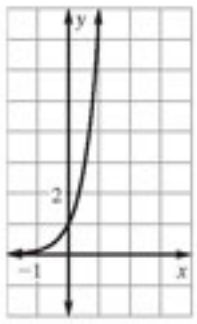
11.



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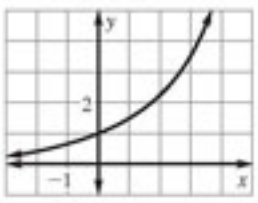

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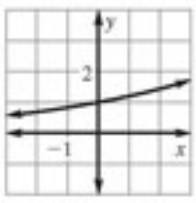

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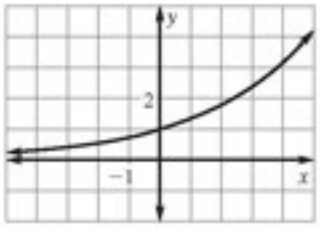
17. 

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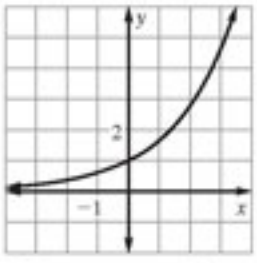
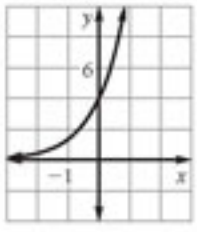
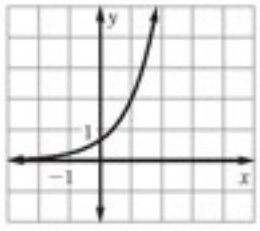
19. 

domain: all real numbers, range: all positive real numbers

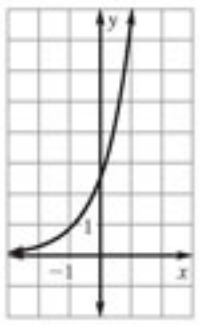
21. The percent increase was not written as a decimal; $0.27(1 + 0.02)^3 = 0.27(1.02)^3 \approx \$.29$.

23. 

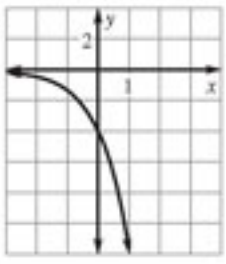
The graph is a vertical stretch.

25. 

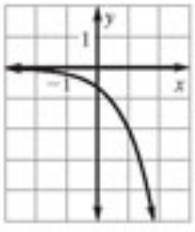
The graph is a vertical shrink.

27. 

The graph is a vertical stretch.

29. 

The graph is a vertical stretch with a reflection in the x-axis.

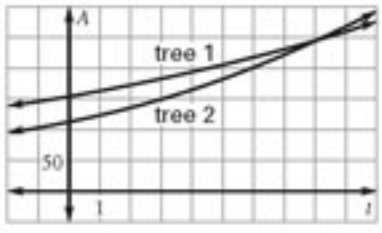
31. 

The graph is a vertical shrink with a reflection in the x-axis.

33. 

The graph is a vertical stretch with a reflection in the x-axis.

35. 200%. *Sample answer:* A growth rate of 200% would create a growth factor of $1 + 2 = 3$, which would represent the tripling of the population every year.

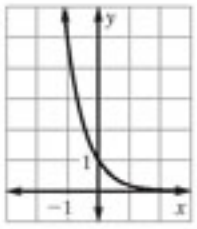
7.4 Problem Solving **39. a.** Let x represent the number of years since 2001 and $f(x)$ represent the number of computers (in hundreds of millions); $f(x) = 6 \cdot (1.1)^x$. **b.** about 1,286,153,286 computers
41. a. tree 1: $A = 154 \cdot (1.06)^t$, tree 2: $A = 113 \cdot (1.1)^t$
b. 

about 8.4 yr

45. $y = 25.96(1.059)^x$; about 145 Hz **47.** \$1266.77
49. \$1271.24

7.4 Problem Solving Workshop
1. a. Let t represent the number of years since 1997 and F represent the bus fare; $F = 20(1.12)^t$. **b.** \$22.40
c. 2000. *Sample answer:* Make a table of values.
3. a. $T = 7.5(1.039)^t$ **b.** about 37.4 million

7.5 Skill Practice **1.** $1 - r$ **3.** exponential function; $y = 8 \cdot 4^x$ **5.** exponential function; $y = 2\left(\frac{1}{3}\right)^x$

7. 

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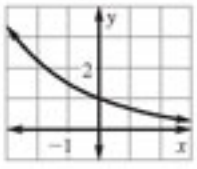
9. 

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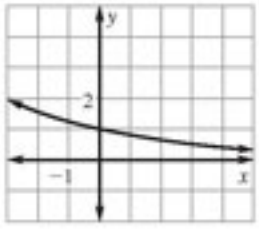
11. 

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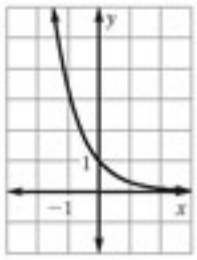
13. 

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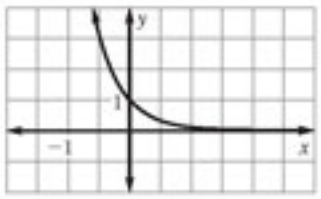
15. 

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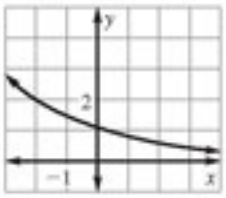
17. 

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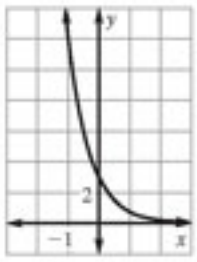
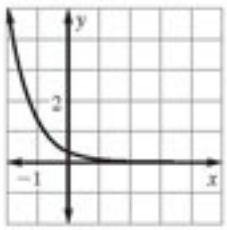
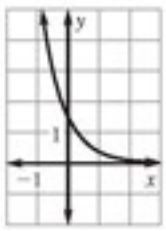
21. 

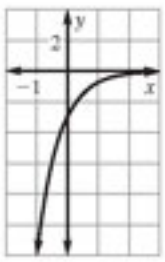
The graph is a vertical stretch.

23. 

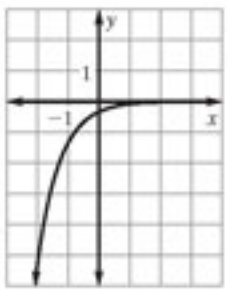
The graph is a vertical shrink.

25. 

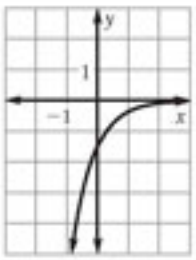
The graph is a vertical stretch.

27. 

The graph is a vertical stretch with a reflection in the x-axis.

29. 

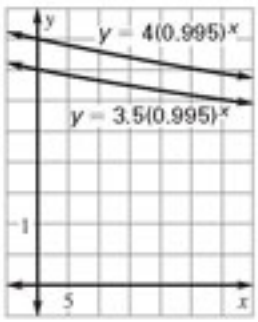
The graph is a vertical shrink with a reflection in the x-axis.

31. 

The graph is a vertical stretch with a reflection in the x-axis.

33. C **35.** initial amount: 90,000 people, decay factor: 0.975, decay rate: 2.5%; Let P represent the population and t represent the number of years; $P = 90{,}000(0.975)^t$. **37.** *Sample answer:* The decay rate, r, is 0.14. So the decay factor $(1 - r)$ should be 0.86, not 0.14; $y = 25{,}000(0.86)^t$. **39.** exponential decay; $y = 8 \cdot 0.6^x$ **41. a.** The graph is a vertical shrink. **b.** The graph is a vertical stretch with a reflection in the x-axis. **c.** The graph is a vertical shift up 1 unit. **45.** To find t, divide the number of days, 40, by the half-life, 10. Then $A = 100(0.5)^4 =$ 6.25 grams.

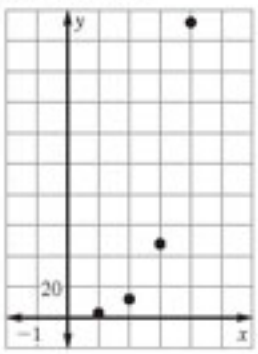
7.5 Problem Solving **47.** Let V represent the value of the cell phone and t represent the number of years since purchase, $V = 125(0.8)^t$; \$64.
49. No. *Sample answer:* The boat's value is about \$3217. **51. a.** decay factor: 0.9439, decay rate: 5.61% **b.** about 1.431 in. **c.** about 0.716 in.
53. a. $y = 4(0.995)^x$, $y = 3.5(0.995)^x$

b. 

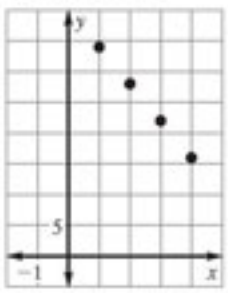
c. about 52 yr

Extension

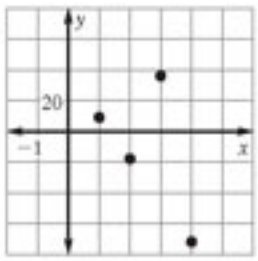
1. geometric



3. arithmetic



5. geometric



7. $a_n = (-5)^{n-1}$; 15,625 **9.** $a_n = 432\left(\frac{1}{6}\right)^{n-1}$; $\frac{1}{108}$

Extension

11. $a_1 = 256$, $a_n = 0.25a_{n-1}$

13. $a_1 = 3$, $a_n = a_{n-1} + 4$

15. $a_1 = -5$, $a_n = a_{n-1} + 2$

17. $a_1 = -2$, $a_n = -2a_{n-1}$

19. $a_1 = 1$, $a_2 = 3$, $a_n = a_{n-2} + a_{n-1}$; 18, 29

21. $a_1 = 1$, $a_2 = 1$, $a_3 = 1$, $a_n = a_{n-3} + a_{n-2} + a_{n-1}$; 17, 31

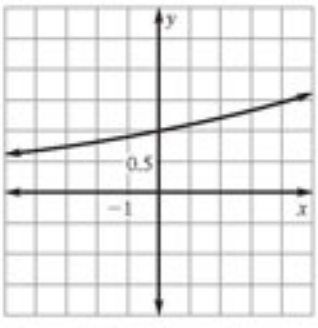
23. $a_1 = 64$, $a_2 = 16$, $a_n = ;$ 4, 0.25

25.a. 3, 5, 7, 9, 11, 13, 15, 17, 19, 21 **b.** 3, 12, 48, 192, 768, 3072, 12,288, 49,152, 196,608, 786, 432

27.a. This is the explicit rule with $n - 1$ substituted for n. **b.** Explicit rule for arithmetic seq.; ident. prop. of add.; inv. prop. of add.; assoc. prop. of add.; dist. prop.; subst. prop. (from part (a))

Chapter Review **1.** decay, decay factor **3.** Exponential decay; $b = 0.85$ which is between 0 and 1, therefore it's exponential decay. **5.** Exponential growth; $b = 2.1$ which is greater than 1, therefore it's exponential growth. **7.** $(-3)^8$ **9.** y^{20} **11.** $(b + 2)^{24}$ **13.** $-64x^2y^2$ **15.** 10^{21} **17.** 5^3 **19.** 17^4 **21.** $\frac{49x^{10}}{y^4}$ **23.** $\frac{6r^{15}}{7s^5}$ **25.** 1 **27.** $\frac{27}{8}$ **29.** 10^6

31.



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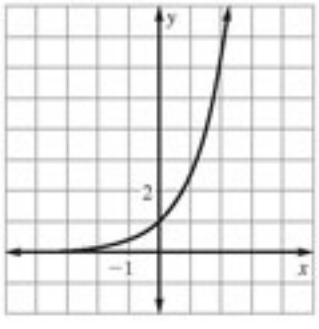

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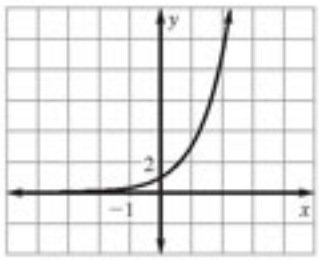
Chapter 7

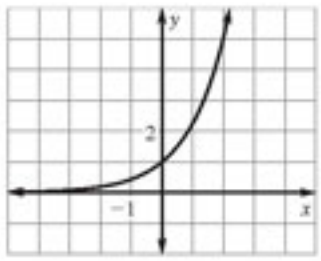
Extra Practice

1. 5^7 **3.** $(-2)^9$ **5.** $(-4)^6$ **7.** m^7 **9.** y^{15} **11.** $54d^8$ **13.** 8^5 **15.** $-\frac{2^5}{3^5}$ **17.** 7^5 **19.** $\frac{p^7}{q^7}$ **21.** $\frac{64y^9}{27}$ **23.** $\frac{25x^2y^6}{4}$ **25.** $\frac{1}{81}$ **27.** 1 **29.** 8 **31.** 32 **33.** $\frac{1}{y^{10}}$ **35.** $\frac{10c^5}{b^3}$ **37.** $\frac{y^5}{x^4}$ **39.** $-96z^5$

41.



43.



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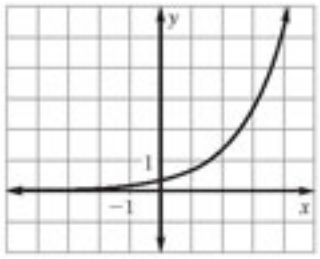

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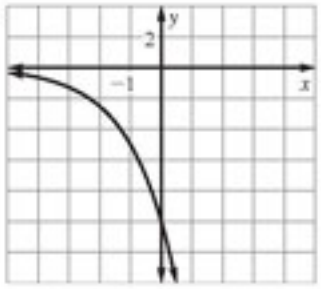

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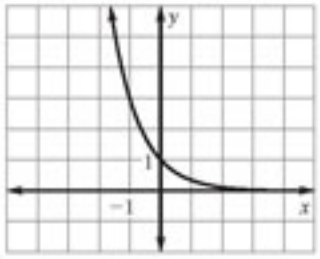
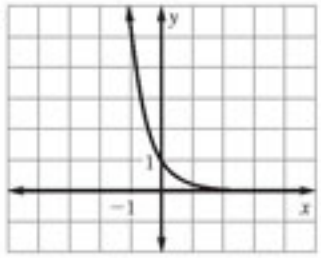
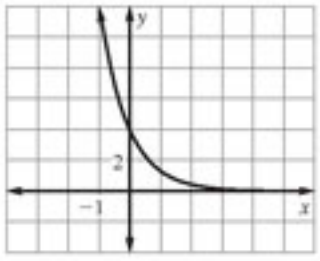


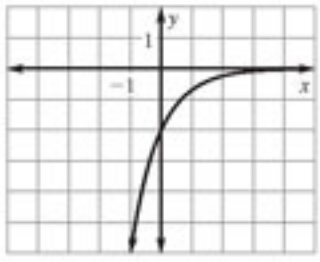
51.



53.



55.



57. exponential; $y = 5 \cdot 2x$ **59.** not exponential