Selected Answers and Solutions

CHAPTER 0

Preparing for Integrated Math III

Pretest

1. D = {−3, 8, 14}, R = {1, 4, 6}; yes **3.** III **5.** II **7.** $a^2 + 3a - 18$ **9.** $c^2 - 64$ **11.** $5b(2ab + 1)$ **13.** $(y - 1)(y + 7)$ **15.** 30 cones **17.** combinations; 455 **19.** mutually exclusive; $\frac{2}{13}$ **21.** independent; $\frac{1}{6}$ **23.** similar **25.** 29 cm **27.** no **29.** ≈ 84.1, 87, 92, 64, ≈ 15.4; 36

Lesson 0-1

1. D = {1, 2, 3}, R = {6, 7, 10}; yes **3.** D = {1, 2}, R = {5, 7, 9}; no **5.** D = {−2, −1, 0, 3}, R = {−3, −2, 2}; yes **7.** D = {−1, 0, 1, 2, 3}, R = {−3, −2, −1, 2, 3, 4}; no **9.** I **11.** none

Lesson 0-2

1. $a^2 + 6a + 8$ **3.** $h^2 - 16$ **5.** $b^2 + b - 12$ **7.** $r^2 - 5r - 24$ **9.** $p^2 + 16p + 64$ **11.** $2c^2 - 9c - 5$ **13.** $6m^2 - 7m - 20$ **15.** $2q^2 - 13q - 34$ **17a.** $n - 7, n + 2$ **17b.** $n^2 - 5n - 14$

Lesson 0-3

1. $4x(3x + 1)$ **3.** $4ab(2b - 3)$ **5.** $(y + 3)(y + 9)$ **7.** $(3y + 1)(y + 4)$ **9.** $(3x + 4)(x + 8)$ **11.** $(y - 4)(y - 1)$ **13.** $2(3a - b)(a - 8b)$ **15.** $(2x - 3y)(9x - 2y)$ **17.** $(3x - 4)^2$ **19.** $(x + 12)(x - 12)$ **21.** $(4y + 1)(4y - 1)$ **23.** $4(3y + 2)(3y - 2)$

Lesson 0-4

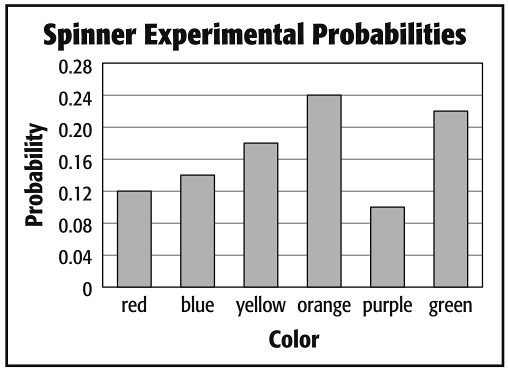
1. 60 **3.** 18 **5.** 120 **7.** 6 **9.** 6 **11.** permutations, 720 **13.** permutations, 5040 **15.** combinations, 15 **17.** permutations, 3024 **19a.** 2,176,782,336; 1,402,410,240 **19b.** 308,915,776; 712,882,560; The password with one digit is more secure, because the chance of someone guessing this password at random is $\frac{1}{712{,}882{,}560}$, which is less than the chance of someone guessing a 6-character password that contains only letters, $\frac{1}{308{,}915{,}776}$.

Lesson 0-5

1a.

Color	Frequency	Experimental Probability
red	6	0.12
blue	7	0.14
yellow	9	0.18
orange	12	0.24
purple	6	0.10
green	11	0.22

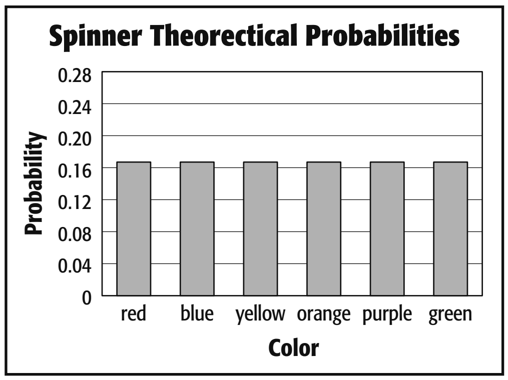
1b.



1c.

Color	Frequency	Experimental Probability	Theoretical Probability
red	6	0.12	$0.1\overline{6}$
blue	7	0.14	$0.1\overline{6}$
yellow	9	0.18	$0.1\overline{6}$
orange	12	0.24	$0.1\overline{6}$
purple	6	0.10	$0.1\overline{6}$
green	11	0.22	$0.1\overline{6}$

1d.



1e. Sample answer: Since all bars in the graph of the theoretical probabilities are the same height, the graph represents a uniform distribution. This means that in theory, the chance of landing on any one of the colors is equally likely. The graph of the experimental probabilities indicates that in practice, it is more likely that the spinner will land on orange or green than on any of the other colors, since the heights of those bars are taller than any others in the graph.

3a. mutually exclusive, $\frac{1}{2}$ **3b.** not mutually exclusive, $\frac{4}{13}$ **3c.** not mutually exclusive, $\frac{7}{13}$ **5a.** mutually exclusive, $\frac{11}{20}$ **5b.** not mutually exclusive, $\frac{29}{40}$ **5c.** not mutually exclusive, $\frac{2}{5}$

7. When events are mutually exclusive, $P(A \text{ and } B)$ will always equal 0, so the probability will simplify to $P(A) + P(B)$. **9.** 1 to 3; 1 to 1

Lesson 0-6

1. independent; $\frac{1}{36}$ **3.** $\frac{1}{36}$ **5.** $\frac{25}{36}$ **7.** $\frac{5}{18}$ **9.** $\frac{5}{17}$ **11.** $\frac{1}{8}$
13. $\frac{1}{26}$ **15a.** $\frac{32}{41}$ **15b.** $\frac{2}{5}$ **15c.** $\frac{3}{7}$ **17a.** $\frac{91}{115}$ or about 79.1%
17b. $\frac{239}{308}$ or about 77.6%

Lesson 0-7

1. similar **3.** neither **5.** similar **7.** 8; 21 **9.** 10.2; 13.6
11. $4\frac{1}{2}$ in.

Lesson 0-8

1. 39 ft **3.** 8.3 cm **5.** 5 **7.** 9.2 **9.** 8.5 **11.** yes **13.** no
15. yes **17.** about 2.66 m

Lesson 0-9

1. 451.8 min, 399 min, no mode **3.** ≈34.4 text messages, 35 text messages, 35 text messages **5.** Sample; Walk A: 47, ≈242.0, ≈15.6; Walk B: 92, ≈1115.4, ≈33.4; since the sample standard deviation of Walk B is greater than that of Walk A, there is more variability in the number of sponsors obtained by participants in Walk B than in Walk A. **7.** 18, 23, 25, 27, 29; Sample answer: There are 18 students in the smallest math class at Central High and 29 students in the largest class. 25% of the classes have less than 23 students, 50% of the classes have less than 25 students, and 75% of the classes have less than 27 students.
9. 13; Sample answer: Any outliers would be less than 14.25 or greater than 60.25. Since $13 < 14.25$, it is an outlier.

Data Set	Mean	Median	Mode	Range	Standard Deviation
with outlier	≈35.8	36	36	38	≈9.3
without outlier	≈37.3	36	36	29	≈7.5

Removing the outlier did not affect the median or mode. However, the removal did affect the mean, standard deviation, and range. The mean and standard deviation increased, and the range decreased.
11a. Yes; sample answer: Any outliers would be less than 15.35 or greater than 17.35. Since $14.9 < 15.35$, it is an outlier.
11b. No; sample answer: Any outliers would be less than 15.4 or greater than 17.4. Since $17.4 > 17.35$, it would not be an outlier. **11c.** Sample answers: data recording errors, manufacturing errors

Posttest

1. D = {0, 4, 5, 7}, R = {−2, −1, 5, 9, 12}; no **3.** II **5.** III
7. $30p^2 - 56p + 10$ **9.** $18k^2 + 15k - 18$ **11.** $(2x + y)^2$
13. $4(a + 2b)^2$ **15.** 30 ways **17.** combinations; 6435
19. mutually exclusive; $\frac{5}{12}$ **21.** dependent; $\frac{21}{190}$ **23.** neither
25. 24 in. **27.** no **29.** ≈ 36.1 students, 33.5 students, 35 students, 59 students, ≈ 16.8 students; 75 students

CHAPTER 1
Equations and Inequalities

Chapter 1 Get Ready

1. 12.25 **3.** −66.15 **5.** $1\frac{13}{15}$ **7.** $-1\frac{1}{3}$ **9.** $10\frac{1}{2}$ yd **11.** −64
13. 15.625 **15.** $\frac{2401}{81}$ **17.** $-\frac{3375}{8}$ **19.** true **21.** false **23.** yes

Lesson 1-1

1. 4.6 **3.** 18.4 **5.** 11.6 **7.** 0.96875 **9.** 0.6 **11.** $6\frac{4}{15}$
13. 28 **15.** −13.4 **17a.** 1524.6 mi **17b.** 720 mi **19.** 20
21. −20 **23.** ≈ 3.71 **25.** $\frac{1}{2}(x + 7)(2x)$
27a. 584,336,233.6 mi **27b.** 8761 h
27c. Yes; $\frac{8761}{24} = 365$ days or 1 year. **29.** 544 **31.** 13.8
33. 131.25 **35.** $6\pi x^3$ **37.** 70°F
39a. \$3.91; \$5.36; \$7.31 **39b.** \$4.42; \$6.62; \$11.62; Sample answer: The average prices found in part a become increasingly higher with time. **41.** 6.9 **43.** Lauren; $-12 - 20 = -32$
45. Sample answer: b; Since t is time, it must be nonnegative. So $-2t(2t + 1)$ will be negative for all values of t other than 0. The maximum value of $-2t(2t + 1)$ is 0, which occurs when $t = 0$. Thus, the maximum value of $-2t(2t + 1) + 6$ is 6.
47. Sample answer: $y\left(\frac{-4z}{x^2} - x\right) + z$
49. A table of on-base percentages is limited to those situations listed, while a formula can be used to find any on-base percentage. **51** month 9 **53.** B **55.** 10 cm **57.** $6x(x + 2)$
59. 3 and 11 **61.** 5 **63.** 11 **65.** −4 **67.** $\frac{5}{8}$

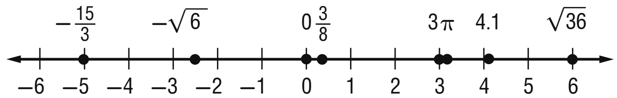
Lesson 1-2

1. N, W, Z, Q, R **3.** I, R **5.** Assoc. (×) **7.** Comm. (+)
9. 7; $-\frac{1}{7}$ **11.** −3.8; $\frac{1}{3.8}$
13a. 22(2 + 4 + 3 + 1 + 5 + 6 + 7) or 22(2) + 22(4) + 22(3) + 22(1) + 22(5) + 22(6) + 22(7) **13b.** \$616 **13c.** If she continues to mow the same number of lawns, at the end of next week she will have the money. This may not be reasonable because not all the lawns she mowed this week may need to be mowed again next week. **15.** $24a + 9b$ **17.** $-16x + 22y$
19. Q, R **21.** Q, R **23.** Z, Q, R **25.** I, R **27.** Dist.
29. Inverse (×) **31.** −12.1; $\frac{1}{12.1}$
33. $-\frac{6}{13}, \frac{13}{6}$ **35.** $-\sqrt{15}; \frac{1}{\sqrt{15}}$ **37.** $12b + 6c$ **39.** $40x - 20y$
41. $28g - 48k$ **43.** 53(60 + 60); 53(60) + 53(60); 6360 yd^2
45a. \$13.50 **45b.** 3 **45c.** 4 times
47. $\frac{27}{5}c - \frac{199}{20}d$ **49.** $-42x - 72y - 30z$
51a. Sample answer:

irrational	rational	integer	whole	natural
$-\sqrt{6}$, π	3, $\frac{-15}{3}$, 4.1, 0, $\frac{3}{8}$, $\sqrt{36}$	3, $\frac{-15}{3}$, 0, $\sqrt{36}$	3, 0, $\sqrt{36}$	3, $\sqrt{36}$

51b. $-\sqrt{6} \approx -2.449$, $3 = 3.0$, $-\frac{15}{3} = -5$, $4.1 = 4.1$, $\pi \approx 3.14$, $0 = 0$, $\frac{3}{8} = 0.375$, $\sqrt{36} = 6$; $-\frac{15}{3}$, $-\sqrt{6}$, 0, $\frac{3}{8}$, 3, π, 4.1, $\sqrt{36}$

51c.



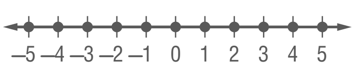
51d. Sample answer: By converting the real numbers into decimal form, they can be easily lined up and compared.
53. $\sqrt{81}$; It is a rational number, while the other three are irrational numbers. **55.** No; Luna did not distribute the negative sign to the second term and Sophia switched the a and b terms because usually a comes first. The correct answer is $32a - 46b$.
57. Sample answer: $\sqrt{5} \cdot \sqrt{5} = \sqrt{25}$ or 5, which is not irrational. **59.** Sample answer: (a) 3.2 and (b) $\sqrt{10}$ **61.** Sample answer: The Commutative Property does not hold for subtraction or division because order matters with these two operations. In addition or multiplication, the order does not matter.
For example, $2 + 4 = 4 + 2$ and $2 \cdot 4 = 4 \cdot 2$. However, with subtraction, $2 - 4 \neq 4 - 2$, and with division, $\frac{2}{4} \neq \frac{4}{2}$.

63. C **65.** B **67.** 24 **69.** about 2.66 m **71.** $3(3x^2 - x + 6)$
73. $10x(x - 2)$ **75.** $6(2x^2 - 3x - 4)$ **77.** $y^2 + y - 2$
79. $b^2 - 10b + 21$ **81.** $p^2 - 8p - 9$ **83.** $\frac{10}{9}$ **85.** 8
87. ≈ -1.176 **89.** -1.7

Lesson 1-3

1. $12\,[x + (-3)]$ **3.** The sum of five times a number and 7 equals 18. **5.** The difference between five times a number and the cube of that number is 12. **7.** Reflexive Property **9.** 53
11. -8 **13.** -6 **15.** 3 **17.** 4 **19.** $q = \frac{8r - 3}{5}$ **21.** B
23. $8x^2$ **25.** $\frac{x}{4} + 5$ **27.** The quotient of the sum of 3 and a number and 4 is 5. **29.** n = number of home runs Jacobs hit; $n + 6$ = number of home runs Cabrera hit; $2n + 6 = 46$; Jacobs: 20 home runs, Cabrera: 26 home runs.
31. Subst. **33.** Mult. (=) **35.** 5 **37.** -3 **39.** -6
41. -3 **43.** s = length of a side; $5s = 100$; 20 in. **45.** $m = \frac{E}{c^2}$
47. $h = \frac{z}{\pi q^3}$ **49.** $a = \frac{y - bx - c}{x^2}$ **51a.** $V = \pi \times r \times r \times h$
51b. $h = \frac{V}{\pi r^2}$ **53.** -2 **55.** -4 **57.** $-\frac{117}{11}$
59. x = the cost of rent each month; $622 + 428 + 240 + 144 + 12x = 10{,}734$; \$775 per month

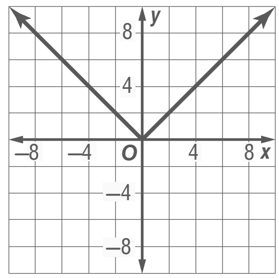
61a.



61b.

Integer	Distance from Zero
−5	5
−4	4
−3	3
−2	2
−1	1
0	0
1	1
2	2
3	3
4	4
5	5

61c.



61d. For positive integers, the distance from zero is the same as the integer. For negative integers, the distance is the integer with the opposite sign because distance is always positive
63. $y_1 = y_2 - \sqrt{d^2 - (x_2 - x_1)^2}$
65. Sample answer: $3(x - 4) = 3x + 5$; $2(3x - 1) = 6x - 2$
67. D **69.** A **71.** $-3x + 6y + 6z$
73. 605 ft **75.** $4\frac{1}{5}$ **77.** $2x$ **79.** $-3\frac{2}{3}$ **81.** $-5x$

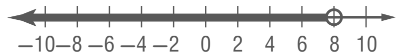
Lesson 1-4

1. 12 **3.** -108 **5a.** $|x - 78| = 2$ **5b.** least: 76°F, greatest: 80°F **5c.** 77°F; This would ensure a minimum temperature of 76°F. **7.** $\{15, -7\}$ **9.** $\varnothing$
11. $\left\{\frac{6}{5}, -\frac{4}{5}\right\}$ **13.** $\{2\}$ **15.** 25 **17.** 9.2 **19.** 49.2
21. -63 **23.** $\{34, -8\}$ **25.** $\{4, -14\}$ **27.** $\{-2, -10\}$
29. $\{2\}$ **31.** $\varnothing$ **33.** $\varnothing$ **35.** $|x - 5.67| = 0.02$; heaviest: 5.69 g; lightest: 5.65 g **37.** 28
39. $\left\{1, \frac{1}{5}\right\}$ **41.** $\left\{-\frac{1}{8}\right\}$
43. $|x - 100| = 245$; $x = 345$ or -145; maximum: 345 ft above sea level; minimum: 145 ft below sea level. No, the maximum is reasonable but the minimum is not. Florida's lowest point should be at sea level where Florida meets the Atlantic Ocean and the Gulf of Mexico. **45.** Ling; Ana included an extraneous solution. She would have caught this error if she had checked to see if her answers were correct by substituting the values into the original equation. **47.** Sometimes; this is only true for certain values of a. For example, it is true for $a = 8$; if $8 > 7$, then $11 > 10$. However it is not true for $a = -8$; if $8 > 7$, then $5 \not> 10$. **49.** Always; starting with numbers between 1 and 5 and subtracting 3 will produce numbers between -2 and 2. These all have an absolute value less than or equal to 2.

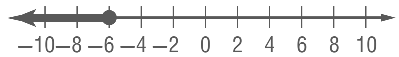
51. Sample answer: Symbols can be used as a shorthand way to represent ideas such as operations, equality, absolute value, and the empty set. For example, instead of writing 5 minus the absolute value of $2x$ equals 10, you could write $5 - |2x| = 10$.
53. 5/8 **55.** E **57.** -2 **59a.** \$6800 **59b.** \$535.83
59c. 1 mo **61.** Distributive **63.** $10x + 2y$ **65.** $11m + 10a$
67. $32c - 46d$ **69.** 2 **71.** -8 **73.** $-\frac{4}{7}$

Lesson 1-5

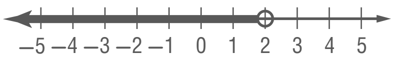
1. $b < 8$



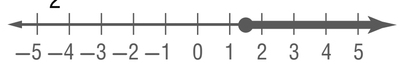
3. $x \leq -6$



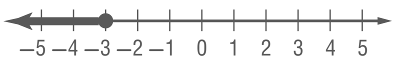
5. $w < 2$



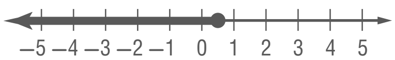
7. $s \geq \frac{3}{2}$



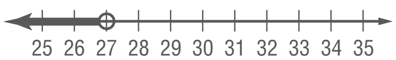
9. 40 bags
11. $n \leq -3$



13. $t \leq \frac{1}{2}$

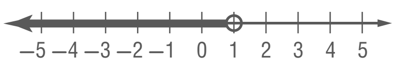


15. $k < 27$

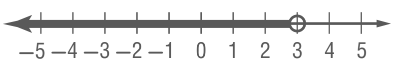


17. $z < 3$

19. $c < 1$

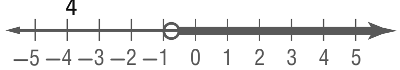


21. $z < 3$



23. $3x - 12 < 21$; $x < 11$ **25.** $5x - 6 > x$; $x > 1.5$
27. 8 hours

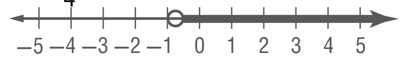
29. $x > -\frac{3}{4}$



31. $y > 18.75$

33. $v > -4.5$

35. $r > -\frac{3}{4}$

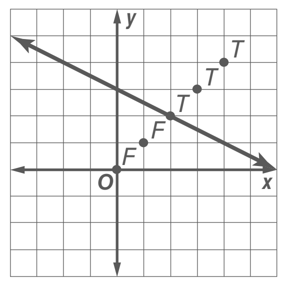


37a. $250 + 0.03(500a) \geq 700$
37b. ≥ 30; He must sell at least 30 advertisements.
39. $\frac{x}{3} + 4 \leq 2x + 12$; $x \geq -4.8$
41a. $3(5 + d) \geq 26.2$ **41b.** $d \geq 3.73$; In order to have enough endurance to run a marathon, Jamie should increase the distance of her average daily run by at least 3.73 miles.

43a.

Point	Resulting Statement	True or False
(0, 0)	$0 \geq 3$	False
(1, 1)	$1 \geq \frac{5}{2}$	False
(2, 2)	$2 \geq 2$	True
(3, 3)	$3 \geq \frac{3}{2}$	True
(4, 4)	$4 \geq 1$	True

43b. Sample answer:



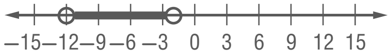
43c. Sample answer: The points on or above the line result in true statements, and the points below the line result in false statements. This is true for all points on the coordinate plane.
45. No; sample answer: Madlynn reversed the inequality symbol when she added 1 to each side. Emilie did not reverse the inequality symbol at all. **47.** Using the Triangle Inequality Theorem, we know that the sum of the lengths of any 2 sides of a triangle must be greater than the length of the remaining side. This generates 3 inequalities to examine.

$3x + 4 + 2x + 5 > 4x$, $x > -9$
$3x + 4 + 4x > 2x + 5$, $x > 0.2$
$2x + 5 + 4x > 3x + 4$, $x > -\frac{1}{3}$

49. Sample answer: When one number is greater than another number, it is either more positive or less negative than that number. When these numbers are multiplied by a negative value, their roles are reversed. That is, the number that was more positive is now more negative than the other number. Thus, it is now *less than* that number and the inequality symbol needs to be reversed.
51. A **53.** D **55.** $\left\{-\frac{1}{3}, 3\right\}$ **57.** $|t - 3647.5| = 891.5$
59a. $SA = 2\pi r(r + h)$ **59b.** 78π cm^2 **59c.** Sample answer: The formula in part b is quicker. **61.** $\{-9, 9\}$
63. $\left\{\frac{1}{2}, 7\right\}$ **65.** $\{-6, 2\}$

Lesson 1-6

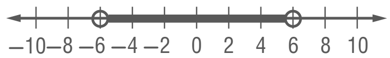
1. $\{g \mid -12 < g < -2\}$



3. $\{z \mid z > -3 \text{ or } z < -6\}$

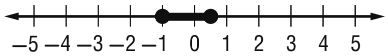
5. $\{c \mid c \geq 8 \text{ or } c \leq -8\}$

7. $\{z \mid -6 < z < 6\}$

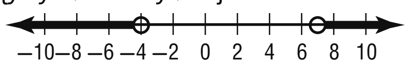


9. $\left\{v \mid v > 3 \text{ or } v < -\frac{19}{3}\right\}$

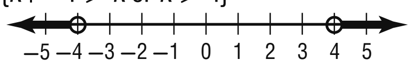
11. $43.96 \leq c \leq 77.94$; between \$43.96 and \$77.94
13. $\{d \mid -1 \leq d \leq 0.5\}$



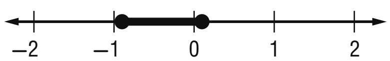
15. $\{y \mid y < -4 \text{ or } y > 7\}$



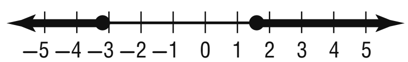
17. $\{k \mid -4 > k \text{ or } k > 4\}$



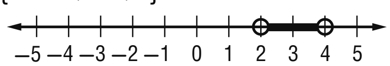
19. $\left\{t \,\middle|\, -\frac{7}{8} \leq t \leq \frac{1}{8}\right\}$



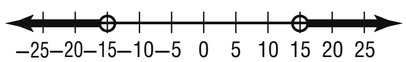
21. $\left\{j \,\middle|\, j \geq \frac{8}{5} \text{ or } j \leq -\frac{16}{5}\right\}$



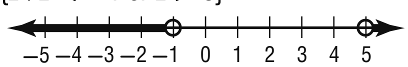
23. $|x - 1| \leq 5$ **25.** $|x + 9| \leq 3$ **27.** $|x - 2| \geq 10$
29. $|x + 3| > 1$ **31.** $55 \leq w \leq 70$
33. $\{k \mid 2 < k < 4\}$



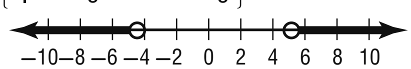
35. $\{h \mid h < -15 \text{ or } h > 15\}$



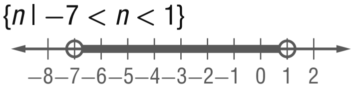
37. $\{z \mid z < -1 \text{ or } z > 5\}$



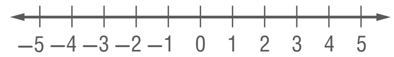
39. $\left\{f \,\middle|\, f > \frac{26}{5} \text{ or } f < -\frac{22}{5}\right\}$



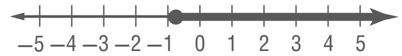
41. $|x + 5| \geq 4$ **43.** $6 \leq |x - 2| \leq 10$
45. $\{n \mid -7 < n < 1\}$



47. $\varnothing$



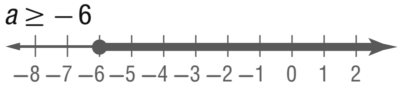
49. $\left\{g \,\middle|\, g \geq -\frac{2}{3}\right\}$



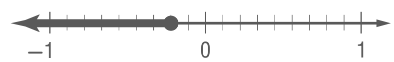
51. $|s - 88| > 38$; $\{s \mid s > 126 \text{ or } s < 50\}$
53. Sample answer: David; when Sarah converted the absolute value into two inequalities, she mistakenly switched the inequality symbols. **55.** False; sample answer: the graph of $x > 2$ and $x > 5$ is a ray bounded only on one end. **57.** true **59.** Sample answer: The graph on the left indicates a solution set from −3 to 5. The graph on the right indicates a solution set of all numbers less than or equal to -3 or greater than or equal to 5. **61.** Each of these has a non-empty solution set except for $x > 5$ and $x < 1$. There are no values of x that are simultaneously greater than 5 and less than 1. **63.** C **65.** 60 **67a.** $750 \leq x \leq 990$
67b. 110 g **69.** $\{0, 10\}$ **71.** $\varnothing$ **73.** Transitive (=)

Chapter 1 Study Guide and Review

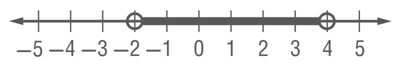
1. false; nonnegative **3.** true **5.** true **7.** false; or **9.** true **11.** 3 **13.** 10 **15.** 21 **17.** ≈ 169.65 in^3
19. N, W, Z, Q, R **21.** $11x + 2y$ **23.** $5m + 41n$ **25.** −7 **27.** $\frac{3}{2}$
29. \$8 **31.** $m = \frac{r + 5}{pn}$ **33.** 8 in. **35.** $\{2, 10\}$ **37.** $\{14\}$
39. $a \geq -6$



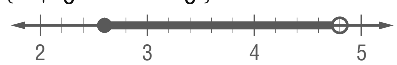
41. $x \leq -\frac{2}{9}$



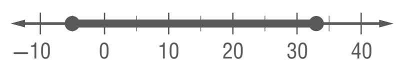
43. 3 or fewer slices each
45. $\{x \mid -2 < x < 4\}$



47. $\left\{m \,\middle|\, \frac{13}{5} \leq m < \frac{24}{5}\right\}$



49. $\{p \mid -5 \leq p \leq 33\}$



51. $\varnothing$

53. $20 \leq 2.50(3) + 1.25b \leq 30$; $10 \leq b \leq 18$

CHAPTER 02

Linear Relations and Functions

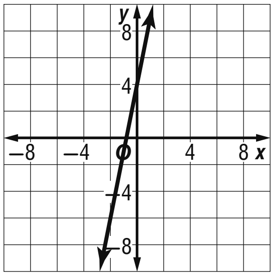
Chapter 2 Get Ready

1. (4, 1); I **3.** (0, 0); origin **5.** (−4, −4); III **7.** −15 **9.** 10
11. \$40 **13.** $b = \frac{a}{3} - 3$ **15.** $x = \frac{8}{3} + \frac{4}{3}y$

Lesson 2-1

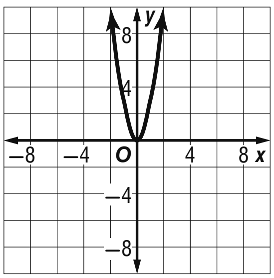
1. D = {−2, 5, 6}, R = {−8, 1, 3}; function; both
3. D = {−2, 1, 4, 8}, R = {−4, −2, 6}; function; onto

5.



D = {all real numbers}; R = {all real numbers}; function; both; continuous

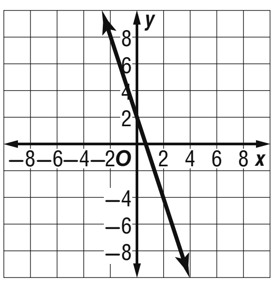
7.



D = {all real numbers}; R = $\{y \mid y \geq 0\}$; function; neither; continuous

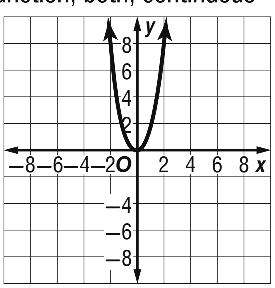
9. 4 **11.** D = {−0.3, 0.4, 1.2}, R = {−6, −3, −1, 4}; not a function **13.** D = {−3, −1, 3, 5}; R = {−4, 0, 3}; function; onto

15.



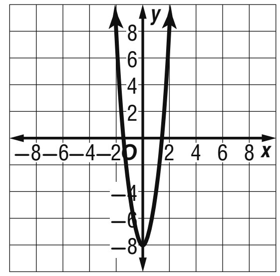
D = {all real numbers}; R = {all real numbers}; function; both; continuous

17.



D = {all real numbers}; R = $\{y \mid y \geq 0\}$; function; neither; continuous

19.

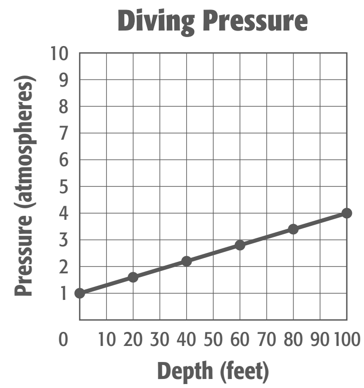


D = {all real numbers}; R = $\{y \mid y \geq -8\}$; function; neither; continuous

21. −2559

23a. {(0, 1), (20, 1.6), (40, 2.2), (60, 2.8), (80, 3.4), (100, 4)}

23b.



23c. D = $\{x \mid x \geq 0\}$; R = $\{y \mid y \geq 1\}$; continuous

23d. Yes; each domain value is paired with only one range value so the relation is a function.

25. 29 **27.** −72 **29.** −267 **31.** −4.5 **33.** 39

35. Sample answer: Omar; Madison did not square the 3 before multiplying by −4. **37.** Never; if the graph crosses the *y*—axis twice, then there will be two separate *y*—values that correspond to $x = 0$, which violates the vertical line test. **39.** Sample answer: False; a function is onto and not one—to—one if all of the elements of the domain correspond to an element of the range, but more than one element of the domain corresponds to the same element of the range. **41.** A **43.** J **45.** $6 > y > 2$

47. $x > \frac{7}{4}$ or $x < -\frac{11}{4}$

49. $15x \leq 120$; She can buy up to 8 shirts. **51.** $\frac{3}{4}$ or $\frac{7}{4}$

53. $33a$ **55.** $10c + 36d$ **57.** 4 **59.** −4 **61.** −4 **63.** −6

Lesson 2-2

1. Yes; it can be written as $f(x) = \frac{x}{5} + \frac{12}{5}$.

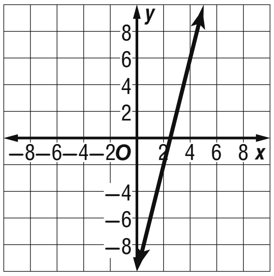
3. No; x has an exponent that is not 1. **5a.** 3 hours **5b.** 8 CDs

7. $6x - y = -5$; $A = 6$, $B = -1$, $C = -5$

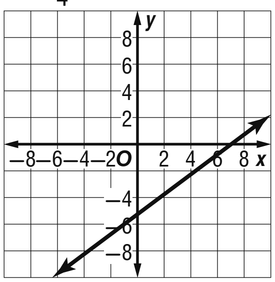
9. $8x + 9y = 6$; $A = 8$, $B = 9$, $C = 6$

11. $2x - 3y = 12$; $A = 2$, $B = -3$, $C = 12$

13. $\frac{5}{2}$; −10

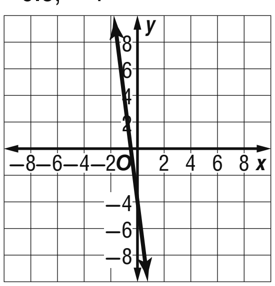


15. 7; $-\frac{21}{4}$

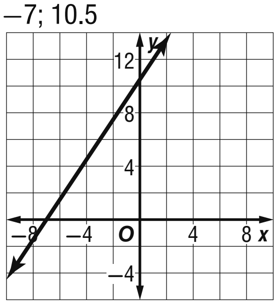


17. No; x has an exponent other than 1 **19.** No; x has an exponent other than 1 **21.** No; it cannot be written in $f(x) = mx + b$ form. **23.** No; it cannot be written in $f(x) = mx + b$ form; There is an xy term. **25a.** 260 m **25b.** Kingda Ka; Sample answer: The Kingda Ka travels 847.5 meters in 25 seconds, so it travels a greater distance in the same amount of time. **27.** $8x + 3y = -6$; $A = 8$, $B = 3$, $C = -6$ **29.** $2x + y = -11$; $A = 2$, $B = 1$, $C = -11$ **31.** $6x + y = 0$; $A = 6$, $B = 1$, $C = 0$ **33.** $5x + 32y = 160$; $A = 5$, $B = 32$, $C = 160$

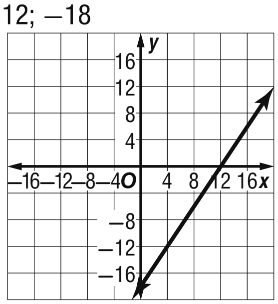
35. −0.5; −4



37. −7; 10.5

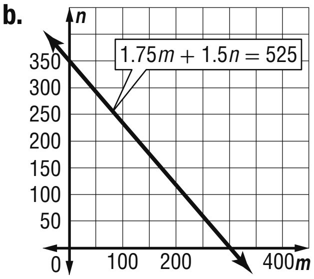


39. 12; −18



41a. 1.75m + 1.5n = 525

41b.



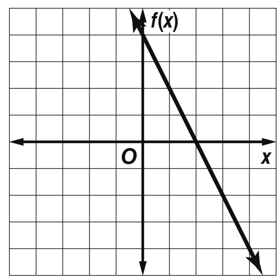
Yes; the graph passes the vertical line test.

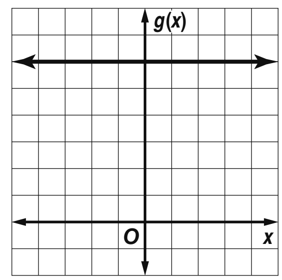
41c. No; the amount that Latonya will sell is 1.75 • 100 + 1.5 • 200, which is $475. **43a.** $y = 3x + 13$ **43b.** $31

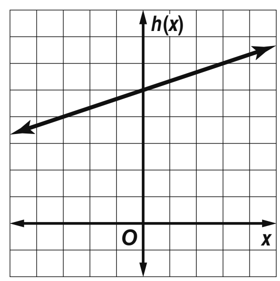
45. $4x - 40y = -59$; $A = 4$, $B = -40$, $C = -59$

47. −10.5; 5.25 **49.** $-1\frac{1}{75}$; $6\frac{1}{3}$

51a.







51b.

Function	One-to-One	Onto
$f(x) = -2x + 4$	yes	yes
$g(x) = 6$	no	no
$h(x) = \frac{1}{3}x + 5$	yes	yes

51c. No; horizontal lines are neither one—to—one nor onto because only one y—value is used and it is repeated for every x—value. Every other linear function is one—to—one and onto because every x—value has one unique y—value that is not used by any other x—element and every possible y—value is used.

53. Sample answer: $f(x) = 2(x - 3)$

55. $y = 2xy$; Sample answer: $y = 2xy$ is not a linear function.

57. C **59.** J **61.** D = {−4, −1, 8}, R = {3, 6, 9}; not a function **63.** D = {−4, −3, 7}, R = {−2, −1, 9}; function; both **65.** 0.78

67. $-\frac{7}{12}$ **69.** $\frac{2}{3}$ **71.** $-\frac{5}{4}$ **73.** $-\frac{1}{3}$ **75.** 9

Lesson 2-3

1. 6 feet/min **3a.** about 11,000 per year **3b.** about −5000 per year **3c.** The positive rate in part a represents an increase in sales of digital cameras. The negative rate in part b represents a decrease in sales of film cameras. **5.** −3 **7.** $\frac{3}{5}$

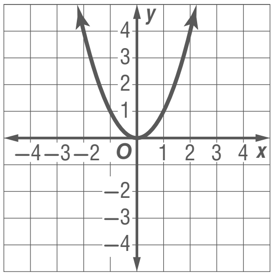
9. $\frac{20}{3}$ mm/day **11a.** 0.15°/h **11b.** −0.125°/h; Yes; the number should be negative because her temperature is dropping.

11c. Tuesday 8:00 a.m.–Tuesday 8:00 p.m. **13.** $\frac{14}{15}$

15. −2 **17.** $\frac{5}{3}$ **19.** 5 **21.** −0.8 **23.** $\frac{4}{3}$ **25.** 3

27. 6/5 **29.** about 3.2 **31.** 9 **33.** 5

35a.



35b.

x	−4	−3	−2	−1	0	1	2	3	4
$f(x)$	16	9	4	1	0	1	4	9	16
slope		−7	−5	−3	−1	1	3	5	7

35c. Sample answer: The rate of change is not constant. The rate of change increases as x approaches infinity.

37. Sample answer: Because the slope from (2, 3) to (5, 8) is the same as the slope from (5, 8) to (11, y), find the slope between each pair of points and set them equal to each other. Then solve for y.

$$\frac{8-3}{5-2} = \frac{y-8}{11-5}$$
$$\frac{5}{3} = \frac{y-8}{6}$$
$$30 = 3(y-8)$$
$$10 = y-8$$
$$18 = y$$

39. Sometimes; the slope of a vertical line is undefined.

41. 3/2 or 1.5 **43.** H **45.** Yes; it can be written in $f(x) = mx + b$ form. **47.** No; it cannot be written in $f(x) = mx + b$ form.

49. −46 **51.** 336 **53.** II **55.** 3.5 **57.** $\frac{7}{3}$

Lesson 2-4

1. $y = 1.5x + 5$ **3.** $y = -2x + 11$ **5.** A **7.** $y = \frac{7}{8}x - \frac{27}{2}$

9. $y = -\frac{1}{2}x + 5$ **11.** $y = 4.5x - 6.5$ **13.** $y = 4x - 15$

15. $y = -\frac{1}{4}x - 1$ **17.** $y = 2x - 2$ **19.** $y = -8x - 20$

21. $y = -0.5x + 3.35$ **23.** $y = \frac{1}{2}x$ **25.** $y = -\frac{1}{2}x + 6$

27. $y = 180x + 5900$ **29.** $y = -25x + 300$

31. $y = \frac{2}{3}x + 6$ **33.** 10 mi **35a.** $y = 5x + 50$

35b. \$50 **35c.** \$150 **37.** Sample answer: Sometimes; while the two sets of parallel and perpendicular lines will always form a quadrilateral with four 90º angles, that figure will always be a rectangle, but not necessarily a square.

39. Sample answer: $y - 0 = a\left(x + \frac{b}{a}\right)$

41. Sample answer: $y - d = -\frac{d}{c}(x - 0)$

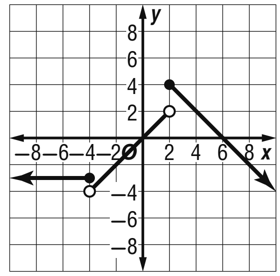
43. 8.75 in., 17.5 in., 26.25 in. **43.** A **45.** G **47.** $-\frac{5}{3}$ **49.** $\frac{1}{5}$

51. $x \geq -4$ **53.** $x \geq -\frac{21}{13}$ **55.** yes **57.** $8c^2 + 8c - 30$

59. $-6a^2 + 7a + 20$ **61.** $\frac{3}{2}$ **63.** $\frac{1}{5}$ **65.** $-\frac{1}{9}$

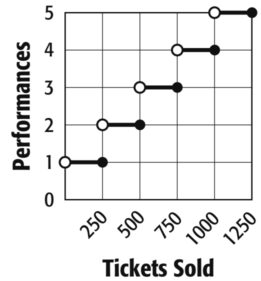
Lesson 2-5

1. D = {all real numbers}; R = $\{y \mid y \leq 4\}$

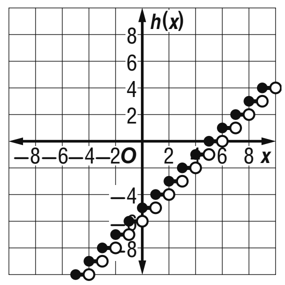


3. $g(x) = \begin{cases} x + 4 & \text{if } x < -2 \\ -3 & \text{if } -2 \leq x \leq 3 \\ -2x + 12 & \text{if } x > 3 \end{cases}$

5.

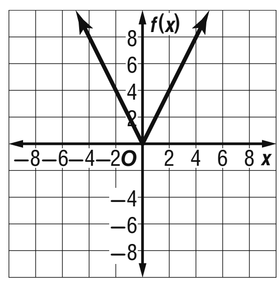


7.



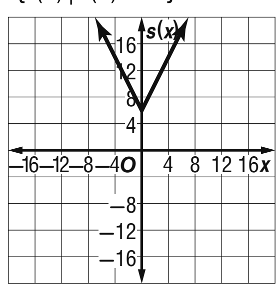
D = {all real numbers};
R = {all integers}

9.



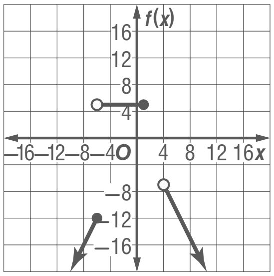
D = {all real numbers}
R = $\{f(x) \mid f(x) \geq 0\}$

11.



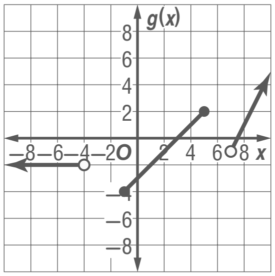
D = {all real numbers}
R = $\{s(x) \mid s(x) \geq 6\}$

13.



$D = \{x \mid x \leq 2 \text{ or } x > 4\}$;
$R = \{f(x) \mid f(x) < -7, \text{ or } f(x) = 5\}$

15.

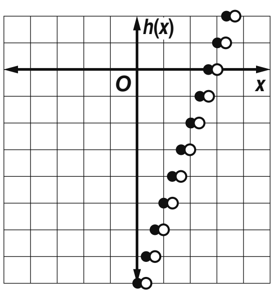


$D = \{x \mid x < -4, -1 \leq x \leq 5, \text{ or } x > 7\}$;
$R = \{g(x) \mid g(x) \geq -4\}$

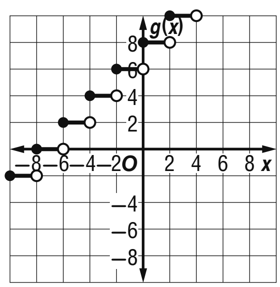
17. $g(x) = \begin{cases} -x - 4 & \text{if } x < -3 \\ x + 1 & \text{if } -3 \leq x \leq 1 \\ -6 & \text{if } x > 4 \end{cases}$

19. $g(x) = \begin{cases} 8 & \text{if } x \leq -1 \\ 2x & \text{if } 4 \leq x \leq 6 \\ 2x - 15 & \text{if } x > 7 \end{cases}$

21.

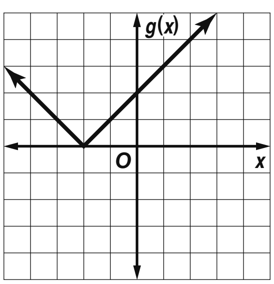


23.

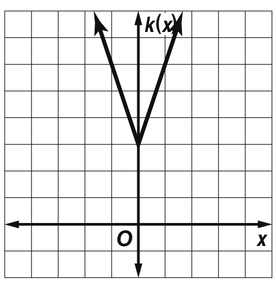


D = {all real numbers}; D = {all real numbers};
R = {all integers} R = {all even integers}

25.

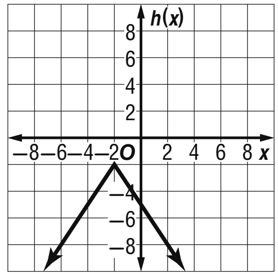


27.



D = {all real numbers}; D = {all real numbers};
$R = \{g(x) \mid g(x) \geq 0\}$ $R = \{k(x) \mid k(x) \geq 3\}$

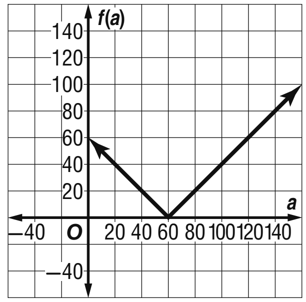
29.



D = {all real numbers} $R = \{h(x) \mid h(x) \leq -2\}$

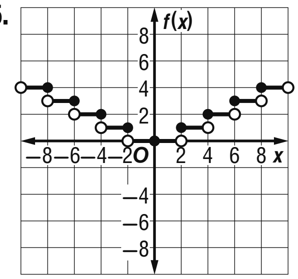
31a. $f(a) = |a - 60|$ **31b.** $\{a \mid a \geq 0\}$

31c.



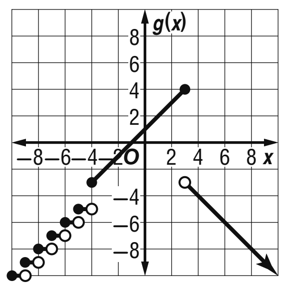
33. $f(x) = |0.5x|$

35.



D = {all real numbers}; R = {all whole numbers}

37.



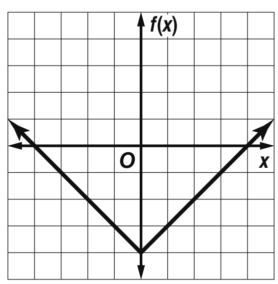
D = {all real numbers}; $R = \{g(x) \mid g(x) \leq 4\}$

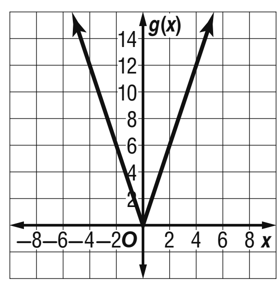
39a.

x	−4	−3	−2	−1	0	1	2	3	4
$f(x)$	0	−1	−2	−3	−4	−3	−2	−1	0

x	−4	−3	−2	−1	0	1	2	3	4
$g(x)$	12	9	6	3	0	3	6	9	12

39b.





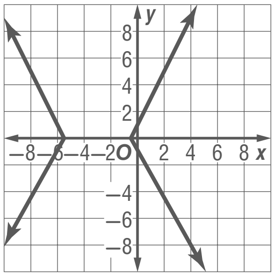
39c.

x	−4	−3	−2	−1	0	1	2	3	4
f(x)	0	−1	−2	−3	−4	−3	−2	−1	0
slope		−1	−1	−1	−1	1	1	1	1

x	−4	−3	−2	−1	0	1	2	3	4
g(x)	12	9	6	3	0	3	6	9	12
slope		−3	−3	−3	−3	3	3	3	3

39d. The two sections of an absolute value graph have opposite slopes. The slope is constant for each section of the graph.

41.

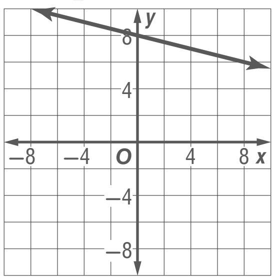


43. Sample answer: $f(x) = -|x - 2|$ **45.** $3n + 1$ **47.** J

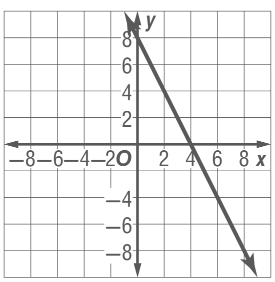
49. $350{,}349 - x = 15{,}991$; 334,358

51. $y = -\frac{3}{2}x + 6$ **53.** $-8c + 6$ **55.** -99

57.



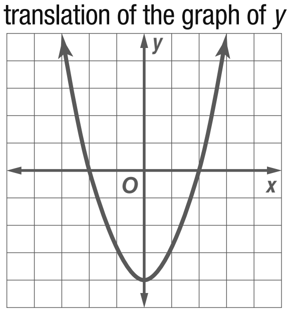
59.



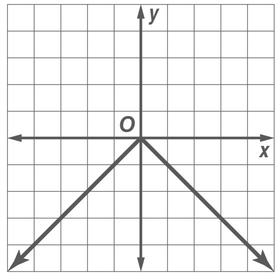
Lesson 2-6

1. linear

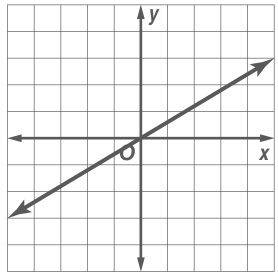
3. translation of the graph of $y = x^2$ down 4 units



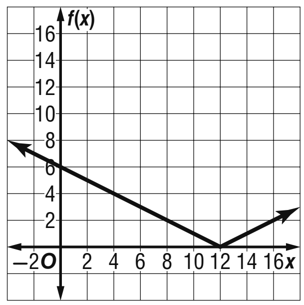
5. reflection of the graph of $y = |x|$ across the x-axis



7. A vertical compression of the graph of $y = x$; the slope is not as steep as that of $y = x$.

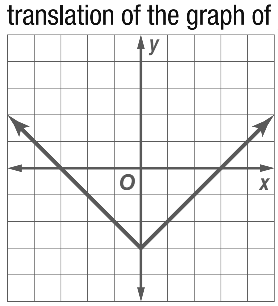


9. The function is a dilation and translation. The graph of $f(x) = \frac{1}{2}|x - 12|$ compresses the graph $f(x) = |x|$ vertically and translates it 12 units to the right.

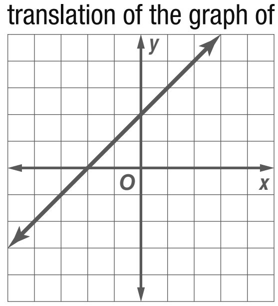


11. quadratic **13.** linear

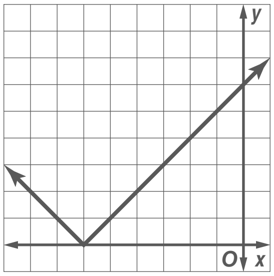
15. translation of the graph of $y = |x|$ down 3 units



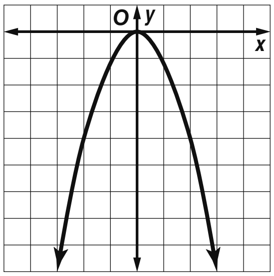
17. translation of the graph of $y = x$ up 2 units or left 2 units



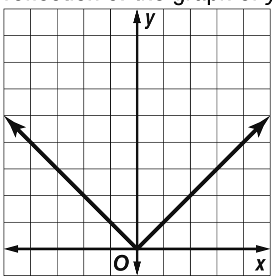
19. translation of the graph of $y = |x|$ left 6 units



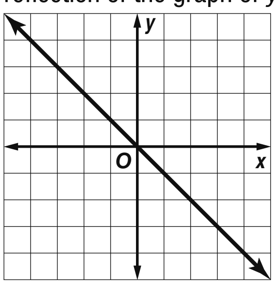
21. reflection of the graph of $y = x^2$ across the x-axis



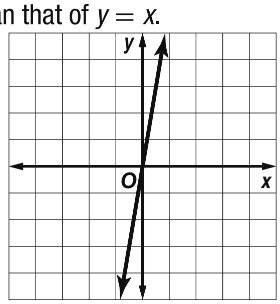
23. reflection of the graph of $y = |x|$ across the y-axis



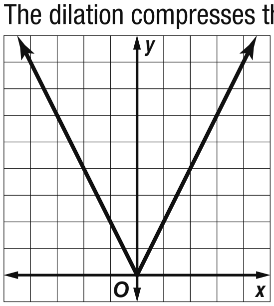
25. reflection of the graph of $y = x$ across the y-axis



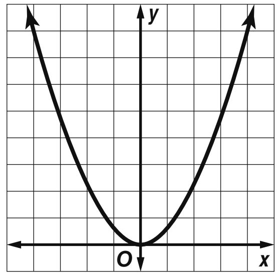
27. vertical expansion of the graph of $y = x$; The slope is steeper than that of $y = x$.



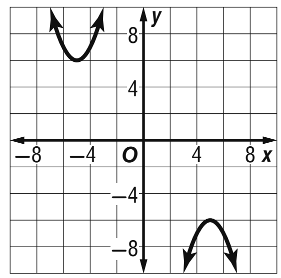
29. The dilation compresses the graph of $y = |x|$ horizontally



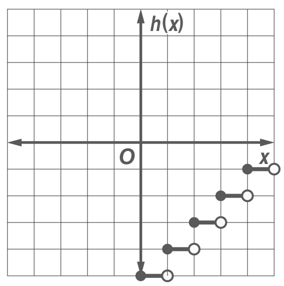
31. vertical compression of the graph of $y = x^2$



33. $y = x^2 + 1$ **35.** $y = x - 5$ **37.** $y = (x - 2)^2$
39. Blue: $y = x + 4$; red: $y = x + 2$; the red line is a translation of the blue line 2 units down. **43.** $y = (x + 4)^2 - 6$
43. Sample answer: Since a vertical translation concerns only y-values and a horizontal translation concerns only x-values, order is irrelevant.
45. Sample graph:



Sample answer: The figure in Quadrant II has been reflected and moved right 10 units.
47. Sample answer: It is not always true. When the axis of symmetry of the parabola is not along the y-axis, the graphs of the preimage and image will be different. **49.** G **51.** A
53.

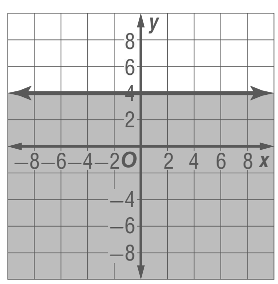


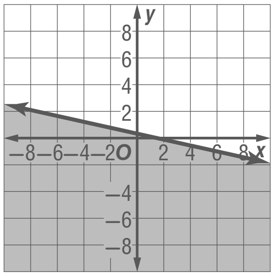
D = {all real numbers} R = {all integers}

55. $-8 \leq x \leq 2$ **57.** $x < -4$ or $x > 10$ **59.** no **61.** yes
63. 10

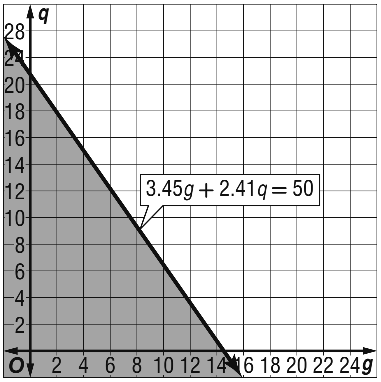
Lesson 2-7

1.

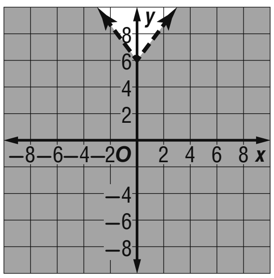


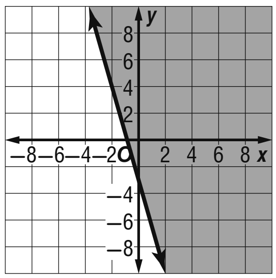
3.


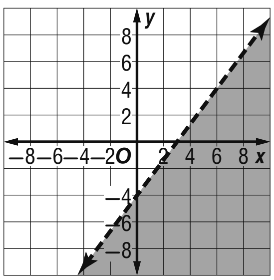
5a. $3.45g + 2.41q \leq 50$

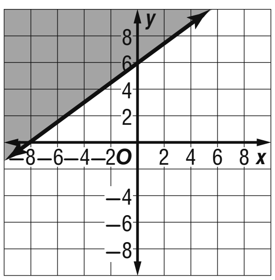
5b.


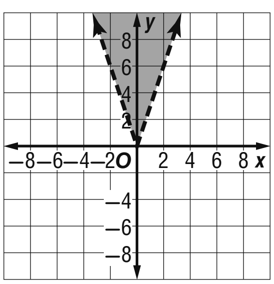
5c. No; (10, 8) is not in the shaded region.

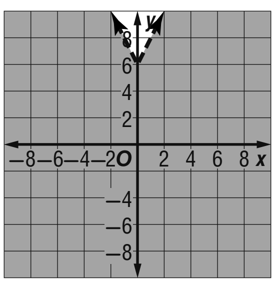
7.


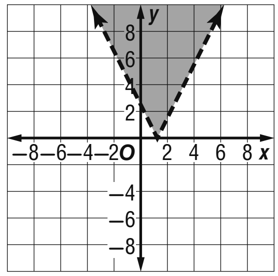
9.


11.


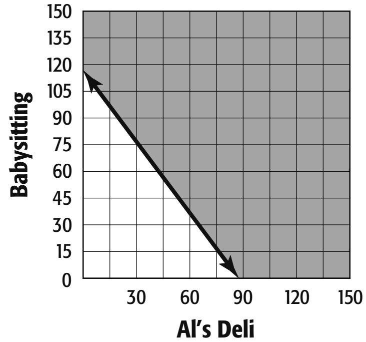
13.


15.


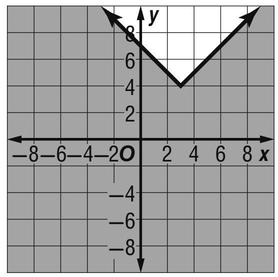
17.


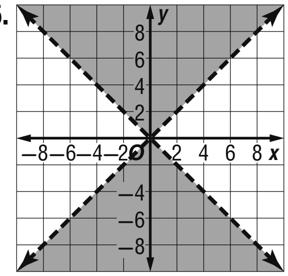
19.


21a. $8a + 6b \geq 700$

21b.


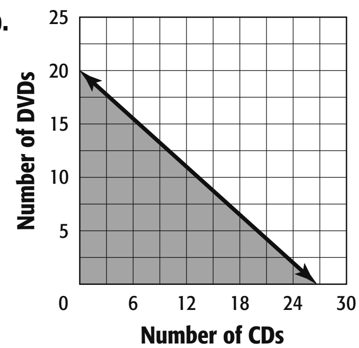
21c. yes

23.


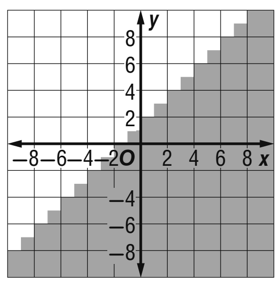
25.


27. ordered pairs of all real numbers (The graph would be shaded everywhere.)

29a. $20d + 15c \leq 400$

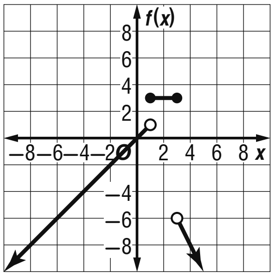
29b.


29c. Sample answer: 18 CDs and 5 DVDs, 12 CDs and 10 DVDs, or 6 CDs and 15 DVDs

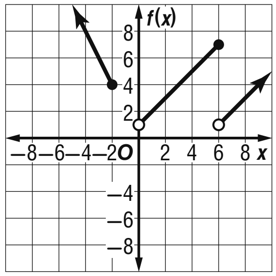
31.


33. Sample answer: $|y| < x$ **35.** Paulo; $x - y \geq 2$ can be written as $y \leq x - 2$. **37.** Sample answer: One possibility is when $|y| < 0$. In order for there to be a solution, the absolute value of y will need to be less than 0, and, by definition of absolute value, this is impossible. **39.** C **41.** K **43.** $y = |x + 4| - 5$

45.



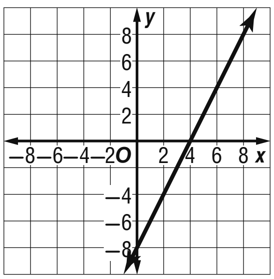
47.



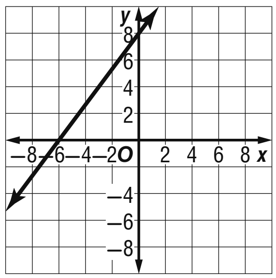
49. $4x - 15y = 6$; $A = 4$, $B = -15$, $C = 6$ **51.** 1000

53. $-6x^2 - 23x - 15$

55.



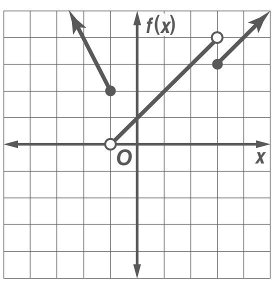
57.



Chapter 2 Study Guide Review

1. one-to-one **3.** identity **5.** piecewise-defined
7. D = {1, 3, 5, 7}, R = {2, 4, 6, 8}; a function; both
9. D = {-4, -2, 1, 3}, R = {-4, 1, 3, 5}; not a function
11. 11 **13.** $-3y + 2$ **15.** $-6w + 2$ **17.** yes
19. No; x^3 has an exponent other than 1. **21.** yes **23.** 2, 5, 10
25. $3x + 4y = 24$; 3, 4, 24 **27.** 520 miles **29.** -2 **31.** 2
33. $y = \frac{2}{3}x - \frac{11}{3}$ **35.** $y = 5$ **37.** $y = \frac{3}{5}x + \frac{22}{5}$
39. $y = -\frac{3}{2}x + \frac{1}{2}$

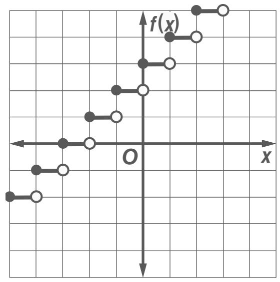
41.



D = {all real numbers}; R = $\{f(x) \mid f(x) > 0\}$

43. $$f(x) = \begin{cases} x - 1 & \text{if } x \leq -2 \\ -2x & \text{if } -2 < x < 1 \\ 3 & \text{if } x \geq 1 \end{cases}$$

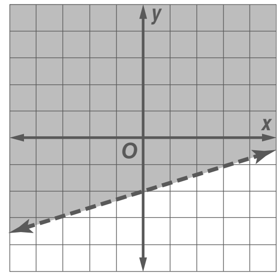
45.



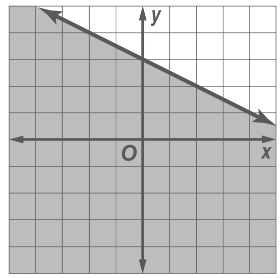
D = {all real numbers}; R = {all integers}

47. absolute value **49.** $y = x^2$ reflected over the x-axis

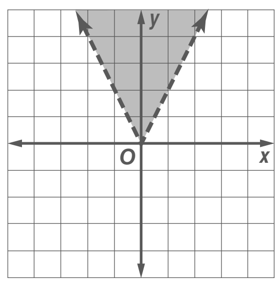
51.



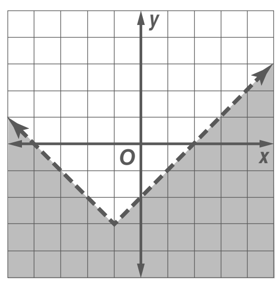
53.



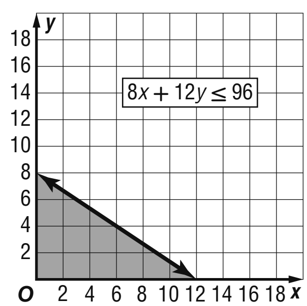
55.



57.



59. $8x + 12y \leq 96$

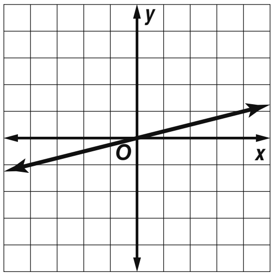


CHAPTER 3

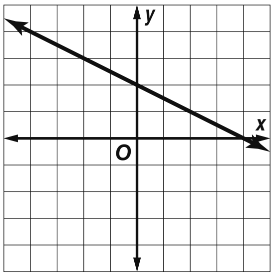
Systems of Equations and Inequalities

Chapter 3 Get Ready

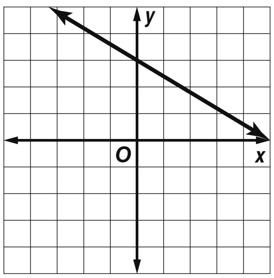
1.



3.

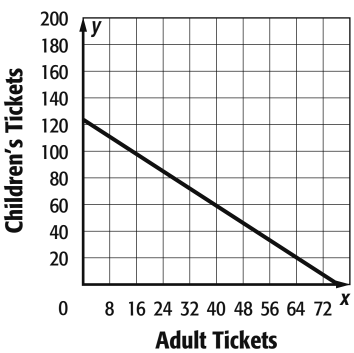


5.

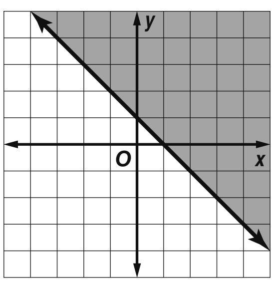


7a. $8.50a + 5.25c = 650$

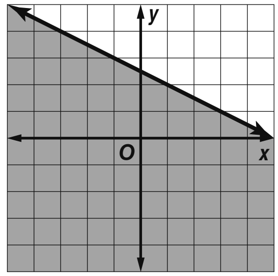
7b.



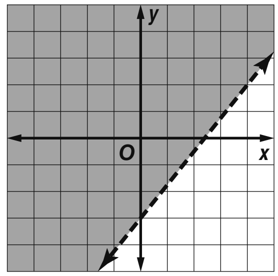
9.



11.



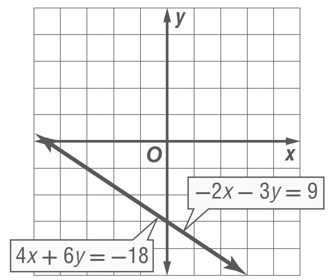
13.



Lesson 3–1

1. (3, 5) **3.** (3, −3) **5.** (6, 7) **7.** (−4, −5)
9a. $y = 0.15x + 2.70$, $y = 0.25x$ **9b.** $6.75 for 27 photos
9c. You should use EZ Online Digital Photos if you are printing more than 27 digital photos, and the local pharmacy if you are printing fewer than 27 photos.

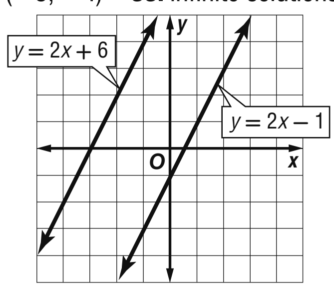
11.



consistent, dependent

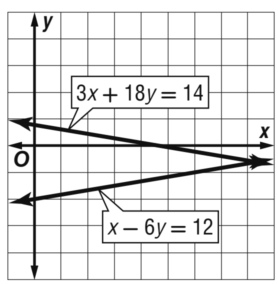
13. (−2, 1) **15.** (4, −2) **17.** (5, 1) **19.** (−2, 7) **21.** (−4, −3)
23. no solution **25.** B **27.** (4, −1) **29.** 250 T–shirts
31. (−3, −4) **33.** infinite solutions **35.** (−1.5, −2)

37.



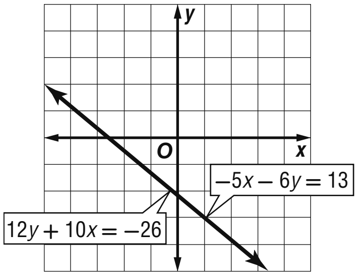
inconsistent

39.



consistent and independent

41.



consistent and dependentt

43. infinite solutions **45.** (8, 4) **47.** (−3, −1)

49a. $x + y = 13$ and $4x + 2y = 38$

49b. 6 doubles matches and 7 singles matches

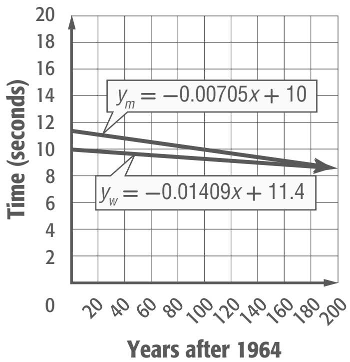
51. (0, 4) **53.** no solution **55.** (8, −6) **57.** (5, 4)

59. (2.07, −0.39) **61.** (15.03, 10.98) **63.** (−5, 4)

65. infinite solutions **67.** (16, −8)

69a. Sample answer for men using (0, 10) and (44, 9.69): $y_m = -0.00705x + 10$; sample answer for women using (0, 11.4) and (44, 10.78): $y_w = -0.01409x + 11.4$

69b.



Based on these data, the women's performance will catch up to the men's performance 198 years after 1964, or in the year 2162. The next Olympic year would be 2164; this prediction is not reasonable. It is unlikely that women's times will ever catch up to men's times because the times cannot continue to increase and decrease infinitely.

71. adult: $16; student: $9

73. $\left(\frac{53}{13}, \frac{153}{26}\right)$

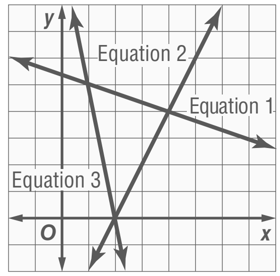
75a.

Equation 1		Equation 2	
x	*y*	*x*	*y*
0	$\frac{16}{3}$	0	−4
1	5	1	−2
2	$\frac{14}{3}$	2	0
3	$\frac{13}{3}$	3	2
4	4	4	4

Equation 3	
x	*y*
0	10
1	5
2	0
3	−5
4	−10

75b. Equations 1 and 2 intersect at (4, 4), equations 2 and 3 intersect at (2, 0), and equations 1 and 3 intersect at (1, 5); there is no solution that satisfies all three equations.

75c.



75d. If all three lines intersect at the same point, then the system has a solution. The system has no solution if the lines intersect at 3 different points, or if two or three lines are parallel.

77. $a \neq 0$, $b = \pm 3$

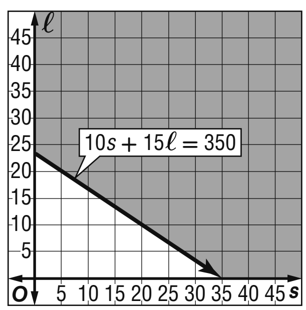
79. Sample answer:

$4x + 5y = 21$ → $3(4x + 5y = 21)$ →
$3x - 2y = 10$ → $4(3x - 2y = 10)$

$12x + 15y = 63$
$(-)\ 12x - 8y = 40$
$23y = 23$
$y = 1$
$4x + 5(1) = 21$
$4x + 5 = 21$
$4x = 16$
$x = 4$ The solution is (4, 1).

81. $12xy + 18y^2 - 15y$ **83.** J **85a.** $10s + 15\ell \geq 350$

85b.

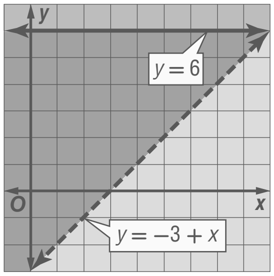


85c. no **87.** $y = -|x - 3|$ **89.** 7 **91.** 3.2

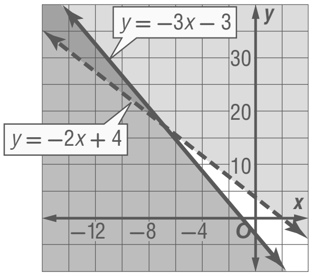
93. −8 **95.** yes **97.** no

Lesson 3–2

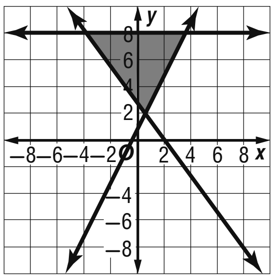
1.



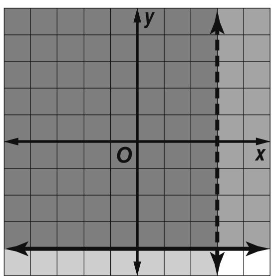
3.



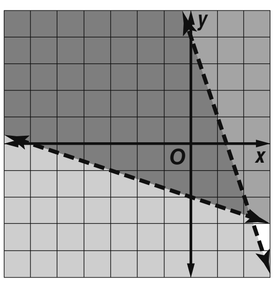
5.



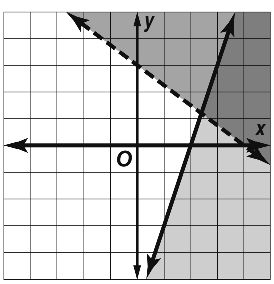
7.



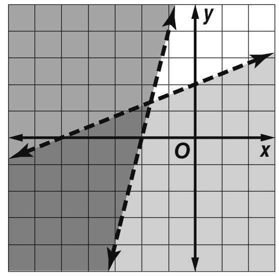
9.



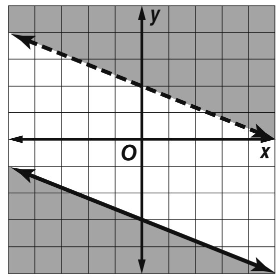
11.



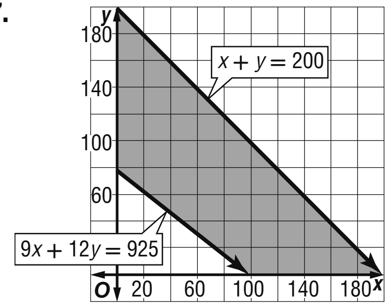
13.



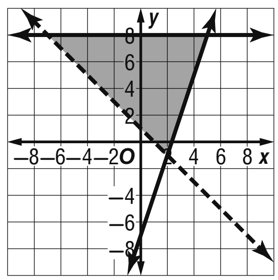
15.



17.

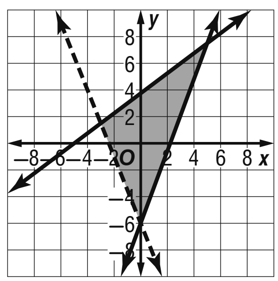


19.



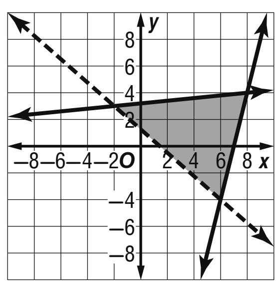
(2, −1), (5, 8), (−7, 8)

21.



(−3, 1.5), (5, 7.5), (0, −6)

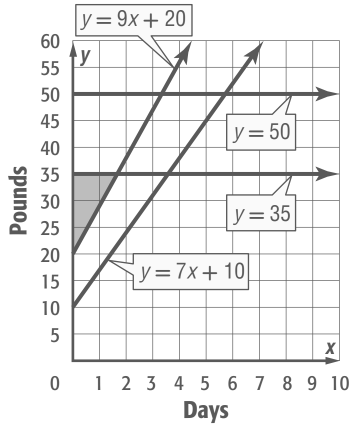
23.



(8, 4), (6, −4), (−2, 3)

25. maximum = \$110, minimum = \$80

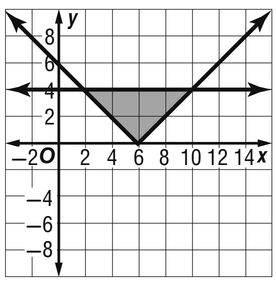
27a.



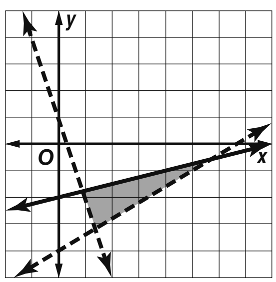
27b. $3\frac{1}{3}$ days

27c. Marc; Jessica could last about a quarter of a day longer than Marc.

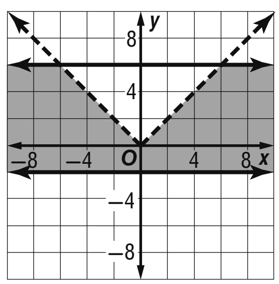
29.



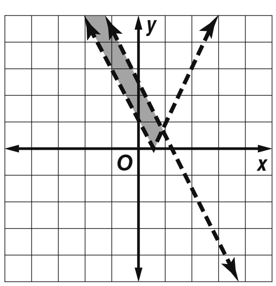
31.



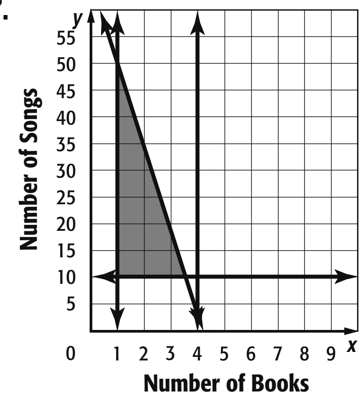
33.



35.



37.

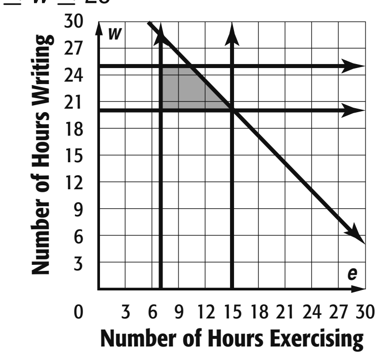


39. Let w = the number of hours writing, and let e = the number of hours exercising.

$w + e \leq 35$

$7 \leq e \leq 15$

$20 \leq w \leq 25$



41. $(-6, -2)$, $\left(-3\frac{13}{17}, 6\frac{16}{17}\right)$, $\left(9\frac{1}{7}, 3\frac{5}{7}\right)$, $(0.8, -8.8)$

43. \$3500

45. 75 units^2

47. Sample answer:

$y \geq 2x - 6$,

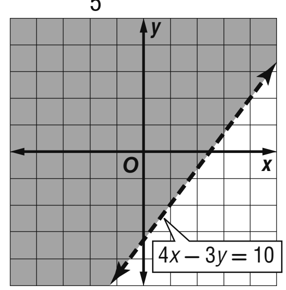
$y \leq -0.5x + 4$,

$y \geq -3x - 6$; 47

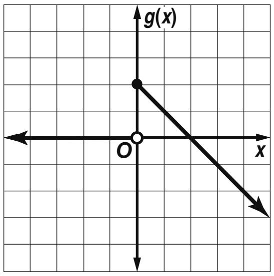
49. Sample answer: Shade each inequality in its standard way, by shading above the line if $y >$ and shading below the line if $y <$ (or you can use test points). Once you determine where to shade for each inequality, the area where every inequality needs to be shaded is the actual solution. This is only the shaded area.

51. A **53.** $\frac{4}{5}z$ **55.** (1.5, 3), (3.5, 7), (8, 3), (10, 7)

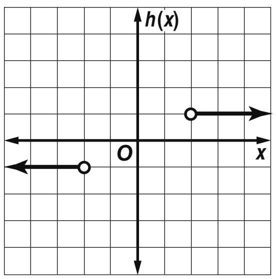
57.



59. D = {all real numbers},
R = $\{g(x) \mid g(x) \le 2\}$



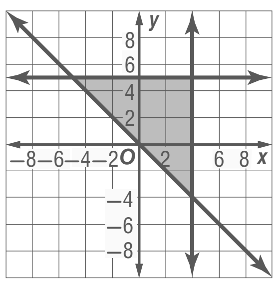
61. D = $\{x \mid x < -2 \text{ or } x > 2\}$, R = {−1, 1}



63. −1 **65.** 3 **67.** 4.5

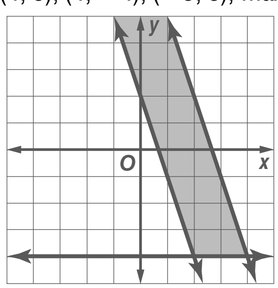
Lesson 3–3

1.



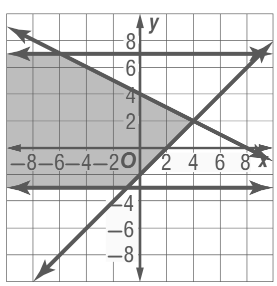
(4, 5), (4, −4), (−5, 5); max = 28, min = −35

3.



(2, −4), (4, −4); max does not exist, min = −52

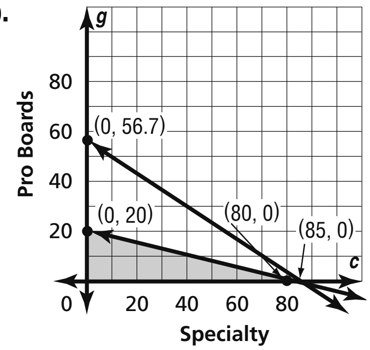
5.



(4, 2), (−1, −3), (−6, 7); max does not exist; min = −30

7a. $g \ge 0$, $c \ge 0$, $1.5g + c \le 85$, $2g + 0.5c \le 40$

7b.

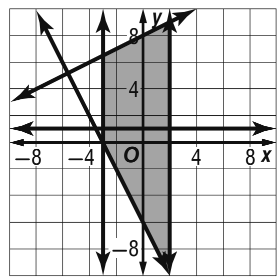


7c. (0, 0), (0, 20), (80, 0)

7d. $f(c, g) = 65c + 50g$

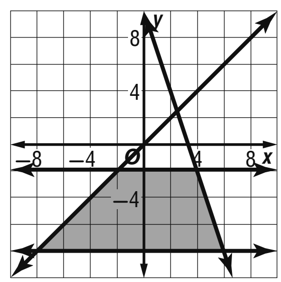
7e. 80 specialty boards, 0 pro boards; $5200

9.



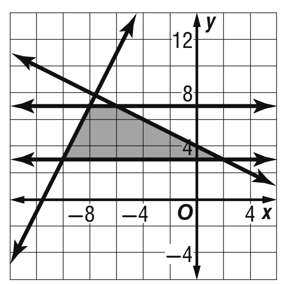
(2, −10), (−3, 0), (−3, 6.5), (2, 9); max = 82, min = −89

11.



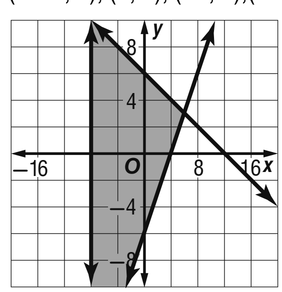
(6, −8), (4, −2), (−2, −2), (−8, −8); max = −8, min = −152

13.



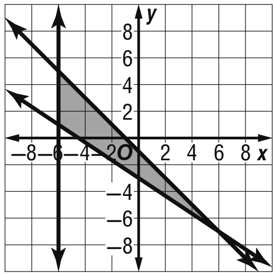
(−10, 3), (2, 3), (−6, 7),(−8, 7); max = 59, min = 9

15.



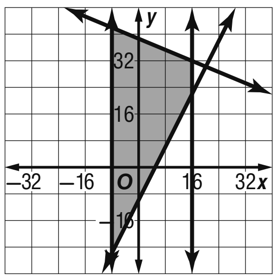
(6, 3), (−8, 10), (−8, −18); max = 42, min = −140

17.



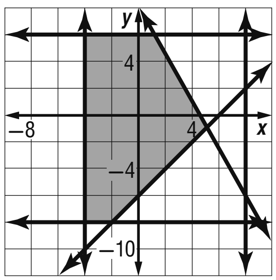
(−6, 1), (6, −7), (−6, 5); max = 48, min = 0

19.



(−8, 44), (16, 32), (−8, −26), (16, 22); max = 672, min = −486

21.

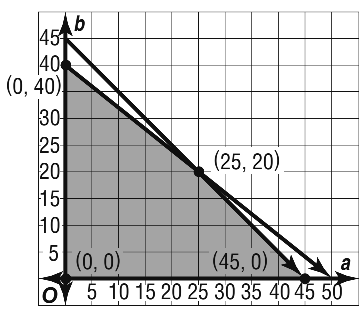


(−4, 6), (2, 4), (2, 1), (1, 0), (−3, 0), (−6, 3), (−6, 6); max = 26, min = −18

23. 225 yellow cakes, 0 strawberry cakes

25a. $a \geq 0$, $b \geq 0$, $a + b \leq 45$, $4a + 5b \leq 200$

25b.



25c. 25 sheds, 20 play houses **25d.** $1250

27a. 160 small packages, 0 large packages **27b.** $800

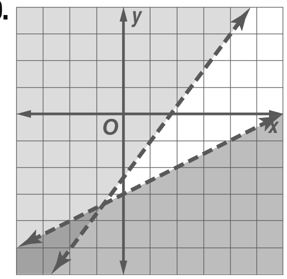
27c. No; if revenue is maximized, the company will not deliver any large packages, and customers with large packages to ship will probably choose another carrier.

29. Sample answer: $-2 \geq y \geq -6$, $4 \leq x \leq 9$

31b. The feasible region of Graph b is unbounded while the other three are bounded.

33. Sample answer: Even though the region is bounded, multiple maximums occur at *A* and *B* and all of the points on the boundary of the feasible region containing both *A* and *B*. This happened because that boundary of the region has the same slope as the function. **35.** $70.20 **37.** D

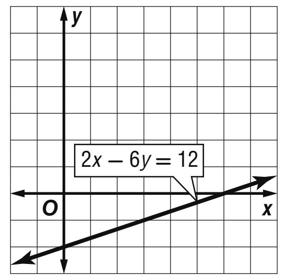
39.



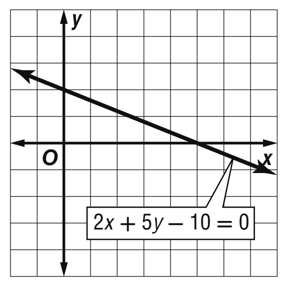
41. $7x + 15y = 330$, $8x + 16y = 360$; hats: 15, shirts: 15

43. $y = -\frac{1}{2}x + \frac{7}{2}$

45.

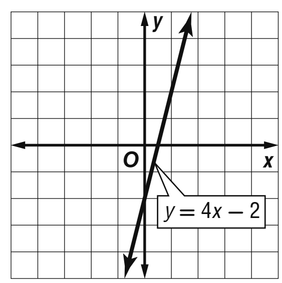


47.



5; 2

49.



$\frac{1}{2}$; −2

51. 9 **53.** −5 **55.** 15

Lesson 3–4

1. (−2, −3, 5) **3.** (−4, 3, 6) **5.** infinite solutions **7a.** $s + d + t = 7$, $d = 2s$, $0.3s + 0.6d + 0.6t = 3.6$ **7b.** 2 sitcoms, 4 dramas, 1 talk show **9.** (−3, −2, −4) **11.** (−2, −1, 4) **13.** infinite solutions **15.** (−4, −1, 6) **17.** no solution **19.** infinite solutions **21.** roller coasters: 5; bumper cars: 1; water slides: 4 **23.** A: $55,000; B: $20,000; C: $25,000 **25.** $y = -3x^2 + 4x - 6$; $a = -3$, $b = 4$, $c = -6$

27. Sample answer:

$$3x + 4y + z = -17$$
$$2x - 5y - 3z = -18$$
$$-x + 3y + 8z = 47$$
$$3x + 4y + z = -17$$
$$3(-5) + 4(-2) + 6 = -17$$

$$\begin{aligned} -15 + (-8) + 6 &= -17 \\ -17 &= -17 \checkmark \\ 2x - 5y - 3z &= -18 \\ 2(-5) - 5(-2) - 3(6) &= -18 \\ -10 + 10 - 18 &= -18 \\ -18 &= -18 \checkmark \\ -x + 3y + 8z &= 47 \\ -(-5) + 3(-2) + 8(6) &= 47 \\ 5 - 6 + 48 &= 47 \\ 47 &= 47 \checkmark \end{aligned}$$

29. Sample answer: First, combine two of the original equations using elimination to form a new equation with three variables. Next, combine a different pair of the original equations using elimination to eliminate the same variable and form a second equation with three variables. Do the same thing with a third pair of the original equations. You now have a system of three equations with three variables. Follow the same procedure you learned in this section. Once you find the three variables, you need to use them to find the eliminated variable.

31. A **33.** J **35.** 16; −8 **37.** 9; −8 **39.** (6, 1) **41.** (8, −5)

Lesson 3−5

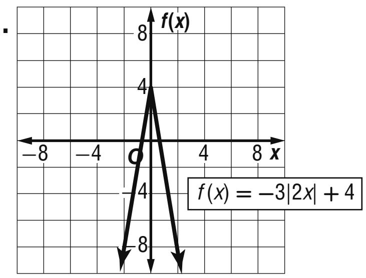
1. 26 **3.** −128 **5.** −19 **7.** −284 **9.** 72 **11.** 182
13. (6, −3) **15.** (4, −1) **17a.** 15.75 units^2
17b. 482,343.75 mi^2 **19.** $\left(\frac{66}{7}, -\frac{116}{7}, -\frac{41}{7}\right)$
21. (−4, −2, 8) **23.** (−1, −3, 7) **25.** (4, 0, 8) **27.** 3
29. −135 **31.** −459 **33.** 0 **35.** 728 **37.** −952
39. (8, −5) **41.** (6, 3) **43.** (−3, −7) **45.** (4, −2, 5)
47. 6 **49.** 2 m^2 **51.** (4, 8, −5)
53. $\left(-\frac{6187}{701}, -\frac{2904}{701}, -\frac{4212}{701}\right)$
55a. small: 650; medium: 325; large: 410
55b. $2426.25 **55c.** It seems like it was a good move for the vendor. Although he sold fewer small drinks, he sold more medium and large drinks and on the whole, made more money this week than in the previous week.
57. Sample answer: There is no unique solution of the system. There are either infinite or no solutions. **59.** 0
61. Sample answer: Given a 2 × 2 system of linear equations, if the determinant of the matrix of coefficients is 0, then the system does not have a unique solution. The system may have no solution and the graphical representation shows two parallel lines. The system may have infinitely many solutions in which the graphical representation will be the same line.

63. H **65.** D **67.** no

69a. $\begin{bmatrix} \$4.50 & \$6.75 & \$9.50 \\ \$4.50 & \$6.75 & \$9.50 \\ \$4.00 & \$6.25 & \$8.75 \\ \$4.75 & \$7.50 & \$10.25 \end{bmatrix}$

69b. $\begin{bmatrix} \$3.60 & \$5.40 & \$7.60 \\ \$3.60 & \$5.40 & \$7.60 \\ \$3.20 & \$5.00 & \$7.00 \\ \$3.80 & \$6.00 & \$8.20 \end{bmatrix}$

69c. $\begin{bmatrix} \$0.90 & \$1.35 & \$1.90 \\ \$0.90 & \$1.35 & \$1.90 \\ \$0.80 & \$1.25 & \$1.75 \\ \$0.95 & \$1.50 & \$2.05 \end{bmatrix}$

71.


73. (−8, 2) **75.** (−3, −4)

Lesson 3−6

1. no **3.** yes **5.** $\begin{bmatrix} 0 & -1 \\ -\frac{1}{3} & -2 \end{bmatrix}$ **7.** $\begin{bmatrix} -\frac{1}{3} & 0 \\ \frac{5}{6} & \frac{1}{2} \end{bmatrix}$ **9.** (−2, 5)
11. (1, −2) **13.** no **15.** no
17. $\begin{bmatrix} \frac{1}{3} & 0 \\ 0 & \frac{1}{2} \end{bmatrix}$ **19.** $\begin{bmatrix} \frac{1}{3} & 0 \\ -\frac{5}{3} & 1 \end{bmatrix}$ **21.** $\begin{bmatrix} \frac{1}{3} & \frac{2}{3} \\ -\frac{2}{3} & -\frac{5}{6} \end{bmatrix}$ **23.** $\begin{bmatrix} \frac{9}{74} & \frac{5}{74} \\ -\frac{2}{37} & \frac{3}{37} \end{bmatrix}$
25. $\begin{bmatrix} \frac{7}{22} & \frac{4}{11} \\ \frac{4}{11} & \frac{3}{11} \end{bmatrix}$ **27.** no solution **29.** (−1, 5) **31.** no solution
33. (−5, 0) **35.** $\left(\frac{3}{4}, 3\right)$

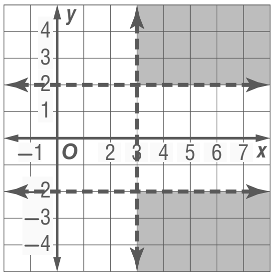
37a.

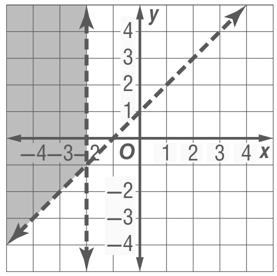
	From CD	From MP3
To CD	0.35	0.12
Mp3	0.65	0.88

37b. about 20,218 **37c.** about 4357
39. Sometimes; sample answer: A square matrix has a multiplicative inverse if its determinant does not equal 0.
41. Sample answer: $\begin{bmatrix} 2 & 3 \\ 4 & 6 \end{bmatrix} \cdot \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 9 \\ 10 \end{bmatrix}$; any matrix that has a determinant equal to 0, such as $\begin{bmatrix} 1 & 1 \\ 0 & 0 \end{bmatrix}$
43. C **45.** $\left(\frac{1}{2}, \frac{1}{4}\right)$ **47.** −54 **49.** 551 **51.** $\begin{bmatrix} -22 \\ -7 \end{bmatrix}$
53. 179 gal of skim and 21 gal of whole milk
55. absolute value

Chapter 3 Study Guide and Review

1. unbounded **3.** constant matrix **5.** consistent
7. break-even point **9.** inverses **11.** infinitely many solutions
13. (−3, 4) **15.** (2, 4) **17.** (5.25, −1.75)
19. notebook: $2.50; pen: $1.25

21. 

23. 

25. 126 simple and 63 grand **27.** $(-23, -8, -6)$
29. hot dog: \$3.25; popcorn: \$2.25; soda: \$2.50
31. -44 **33.** $(2, -3, 6)$

35. $\begin{bmatrix} 2 & -4 \\ -3 & 7 \end{bmatrix}$ **37.** No inverse exists. **39.** $(2, 1)$

CHAPTER 4

Polynomials and Polynomial Functions

Chapter 4 Get Ready

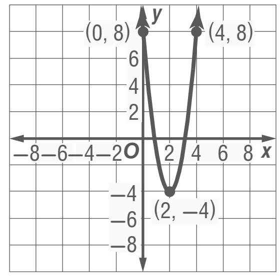
1. $-5 + (-13)$ **3.** $5mr + (-7mp)$ **5.** $20 + (-2x)$
7. $-3b^2 - 2b + 1$ **9.** $-\frac{9}{4}z - \frac{15}{4}$ **11.** $-4, 2$ **13.** $-\frac{4}{3}, \frac{1}{2}$
15. about 1.77 seconds

Lesson 4-1

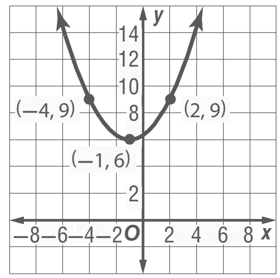
1. $-8a^5b^2$ **3.** $\frac{8a^6}{27b^3}$ **5.** yes; 1 **7.** no
9. $-2x^2 - 6x + 3$ **11.** $8ab + 10a$ **13.** $n^2 - 2n - 63$
15. $750 - 2.5x$ **17.** $-8b^5c^3$ **19.** $-yz^2$ **21.** $\frac{a^2c^2}{2b^4}$
23. z^{18} **25.** yes; 3 **27.** no **29.** $-3b^2 + 6b - 5$
31. $8x^3 + 4xy$ **33.** $a^4 + a^3b - 3a^2b - 4ab^2 - b^3$
35. $10c^3 - c^2 + 4c$ **37.** $12a^2b + 8a^2b^2 - 15ab^2 + 4b^2$
39. $4a^2x - 2a^2y + 10abx - 5aby + 6b^2x - 3b^2y$
41. $\frac{y^4}{81x^4}$ **43.** $\frac{x^6}{16y^{14}}$ **45.** b **47.** $\frac{2}{5}cd^4$
49. $\frac{1}{2}x^6y^3$ **51a.** 7.89×10^{12} s or about 250,190.26 yr
53. $2n^4 - 3n^3p + 6n^4p^4$ **55.** $b^3 + \frac{b}{a} + \frac{1}{a^2}$
57. $2n^5 - 14n^3 + 4n^2 - 28$ **59.** $64n^3 - 240n^2 + 300n - 125$
61a. $0.155x^2 + 8.818x + 835.8$
61b. $0.061x^2 - 10.57x + 112.4$
63. 9 **65.** $\frac{1}{a^n} = \frac{a^0}{a^n} = a^{0-n} = a^{-n}$

67. Sample answer: We would have a 0 in the denominator, which makes the expression undefined. **69.** Sample answer: Astronomy deals with very large numbers that are sometimes difficult to work with because they contain so many digits. Properties of exponents make very large or very small numbers more manageable. As long as you know how far away a planet is from a light source you can divide that distance by the speed of light to obtain how long it will take light to reach that planet. **71.** D **73.** D **75.** 22

77. No; it cannot be written as $y = mx + b$



79. Yes; it is written in $y = mx + b$ form, $m = 0$.



81. 42 **83.** 28 **85.** $\frac{7}{8}$ **87.** $\frac{1}{2}$ **89.** $\frac{5}{9}$
91. $4x(3ax^2 + 5bx + 8c)$ **93.** $(3y + 2)(4y + 3)$
95. $(2x - 3)(4a - 3)$

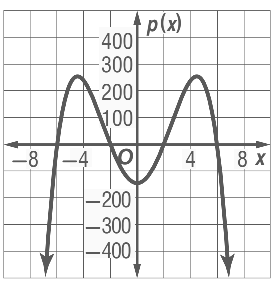
Lesson 4-2

1. $4y + 2x - 2$ **3.** $x - 8 - \frac{4}{x+2}$
5. $3z^3 - 15z^2 + 36z - 105 + \frac{309}{z+3}$ **7.** A
9. $6a + 6 + \frac{21}{3a-2}$ **11.** $3y + 5$ **13.** $x + 3y - 2$
15. $2a^2 + b - 3$ **17.** $3np - 6 + 7p$ **19.** $-w + 16 + \frac{1000}{w}$
21. $b^2 - 5b + 6 - \frac{8}{b+1}$
23. $x^4 + 4x^3 + 12x^2 + 52x + 208 + \frac{832}{x+4}$
25. $g^3 + 2g^2 + g + 2 - \frac{14}{g-2}$
27. $2x^4 + x^3 - x + \frac{2}{3} - \frac{2}{9x+3}$ **29.** $b^2 - 4b + 8 - \frac{8}{b+1}$
31. $2y^5 - y^4 + y^3 + y^2 - y - 3$ **33.** $V(t) = t^2 + 5t + 6$
35a. $3500 - \frac{350{,}000}{a^2 + 100}$ **35b.** about 2423 subscriptions
37. $\frac{4c^2d - 3d}{2}$ **39.** $n^2 - n - 1$
41. $3z^4 - z^3 + 2z^2 - 4z + 9 - \frac{13}{z+2}$
43. Sample answer: Sharon; Jamal actually divided by $x + 3$.
45. Sample answer: The degree of the quotient plus the degree of the divisor equals the degree of the dividend.
47. $\frac{5}{x^2}$ does not belong with the other three. The other three expressions are polynomials. Since the denominator of $\frac{5}{x^2}$ contains a variable, it is not a polynomial.
49. A **51.** 360 **53.** $3x^3 + 2x^2 + x + 4$ **55.** $23a^2 - 24a$
57. $8x^5y^8z^3$ **59.** no **61.** yes **63.** $(-3, 4)$ **65.** $x \leq -\frac{8}{3}$
67. $x \leq \frac{19}{9}$ **69.** -21 **71.** -20 **73.** $-9d^2$

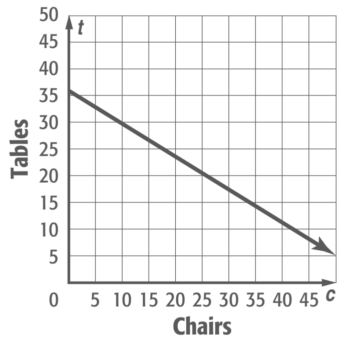
Lesson 4-3

1. degree = 6, leading coefficient = 11 **3.** not in one variable because there are two variables, *x* and *y* not in one variable because there are two variables, *x* and $y = 4$
5. $w(5) = -247$; $w(-4) = 104$ **7.** $4y^9 - 5y^6 + 2$
9. $1536a^3 - 426a^2 - 144a + 82$
11a. $f(x) \to -\infty$ as $x \to -\infty$. $f(x) \to +\infty$ as $x \to +\infty$.
11b. Since the end behavior is in opposite directions, it is an odd-degree function.
11c. The graph intersects the *x*-axis at three points, so there are three real zeros.
13. not in one variable because there are two variables, *x* and *y*
15. degree = 6, leading coefficient = −12
17. degree = 4, leading coefficient = −5
19. degree = 2, leading coefficient = 3
21. degree = 9, leading coefficient = 2
23. $p(-6) = 1227$; $p(3) = 66$ **25.** $p(-6) = -156$; $p(3) = 78$
27. $p(-6) = 319$; $p(3) = -5$ **29.** $18a^2 - 12a + 3$
31. $2b^4 - 4b^2 + 3$ **33.** $-64y^3 + 144y^2 - 104y + 25$
35a. $f(x) \to +\infty$ as $x \to -\infty$. $f(x) \to +\infty$ as $x \to +\infty$.
35b. Since the end behavior is in the same direction, it is an even-degree function.
35c. The graph intersects the *x*-axis at four points, so there are four real zeros.
37a. $f(x) \to -\infty$ as $x \to -\infty$. $f(x) \to +\infty$ as $x \to +\infty$.
37b. Since the end behavior is in opposite directions, it is an odd-degree function.
37c. The graph intersects the *x*-axis at one point, so there is one real zero.
39a. $f(x) \to -\infty$ as $x \to -\infty$. $f(x) \to -\infty$ as $x \to +\infty$.
39b. Since the end behavior is in the same direction, it is an even-degree function.
39c. The graph intersects the *x*-axis at two points, so there are two real zeros.
41. 10,345.5 joules **43.** $p(-2) = -16$; $p(8) = 1024$
45. $p(-2) = -0.5$; $p(8) = 3112$ **47.** D **49.** A
51. $3a^3 - 24a^2 + 240a + 66$ **53.** $5a^6 - 298a^2 + 1008a - 928$
55a.

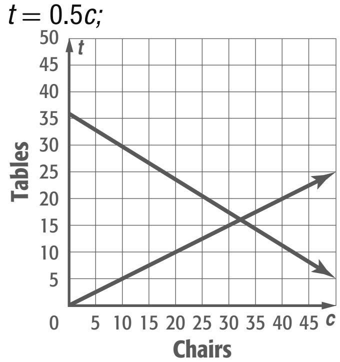
x	p(x)
−7	−585
−6	0
−4	240
−3	135
−2	0
0	−144
1	−105
2	0
4	240
6	0
7	−585



55b. −6, −2, 2, 6 **55c.** 2000 and 6000 items
55d. Sample answer: The negative values should not be considered because the company will not produce negative items.
57. $f(x) \to -\infty$ as $x \to -\infty$; $f(x) \to -\infty$ as $x \to +\infty$
59. $h(x) \to +\infty$ as $x \to -\infty$; $h(x) \to -\infty$ as $x \to +\infty$
61. $g(x) \to -\infty$ as $x \to -\infty$; $g(x) \to +\infty$ as $x \to +\infty$
63. Sample answer: Virginia is correct; an even function will have an even number of zeros and the double root represents 2 zeros.
65. Sample answer: $f(x) \to +\infty$ as $x \to -\infty$; $f(x) \to -\infty$ as $x \to +\infty$ as $x \to +\infty$; $\frac{f(x)}{g(x)}$ will become a 2-degree function with a positive leading coefficient.
67. Sometimes; a polynomial function with four real roots may be a sixth-degree polynomial function with two imaginary roots. A polynomial function that has four real roots is at least a fourth-degree polynomial.
69. Student A
71a.



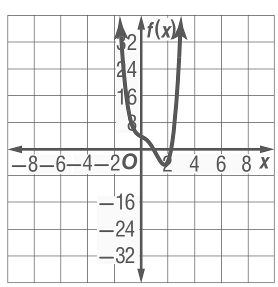
71b. $t = 0.5c$;



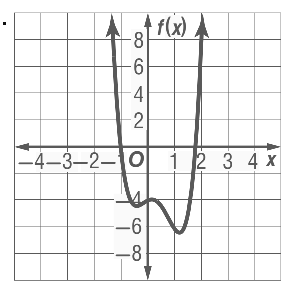
71c. 16 tables and 32 chairs
71d. Sample answer: This can be determined by the intersection of the graphs. This point of intersection is the optimal amount of tables and chairs manufactured.
73. $2x^2y^2 + 4x^4y^4z^2$ **75.** $6c^3 - 1 + 4a^5cd^2$ **77.** yes; 6
79a. $h(d) = -2d^2 + 4d + 6$; The graph opens downward and is narrower than the parent graph, and the vertex is at (1, 8).
79b. $h(d) = -2(d - 1.25)^2 + 12.5$; It shifted the graph up 4.5 ft and to the right 3 in.
79c. $c \geq 0$, $\ell \geq 0$, $c + 3\ell \leq 56$, $4c + 2\ell \leq 104$
79d. $f(c, \ell) = 20c + 35\ell$
81. $x \leq -\frac{2}{3}$ or $x \geq 2$ **83.** minimum; $-\frac{4}{3}$ 85. maximum; 11

Lesson 4-4

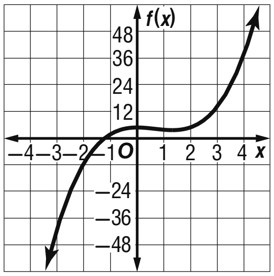
1.



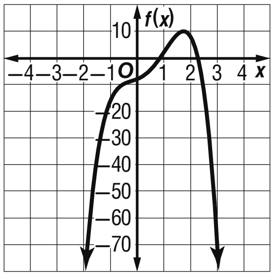
3.



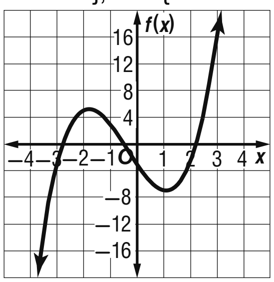
5. between -2 and -1



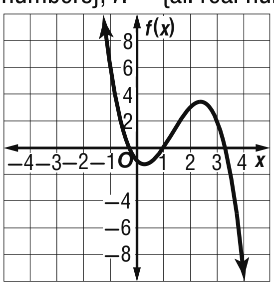
7. between 0 and 1 and between 2 and 3



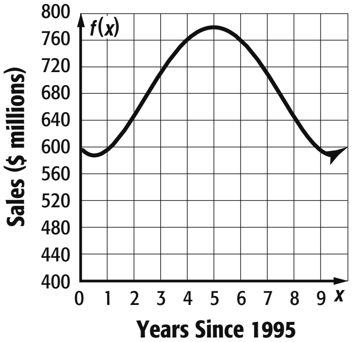
9. rel. max at $x \approx -1.8$; rel. min at $x \approx 1.1$; D = {all real numbers}, R = {all real numbers}



11. rel. max at $x \approx 2.4$; rel. min at $x \approx 0.3$; D = {all real numbers}, R = {all real numbers}

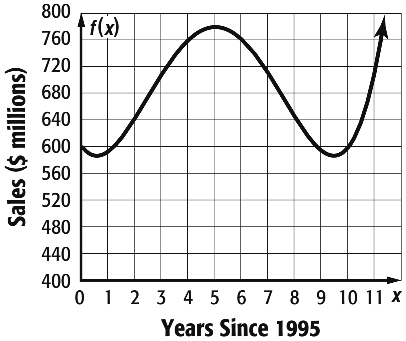


13a.



13b. Sample answer: Relative maximum at x = 5 and relative minimum at x ~ 9.5 $f(x) \to \infty$ as $x \to -\infty$ and $f(x) \to \infty$ as $x \to \infty$. The graph increases when $x < 5$ and $x > 9.5$ and decreases when $5 < x < 9.5$.

13c.

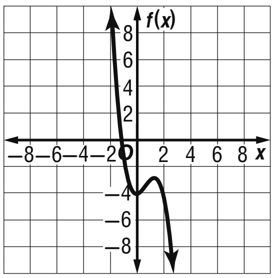


Sample answer: This suggests a dramatic increase in sales.

13d. Sample answer: No; with so many other forms of media on the market today, CD sales will not increase dramatically. In fact, the sales will probably decrease. The function appears to be accurate only until about 2005.

15a.

x	$f(x)$
−4	92
−3	41
−2	12
−1	−1
0	−4
1	−3
2	−4
3	−13
4	−36

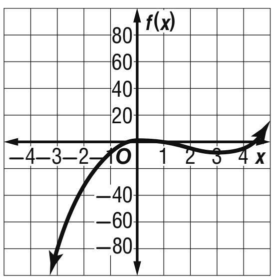


15b. between -2 and -1

15c. rel. min: $x = 0$; rel. max: $x = 1$

17a.

x	$f(x)$
−4	−155
−3	−80
−2	−33
−1	−8
0	1
1	0
2	−5
3	−8
4	−3
5	16

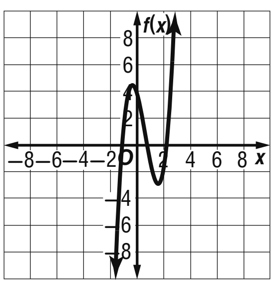


17b. at $x = 1$, between -1 and 0, and between $x = 4$ and $x = 5$

17c. rel. max: $x \approx \frac{1}{3}$, rel. min: $x \approx 3$

19a.

x	$f(x)$
−4	−176
−3	−77
−2	−22
−1	1
0	4
1	−1
2	−2
3	13
4	56

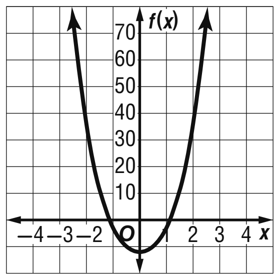


19b. between $x = -2$ and $x = -1$, between $x = 0$ and $x = 1$, and between $x = 2$ and $x = 3$

19c. rel. max: near $x = -0.3$; rel. min: near $x = 1.6$

21a.

x	$f(x)$
−4	372
−3	141
−2	36
−1	−3
0	−12
1	−3
2	36
3	141
4	372

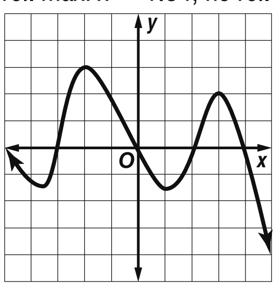


21b. between $x = -2$ and $x = -1$ and between $x = 1$ and $x = 2$

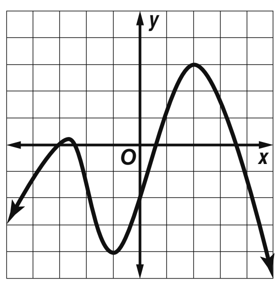
21c. min: near $x = 0$ **23.** rel. max: $x = -2.73$; rel. min: $x = 0.73$

25. rel. max: $x = 1.34$; no rel. min

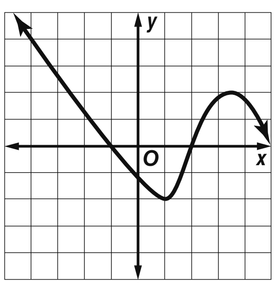
27.



29.



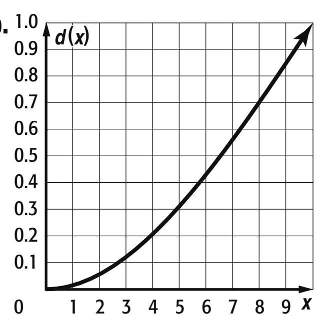
31.



33a.

x	$d(x)$
0	0
1	0.0145
2	0.056
3	0.1215
4	0.208
5	0.3125
6	0.432
7	0.5635
8	0.704
9	0.8505
10	1

33b.



33c. $d(x)$ increases. **33d.** Sample answer: no; x cannot be greater than 10

35a. −2.5(min), −0.5(max), 1.5(min)

35b. −3.5, −1, 0, 3 **35c.** 4

35d. D = {all real numbers}; R = $\{y \mid y \geq -3.1\}$

37a. −3.5(min), −2.5(max), −2(min), −1(max), 1(min)

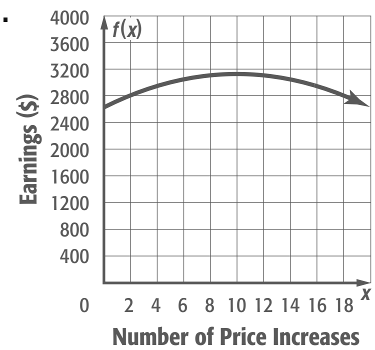
37b. −3.75, −3.25, −2, −1.75, −0.25, 2.9 **37c.** 6

37d. D = {all real numbers}; R = $\{y \mid y \geq -5\}$

39a. −2(max), 1(min) **39b.** −3, −0.5, 2

39c. 3 **39d.** D = {all real numbers}; R = {all real numbers}

41.



$1.25

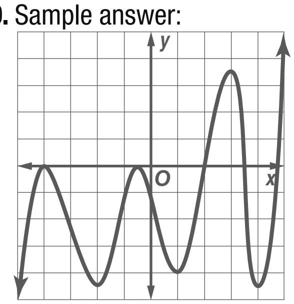
43a. zeros: $x \approx 1.75$; x-intercept: ≈ 1.75; y-intercept: −4; turning points: $x \approx -1.25, -0.5, 0.5, 1.25$

43b. no axis of symmetry **43c.** decreasing: $-1.25 \leq x \leq -0.5$ and $0.5 \leq x \leq 1.25$; increasing: $x \leq -1.25$, $-0.5 \leq x \leq 0.5$, and $x \geq 1.25$ **45a.** no zeros, no x-intercepts, y-intercept: 5; no turning points **45b.** no axis of symmetry

45c. decreasing: $x \leq -4$; constant: $-4 < x \leq 0$; increasing $x > 0$

47. As the x-values approach large positive or negative numbers, the term with the largest degree becomes more and more dominant in determining the value of $f(x)$.

49. Sample answer:



51. Sample answer: No; $f(x) = x^2 + x$ is an even degree, but $f(1) \neq f(-1)$. **53.** Sample answer: From the degree, you can determine whether the graph is even or odd and the maximum number of zeros and turning points for the graph. You can create a table of values to help you find the approximate locations of turning points and zeros. The leading coefficient can be used to determine the end behavior of the graph, and, along with the degree, build the shape of the graph. **55.** 95 **57.** C

59. $f(x) \to -\infty$ as $x \to -\infty$. $f(x) \to -\infty$ as $x \to +\infty$. Since the end behavior is in the same direction, it is an even-degree function. The graph intersects the x-axis at six points, so there are six real zeros.

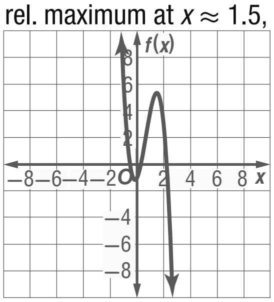
61. $(x - 2)(x + 3)$ **63.** $2a^2 + a - 3 - \frac{3}{a - 1}$

65. $(x + 6)(x + 3)$ **67.** $(a + 8)(a - 2)$ **69.** $(3x - 4)(2x + 1)$

Lesson 4-5

1. $(a + b)(3x + 2y - z)$ **3.** prime **5.** $12q(w - q)(w^2 + qw + q^2)$ **7.** $x^2(a - b)(a^2 + ab + b^2) \cdot (a + b)(a^2 - ab + b^2)$

9. $(2c - 5d)(4c^2 + 10cd + 25d^2)$ **11.** $4, -4, \pm\sqrt{3}$
13. $-3, \frac{3 \pm 3i\sqrt{3}}{2}$ **15.** 5ft **17.** not possible
19. $\sqrt{6}, -\sqrt{6}, 2\sqrt{3}, -2\sqrt{3}$
21. $x(4x + y) \cdot (16x^2 - 4xy + y^2)$
23. $y^3(x^2 + y^2) \cdot (x^4 - x^2y^2 + y^4)$ **25.** prime
27. $(6x^2 - 5y^2)(2a - 3b + 4c)$ **29.** $(2x - y)(4x^2 + 2xy + y^2)$ $(x + 5)^2$ **31.** $6, -6, \pm 2i\sqrt{5}$ **33.** $\pm\sqrt{7}, \pm i\sqrt{13}$
35. $-1/4, \frac{1 \pm i\sqrt{3}}{8}$ **37.** $-15(x^2)^2 + 18(x^2) - 4$
39. not possible **41.** $4(2x^5)^2 + 1(2x^5) + 6$ **43.** $\pm\sqrt{5}, \pm i\sqrt{2}$
45. $\pm\frac{2\sqrt{3}}{3}, \pm\frac{\sqrt{15}}{3}$ **47.** $\pm\frac{\sqrt{6}}{6}, \pm i\frac{\sqrt{3}}{2}$
49. $(x^2 + 25)(x + 5)(x - 5)$ **51.** $x(x + 2)(x - 2)(x^2 + 4)$
53. $(5x + 4y + 5z)(3a - 2b + c)$
55. $x(x + 3)(x - 3)(3x + 2)(2x - 5)$ **57.** $x = 8$; 5, 8, 11
59. $\pm\frac{2\sqrt{3}}{3}, \pm i\frac{\sqrt{2}}{2}$ **61.** $\pm\frac{1}{3}, \pm i\frac{\sqrt{10}}{2}$ **63.** $3, -3, \pm i\frac{\sqrt{15}}{3}$
65. $-1, 3, \frac{-3 \pm 3i\sqrt{3}}{2}, \frac{1 \pm i\sqrt{3}}{2}$ **67.** $-1, 1, \pm\frac{1}{2}$
69. $\pm i\sqrt{5}, \pm i\sqrt{3}$ **71a.** 2 ft **71b.** 176 ft^2 **71c.** 428 ft^2
73a. $f(x) = 8x^2 + 34x + 24$ **73b.** 11 ft **75.** $(x + 2)^3(x - 2)^3$
77. $(x + y)^3(x - y)^3$ **79.** $(6x^n + 1)^2$
81. Sample answer: $a = 1, b = -1$ **83.** Sample answer: The factors can be determined by the x-intercepts of the graph. An x-intercept of 5 represents a factor of $(x - 5)$. **85.** D **87.** D
89. rel. maximum at $x \approx 1.5$, rel. minimum at $x \approx 0.1$;



91. degree = 4; leading coefficient = 5
93. degree = 7; leading coefficient = −1
95. 18 skis and 10 snowboards **97.** $x + 2 - \frac{10}{x + 4}$
99. $8x^2 - 12x + 24 - \frac{42}{x + 2}$

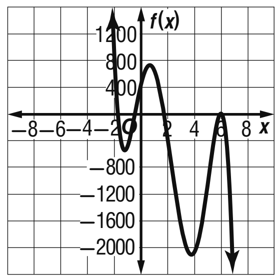
Lesson 4-6

1. 58; −20 **3.** 12,526 **5.** $x + 4, x - 4$ **7.** $x - 5, 2x - 1$
9. 71; −6 **11.** −435; −15 **13.** −4150; 85 **15.** 647; −4
17. $(x - 1)^2$ **19.** $x - 4, x + 1$ **21.** $x + 6, 2x + 7$
23. $x + 1, x^2 + 2x + 3$ **25.** $x - 4, 3x - 2$
27a. 0.26 ft/s, 5.76 ft/s, 19.86 ft/s **27b.** 132.96 ft/s; This means the boat is traveling at 132.96 ft/s when it passes the second buoy. **29.** $x + 2, x - 3, x^2 - x + 4$
31a. $g(x) = -9x^4 + 50x^3 + 51x^2 - 150x - 72$

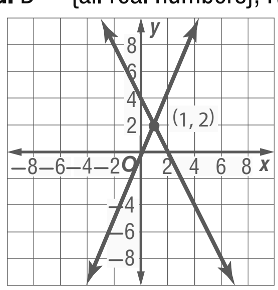
31b.

x	$g(x)$
−5	−9922
−4	−4160
−3	−1242
−2	−112
−1	70
0	−72
1	−130
2	88
3	558
4	1040
5	1078
6	0

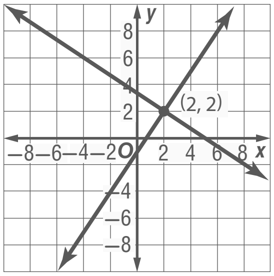
31c. There is a zero between $x = -2$ and $x = -1$ because $g(x)$ changes sign between the two values. There are also zeros between $x = -1$ and 0 and between $x = 1$ and $x = 2$ because $g(x)$ changes sign between the two values. There is also a zero at $x = 6$.
31d.



33. 8 **35.** −3 **37.** $\pm\sqrt{6}, \pm\sqrt{3}$ **39a.** $x - c$ is a factor of $f(x)$.
39b. $x - c$ is a not factor of $f(x)$.
41. Sample answer: $f(x) = -x^3 + x^2 + x + 10$
43. Sample answer: A zero can be located using the Remainder Theorem and a table of values by determining when the output, or remainder, is equal to zero. For instance, if $f(6)$ leaves a remainder of 2 and f (7) leaves a remainder of -1, then you know that there is a zero between $x = 6$ and $x = 7$.
45. 4 **47.** B **49.** $\pm 3, \pm i\sqrt{3}$
51a. −1.5(max), 0.5(min), 2.5(max) **51b.** −3.5, 3.75 **51c.** 4
51d. D = {all real numbers}; R = $\{y \mid y \leq 4.5\}$
53a. −3(min), −1(max), 1(min) **53b.** −0.25, 3 **53c.** 4
53d. D = {all real numbers}; R = $\{y \mid y \geq -4.5\}$
55.



Selected Answers and Solutions

57. 

59. $4a^2 + 8a - 16$ **61.** $79a^2 - 58a + 12$

63. $-4a^4 - 24a^2 - 48a - 22$

Lesson 4–7

1. −2, 5; 2 real **3.** $-\frac{3}{2}, \frac{3}{2}, -\frac{3}{2}i, \frac{3}{2}i$ **5.** 3 or 1; 0; 0 or 2

7. 1 or 3; 0 or 2; 0, 2, or 4 **9.** −8, −2, 1 **11.** −4, 6, $-4i$, $4i$

13. $f(x) = x^3 - 9x^2 + 14x + 24$

15. $f(x) = x^4 - 3x^3 - x^2 - 27x - 90$

17. $-2, \frac{3}{2}$; 2 real

19. $-1, \frac{1 \pm i\sqrt{3}}{2}$; 1 real, 2 imaginary

21. $-\frac{8}{3}$, 1; 2 real

23. $-\frac{5}{2}, \frac{5}{2}, -\frac{5}{2}i, \frac{5}{2}i$; 2 real, 2 imaginary

25. −2, −2, 0, 2, 2; 5 real

27. 0 or 2; 0 or 2; 0, 2, or 4 **29.** 0 or 2; 1; 2 or 4

31. 0 or 2; 0 or 2; 2, 4, or 6 **33.** −6, −2, 1

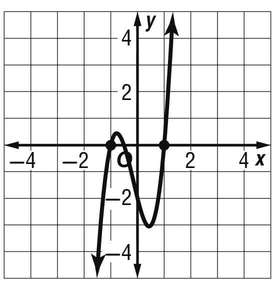
35. −4, 7, $-5i$, $5i$ **37.** 4, 4, $-2i$, $2i$

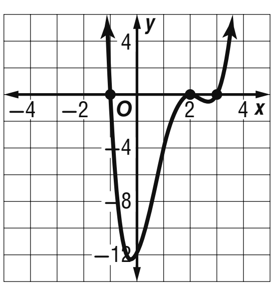
39. $f(x) = x^3 - 2x^2 - 13x - 10$

41. $f(x) = x^4 + 2x^3 + 5x^2 + 8x + 4$

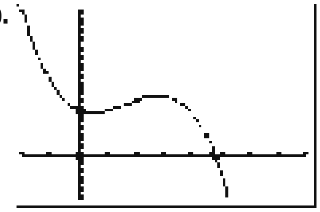
43. $f(x) = x^4 - x^3 - 20x^2 + 50x$

45a. 2 or 0; 1; 1 or 3 **45b.** Nonnegative roots represent numbers of computers produced per day which lead to no profit for the manufacturer.

47. 

49. 

51a. c **51b.** b **53a.** 3 or 1; 0; 2 or 0

53b. 

[−10, 40] scl: 5 by [−4000, 13,200] scl: 100

53c. 23.8; Sample answer: According to the model, the music hall will not earn any money after 2026.

55. 1 positive, 2 negative, 2 imaginary; Sample answer: The graph crosses the positive x-axis once, and crosses the negative x-axis twice. Because the degree of the polynomial is 5, there are 5 − 3 or 2 imaginary zeros.

57. Sample answer: $f(x) = (x + 2i)$
$(x - 2i)(3x + 5)(x + \sqrt{5})$
$(x - \sqrt{5})$ Use conjugates for the imaginary and irrational values.

59. Sample answer: $f(x) = x^4 + 4x^2 + 4$

59b. Sample answer: $f(x) = x^3 + 6x^2 + 9x$

61. C **63.** H **65.** $f(-8) = -1638$; $f(4) = 342$

67. $f(-8) = -63{,}940$; $f(4) = 1868$

69. $(a^2 + b^2)(a^4 - a^2b^2 + b^4)$ **71.** $(a - 4)(a - 2)(5a + 2b)$

73. $t \geq 50p + 150$ **75.** $\pm1, \pm2, \pm4, \pm8, \pm\frac{1}{5}, \pm\frac{2}{5}, \pm\frac{4}{5}, \pm\frac{8}{5}$

Lesson 4–8

1. ±1, ±2, ±3, ±4, ±6, ±8, ±12, ±24

3. 5 in. × 9 in. × 28 in. **5.** $-\frac{3}{2}$, −1 7. $-\frac{1}{2}, \frac{-5 \pm i\sqrt{23}}{8}$

9. $-\frac{1}{2}, \frac{3}{2}, 1 + 2i, 1 - 2i$

11. ±1, ±2, ±4, ±7, ±8, ±14, ±28, ±56

13. $\pm1, \pm5, \pm7, \pm35, \pm\frac{1}{3}, \pm\frac{5}{3}, \pm\frac{7}{3}, \pm\frac{35}{3}$

15. ±1, ±2, ±3, ±6, ±7, ±14, ±21,
$\pm42, \pm\frac{1}{2}, \pm\frac{3}{2}, \pm\frac{7}{2}, \pm\frac{21}{2}, \pm\frac{1}{4}, \pm\frac{3}{4}, \pm\frac{7}{4}, \pm\frac{21}{4}, \pm\frac{1}{8}, \pm\frac{3}{8}$,
$\pm\frac{7}{8}, \pm\frac{21}{8}$

17. ±1, ±2, ±4, ±8, ±16, ±32,
$\pm64, \pm128, \pm\frac{1}{2}, \pm\frac{1}{4}, \pm\frac{1}{8}, \pm\frac{1}{16}$

19. −5, −3, −2

21. $-5, \frac{3}{4}, 5$

23. −1, 2 **25.** $-\frac{1}{4}$ **27.** −7, 1, 3 29. 2, −1, i, $-i$

31. 0, 3, $-i$, i **33.** $-2, \frac{4}{3}, \frac{-3 \pm i}{2}$ **35.** $3, \frac{2}{3}, -\frac{2}{3}, \frac{-3 \pm \sqrt{13}}{2}$

37. $-\frac{1}{2}, \frac{1}{3}, \frac{1}{2}, \frac{3}{4}$

39a. $V(x) = 324x^3 + 54x^2 - 19x - 2$

39b. $\frac{-57 \pm i\sqrt{8987}}{36}$, 3; 3 is the only reasonable value for x. The other two values are imaginary.

41a. $V = \pi r^3 + 6\pi r^2$ 41b. 4, $-5 \pm i\sqrt{15}$; 4

41c. r = 4 in., h = 10 in.

43a. $30x^3 - 478x^2 + 1758x + 1092 = 0$

43b. 1, 2, 3, 4, 6, 7, 12, 13, 14, 21, 26, 28, 39, 42, 52, 78, 84, 91, 156, 182, 273, 364, 546, 1092

43c. 2013 **43d.** No; Sample answer: Music sales fluctuate from 2005 to 2015, then increase indefinitely. It is not reasonable to expect sales to increase forever.

45. 2, 3, 3, −3, −4 **47.** Sample answer: $f(x) = x^4 - 12x^3 + 47x^2 - 38x - 58$

49. Sample answer: $f(x) = 4x^5 + 3x^3 + 8x + 18$

51. Sample answer: You can start by using the Rational Zero Theorem to generate a list of possible zeros. Then, you could graph the function to narrow the list down. You could then perform polynomial division using the possible zeros in order to rewrite the polynomial as the product of linear expressions and a quadratic expression. You could then solve the quadratic expression to find the remaining zeros.

53. j **55.** 6 **57.** $f(x) = x^4 - 4x^3 + 11x^2 - 64x - 80$

59. $(x - 1)(x + 2)(x + 1)$ **61.** $(x - 3)(x + 4)(x - i)$

63. 120 **65.** $3x^3 + 12x$ **67.** 32 **69.** $18c + 2$

Chapter 4 Study Guide and Review

1. true **3.** false; depressed polynomial **5.** true

7. true **9.** true **11.** $\frac{7x}{y^4}$

13. $r^2 + 8r - 5$ **15.** $m^3 - m^2p - mp^2 + p^3$

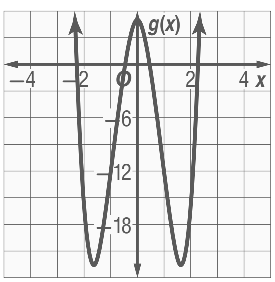
17. $3x^3 + 2x^2y^2 - 4xy$ **19.** $a^3 + 3a^2 - 4a + 2$

21. $x^2 + 3x - 40$ units^2 **23.** This is not a polynomial in one variable. It has two variables, x and y.

25. $p(-2) = -3$; $p(x + h) = x^2 + 2xh + h^2 + 2x + 2h - 3$

27. $p(-2) = -25$; $p(x + h) = 3 - 5x^2 - 10xh - 5h^2 + x^3 + 3hx^2 + 3h^2x + h^3$

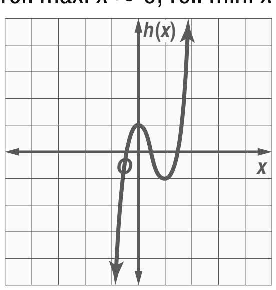
29a.



29b. between −3 and −2, between −1 and 0, between 0 and 1, between 2 and 3

29c. rel. max: $x \approx 0$; rel. min: $x \approx 1.62$ and $x \approx -1.62$

31a.



31b. between −1 and 0, between 0 and 1, and between 1 and 2

31c. rel. max: $x \approx 0$; rel. min: $x \approx 1$

33. 2 relative maxima and 1 relative minima **35.** prime

37. $(2y + z)(3a + 2b - c)$

39. $\pm\frac{\sqrt{3}}{2}, \pm\frac{\sqrt{2}}{2}$ **41.** $f(-2) = 1$; $f(4) = 13$

43. $f(-2) = 16$; $f(4) = 118$

45. $x + 2, 3x - 1$ **47.** $x + 3, x + 4$

49. positive real zeros: 0
negative real zeros: 4, 2, or 0
imaginary zeros: 4, 2, or 0

51. positive real zeros: 2 or 0
negative real zeros: 1
imaginary zeros: 4 or 2

53. $-2, -1 \pm \sqrt{2}$ **55.** $-2, \pm 2i$

CHAPTER 05
Inverses and Radical Functions and Relations

Chapter 5 Get Ready

1. between 0 and 1, and between 3 and 4 **3.** between 1 and 2 seconds

5. $3x + 2 - \frac{20}{x + 4}$ **7.** $3x^3 - 4x^2 + 5x - 3 + \frac{6}{x - 3}$

Lesson 5-1

1. $(f + g)(x) = 4x + 1$; $(f - g)(x) = -2x + 3$;
$(f \cdot g)(x) = 3x^2 + 5x - 2$;
$\left(\frac{f}{g}\right)(x) = \frac{x + 2}{3x - 1}, x \neq \frac{1}{3}$

3. $f \circ g$ is undefined, D = ∅, R = ∅; $g \circ f$ = {(2, 8), (6, 13), (12, 11), (7, 15)}, D = {2, 6, 7, 12}, R = {8, 11, 13, 15}.

5. $[f \circ g](x) = -15x + 18$, R = {all multiples of 3}
$[g \circ f](x) = -15x - 6$ **7.** Either way, she will have $228.95 taken from her paycheck. If she takes the college savings plan deduction before taxes, $76 will go to her college plan and $152.95 will go to taxes. If she takes the college savings plan deduction after taxes, only $62.70 will go to her college plan and $166.25 will go to taxes.

9. $(f + g)(x) = 6x - 3$; $(f - g)(x) = -4x + 1$;
$(f \cdot g)(x) = 5x^2 - 7x + 2$; $\left(\frac{f}{g}\right)(x) = \frac{x - 1}{5x - 2}, x \neq \frac{2}{5}$

11. $(f + g)(x) = x + 6$; $(f - g)(x) = 5x - 6$;
$(f \cdot g)(x) = -6x^2 + 18x$;
$\left(\frac{f}{g}\right)(x) = \frac{3x}{-2x + 6}, x \neq 3$

13. $(f + g)(x) = x^2 + x - 5$; $(f - g)(x) = x^2 - x + 5$;
$(f \cdot g)(x) = x^3 - 5x^2$; $\left(\frac{f}{g}\right)(x) = \frac{x^2}{x - 5}, x \neq 5$

15. $(f + g)(x) = 4x^2 - 8x$; $(f - g)(x) = 2x^2 + 8x - 8$;
$(f \cdot g)(x) = 3x^4 - 24x^3 + 8x^2 + 32x - 16$; $\left(\frac{f}{g}\right)(x) = \frac{3x^2 - 4}{x^2 - 8x + 4}, x \neq 4 \pm 2\sqrt{3}$

17. $f \circ g$ = {(−4, 4)}, D = {−4}, R = {4}; $g \circ f$ = {(−8, 0), (0, −4), (2, −5), (−6, −1)}, D = {−6, 0, 2}, R = {−5, −4, −1, 0}

19. $f \circ g$ is undefined, D = ∅, R = ∅; $g \circ f$ is undefined, D = ∅, R = ∅.

21. $f \circ g$ is undefined, D = ∅, R = ∅; $g \circ f$ = {(−4, 0), (1, 2)}, D = {−4, 1}, R = {0, 2}.

23. $f \circ g$ = {(4, 6), (3, −8)}, D = {3, 4}, R = {−8, 6}; $g \circ f$ is undefined, D = ∅, R = ∅.

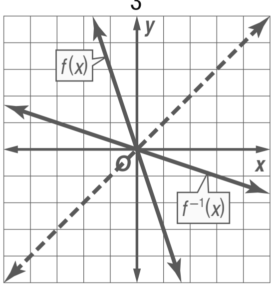
25. $f \circ g$ = {(3, −1), (6, 11)}, D = { 3, 6}, R = {−1, 11}; $g \circ f$ = {(−4, 5), (−2, 4), (−1, 8)}, D = { −4, −2, −1}, R = {4, 5, 8}

27. D = {all real numbers}
$[f \circ g](x) = 2x + 10$; $[g \circ f](x) = 2x + 5$
29. D = {all real numbers}
$[f \circ g](x) = 3x - 2$; $[g \circ f](x) = 3x + 8$
31. D = {all real numbers}
$[f \circ g](x) = x^2 - 6x - 2$, $R = \{y \mid y \geq -11\}$;
$[g \circ f](x) = x^2 + 6x - 8$, $R = \{y \mid y \geq -17\}$
33. D = {all real numbers}
$[f \circ g](x) = 4x^3 + 7$; $[g \circ f](x) = 64x^3 - 48x^2 + 12x + 1$
35. D = {all real numbers}
$[f \circ g](x) = 128x^4 + 96x^3 + 18x^2$, $R = \{y \mid y \geq 0\}$;
$[g \circ f](x) = 32x^4 + 6x^2$, $R = \{y \mid y \geq 0\}$
37a. $p(x) = 0.65x$; $t(x) = 1.0625x$
37b. Since $[p \circ t](x) = [t \circ p](x)$, either function represents the price. **37c.** \$1587.75
39. $2(g \cdot f)(x) = 2x^3 - 4x^2 - 30x + 72$; $D =$ {all real numbers}
41. 25 **43.** 483 **45.** −5 **47.** $-30a + 5$
49. $-10a^2 + 10a + 1$ **51a.** $y = 2085.6x + 123{,}060$
51b. The function represents the difference in the number of men and women employed in the U.S. **53.** 0 **55.** 1 **57.** 256
59. Sample answer: $f(x) = x - 9$, $g(x) = x + 5$
61a. D = {all real numbers} **61b** $D = \{x \mid x \geq 0\}$
63. Sample answer: Many situations in the real world involve complex calculations in which multiple functions are used. In order to solve some problems, a composition of those functions may need to be used. For example, the product of a manufacturing plant may have to go through several processes in a particular order, in which each process is described by a function. By finding the composition, only one calculation must be made to find the solution to the problem. **65.** G **67.** D **69.** −3, 2, 4

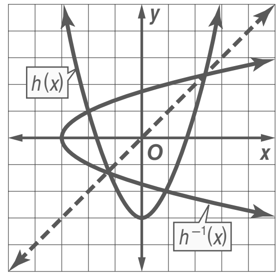
71. $-3, 5, \frac{1}{2}$ **73.** 1; 1; 2 **75.** 2 or 0; 2 or 0; 4, 2, or 0
79. (3, −1, 5) **77.** (1, 2, 3) **81.** $x = \frac{12 + 7y}{5}$
83. $x = \frac{15 - 8yz}{4}$ **85.** $k = \pm\sqrt{A - b}$

Lesson 5-2

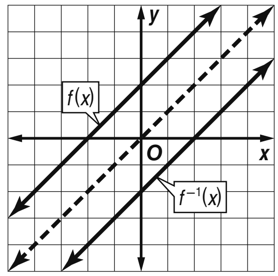
1. {(10, −9), (−3, 1), (−5, 8)}
3. $f^{-1}(x) = -\frac{1}{3}x$

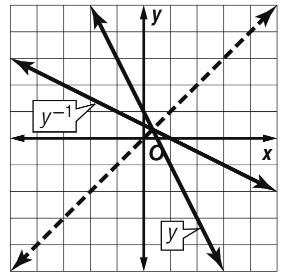


5. $h^{-1}(x) = \pm\sqrt{x + 3}$

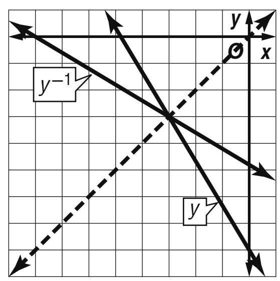


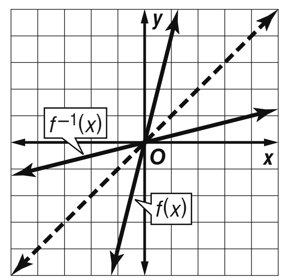
7. no **9.** {(6, −8), (−2, 6), (−3, 7)}
11. {(−1, 8), (−1, −8), (−8, −2), (8, 2)}
13. {(−5, 1), (6, 2), (−7, 3), (8, 4), (−9, 5)}
15. $f^{-1}(x) = x - 2$ **17.** $y^{-1} = \frac{x - 1}{-2}$



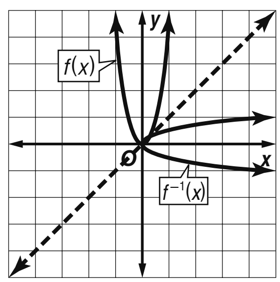


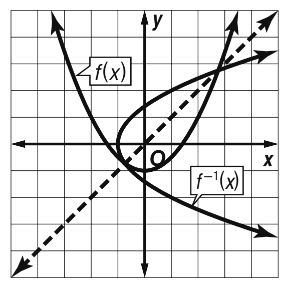
19. $y^{-1} = -\frac{3}{5}(x + 8)$ **21.** $f^{-1}(x) = \frac{1}{4}x$





23. $f^{-1}(x) = \pm\sqrt{\frac{1}{5}x}$ **25.** $f^{-1}(x) = \pm\sqrt{2x + 2}$





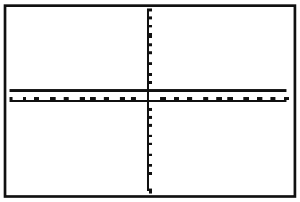
27. no **29.** yes **31.** yes **33.** yes **35.** no **37.** yes
39a. $c(g) = 2.95g$ **39b.** $c(m) \approx 0.105m$
41a. $r = \sqrt{\frac{A}{\pi}}$ **41b.** ≈3.39 cm **43.** yes **45.** no **47.** no
49a. $F^{-1}(x) = \frac{5}{9}(x - 32)$;

$$F[F^{-1}(x)] = \frac{9}{5}\left[\frac{5}{9}(x - 32)\right] + 32 = x - 32 + 32 = x$$

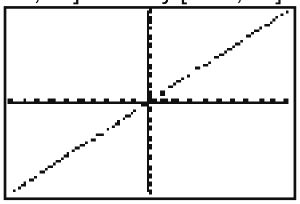
$$F^{-1}[F(x)] = \frac{5}{9}\left(\frac{9}{5}x + 32 - 32\right) = \frac{5}{9}\left(\frac{9}{5}x + 0\right) = x$$

49b. It can be used to convert Fahrenheit to Celsius.

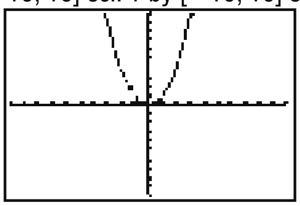
51a.



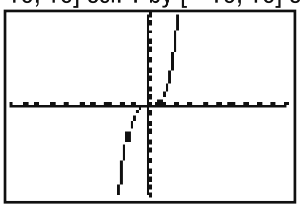
[−10, 10] scl: 1 by [−10, 10] scl: 1



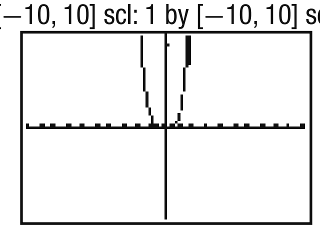
[−10, 10] scl: 1 by [−10, 10] scl: 1



[−10, 10] scl: 1 by [−10, 10] scl: 1



[−10, 10] scl: 1 by [−10, 10] scl: 1



[−10, 10] scl: 1 by [−10, 10] scl: 1

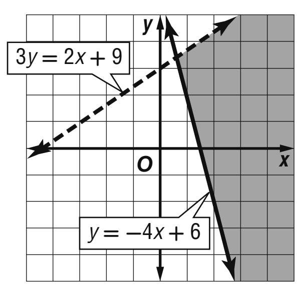
51b.

Function	Inverse a function?
$y = x^0$ or $y = 1$	no
$y = x^1$ or $y = x$	yes
$y = x^2$	no
$y = x^3$	yes
$y = x^4$	no

51c. n is odd.

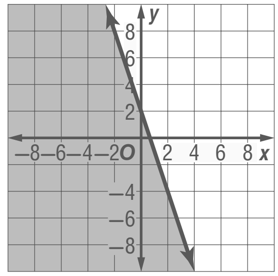
53. Sample answer: $f(x) = 2x$, $f^{-1}(x) = 0.5x$; $f[f^{-1}(x)] = f^{-1}[f(x)] = x$ **55.** $y^{-1} = \frac{1}{m}x - \frac{b}{m}$ **57.** 30 in. **59.** J **61.** 12 **63.** 0 **65.** (3, −1, 4) **67.** (4, −3, −2)

69.



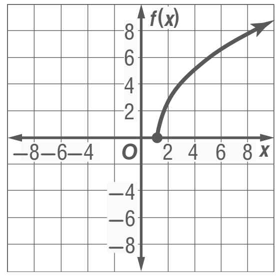
71. $\frac{1}{2}$ **73.** $\frac{3}{2}$

75.

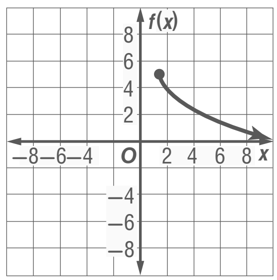


Lesson 5-3

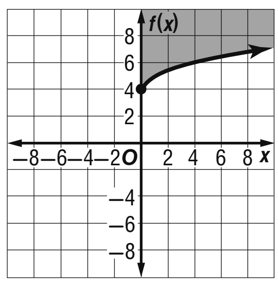
1. $D = \{x \mid x \geq 0\}$; $R = \{f(x) \mid f(x) \geq 0\}$
3. $D = \{x \mid x \geq -8\}$; $R = \{f(x) \mid f(x) \geq -2\}$
5. $D = \{x \mid x \geq 1\}$; $R = \{f(x) \mid f(x) \geq 0\}$



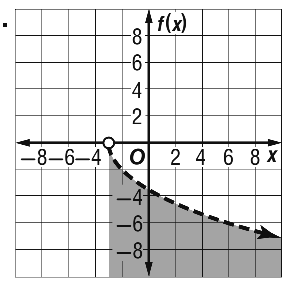
7. $D = \left\{x \mid x \geq \frac{5}{3}\right\}$; $R = \{f(x) \mid f(x) \leq 5\}$



9.

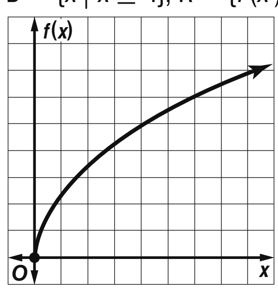


11.



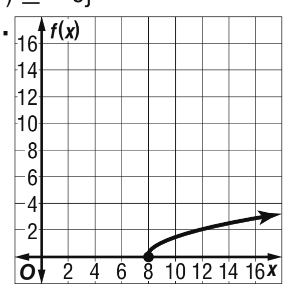
13. $D = \{x \mid x \geq 0\}$; $R = \{f(x) \mid f(x) \leq 2\}$
15. $D = \{x \mid x \geq 2\}$; $R = \{f(x) \mid f(x) \geq -8\}$
17. $D = \{x \mid x \geq 4\}$; $R = \{f(x) \mid f(x) \geq -6\}$

19.



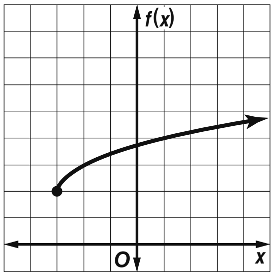
$D = \{x \mid x \geq 0\}$;
$R = \{f(x) \mid f(x) \geq 0\}$

21.



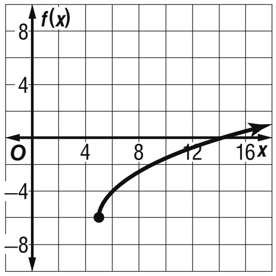
$D = \{x \mid x \geq 8\}$;
$R = \{f(x) \mid f(x) \geq 0\}$

23.



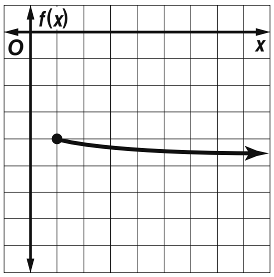
$D = \{x \mid x \geq -3\}$;
$R = \{f(x) \mid f(x) \geq 2\}$

25.



$D = \{x \mid x \geq 5\}$;
$R = \{f(x) \mid f(x) \geq -6\}$

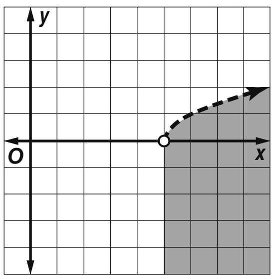
27.



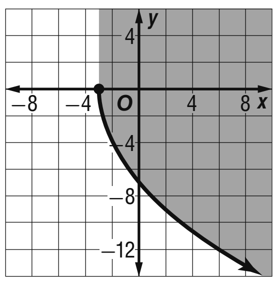
$D = \{x \mid x \geq 1\}$; $R = \{f(x) \mid f(x) \leq -4\}$

29. 1936 ft

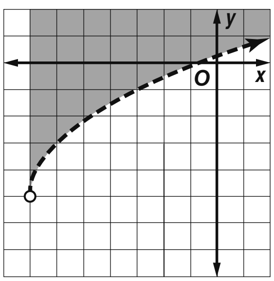
31.



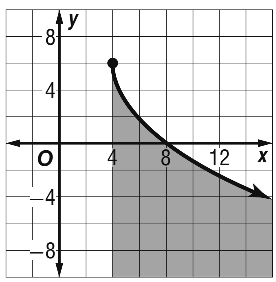
33.



35.



37.

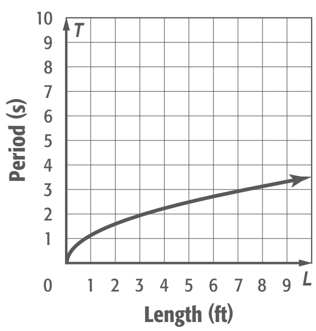


39a. $v = \sqrt{\frac{2E}{m}}$

39b. about 36.5 m/s **39c.** about 85,135 m/s

41. $y = \sqrt{x - 4} - 6$ **43.** $y = -\sqrt{x + 6} - 6$

45.



45b. 1.57 *s*, 2.48 *s*, 3.14 *s*

47. Sample answer: $y = -\sqrt{x + 4} + 6$

51. Molly; $y = \sqrt{5x + 10}$ has an x-intercept of -2 and would be to the right of the given graph.

53a. Sample answer: The original is $y = x^2 + 2$ and inverse is $y = \pm\sqrt{x - 2}$.

53b. Sample answer: The original is $y = \pm\sqrt{x} + 4$ and inverse is $y = (x - 4)^2$.

55. G **57.** E **59.** no **61.** $[d \circ h](m) = \frac{m}{1440}$

63. rational **65.** rational

Lesson 5-4

1. $\pm 10y^4$ **3.** $(y - 6)^4$ **5.** $\pm 4iy^2$ **7.** 7.616 **9.** -2.122

11. about 4.088×10^8 m **13.** $\pm 15a^8b^{18}$

15. $-4c^2|d|$ **17.** $-20x^{16}y^{20}$ **21.** $2a^2b^4$ **23.** $3b^6c^4$

25. $\pm i(x + 2)^4$ **27.** $|x^3|$ **29.** a^4 **31.** $(4x - 7)^8$

33. $4|(5x - 2)^3|$ **35.** $2a^3b^2$ **37.** 8 cm **39.** -12.247

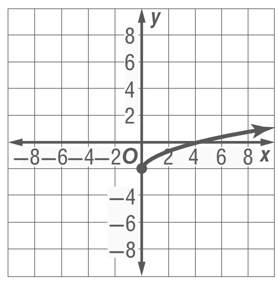
41. 0.787 **43.** -5.350 **45.** 29.573 **47.** $14|c^3|d^2$

49. $-3a^5b^3$ **51.** $20x^8|y^3|$ **53.** $4(x + y)^2$

55. about 141 million mi **57.** bald eagle: ≈ 226.5 Cal/d; golden retriever: ≈ 939.6 Cal/d; komodo dragon: ≈ 1811.8 Cal/d; bottlenose dolphin: ≈ 3235.5 Cal/d; Asian elephant: ≈ 24,344.4 Cal/d **59.** Kimi; Ashley's error was keeping the y^2 inside the absolute value symbol. **61.** Sample answer: Sometimes; when $x = -3$, $\sqrt[4]{(-x)^4} = |(-x)|$ or 3. When $x = 3$, $\sqrt[4]{(-x)^4} = |3|$ or 3. **63.** Sample answers: 1, 64 **65.** $2\sqrt[3]{2xy}$

67. -0.1 **69.** $\frac{1}{625}$ **71.** G **73.** B

75.



77. 3.41 kg and 49.53 cm **79.** $4x^2 + 22x - 34$

81. $4a^4 + 24a^2 + 36$ **83.** $20 + 5x = 100$; 16 bags

85. $y^2 + y - 12$ **87.** $a^2 - 4ab + 3b^2$

89. $2w^2 - 6wz - 8z^2$

Lesson 5-5

1. $6b^2c^2\sqrt{ac}$ **3.** $\frac{c^2\sqrt{cd}}{d^5}$ **5.** $60x$ **7.** $36xy$

9. $20\sqrt{2} + 13\sqrt{3}$ **11.** $12\sqrt{3} + 16\sqrt{5} + 40 + 6\sqrt{15}$

13. $15 - \frac{5\sqrt{2}}{7}$ **15.** $-2 - \sqrt{2}$ **17.** $32 - 2\sqrt{3}$ cm

19. $3a^7b\sqrt{ab}$ **21.** $3|a^3|bc^2\sqrt{2bc}$

23. $\frac{\sqrt{70xy}}{10y^2}$ **25.** $\frac{\sqrt[4]{28b^2x^3}}{2|b|}$ **27.** $32a^5b^3\sqrt{b}$ **29.** $25x^6y^3\sqrt{2xy}$

31. $18\sqrt{3} + 14\sqrt{2}$ **33.** $9\sqrt{6} + 72\sqrt{2} - 7\sqrt{3}$

35. $8\sqrt{6} + 3\sqrt{2}$ ft^2 **37.** $56\sqrt{3} + 42\sqrt{6} - 36\sqrt{2}$

39. 1260 **41.** $6\sqrt{3} + 6\sqrt{2}$ **43.** $\frac{20 - 7\sqrt{3}}{11}$

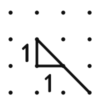
45. $2yz^4\sqrt[3]{2y}$ **47.** $3|a|b^3\sqrt[4]{2a^2bc}$ **49.** $\frac{\sqrt[4]{1500a^2b^3x^3y^2}}{5|a|b}$

51. $\frac{(x+1)(\sqrt{x}+1)}{x-1}$ or $\frac{x\sqrt{x}+\sqrt{x}+x+1}{x-1}$

53. $\frac{\sqrt{x^3-x}}{x^2-1}$ **55.** $|a|$ **57.** a^2

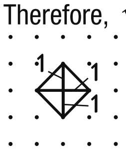
59a. $a^2+b^2=c^2$
$1^2+1^2=c^2$
$2=c^2$
$c=\sqrt{2}$

59b.



59c. $\sqrt{2}+\sqrt{2}$ units is the length of the hypotenuse of an isosceles right triangle with legs of length 2 units. Therefore, $\sqrt{2}+\sqrt{2}>2$.

59d.



59e. The square creates 4 triangles with a base of 1 and a height of 1. Therefore the area of each triangle is $\frac{1}{2}bh=\frac{1}{2}(1)(1)$ or $\frac{1}{2}\cdot 4\left(\frac{1}{2}\right)=2$. The area of the square is 2, so $\sqrt{2}\cdot\sqrt{2}=2$.

61. $\left(\frac{-1-i\sqrt{3}}{2}\right)^3=\left(\frac{-1-i\sqrt{3}}{2}\right)\cdot\left(\frac{-1-i\sqrt{3}}{2}\right)\cdot\left(\frac{-1-i\sqrt{3}}{2}\right)$

$=\frac{(-1-i\sqrt{3})(-1-i\sqrt{3})(-1-i\sqrt{3})}{8}$

$=\frac{(1+i\sqrt{3}+i\sqrt{3}+3i^2)(-1-i\sqrt{3})}{8}$

$=\frac{(2i\sqrt{3}-2)(-1-i\sqrt{3})}{8}$

$=\frac{-2i\sqrt{3}-6i^2+2+2i\sqrt{3}}{8}$

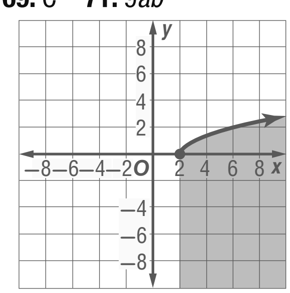
$=\frac{-6i^2+2}{8}=\frac{8}{8}$ or 1

63. $a=1, b=256$; $a=2, b=16$; $a=4, b=4$; $a=8, b=2$

65. Sample answer: It is only necessary to use absolute values when it is possible that n could be odd or even and still be defined. It is when the radicand must be nonnegative in order for the root to be defined that the absolute values are not necessary.

67. G **69.** C **71.** $9ab^3$

73.



75. $-4, 4, -i, i$ **77.** $-4, 2+2i\sqrt{3}, 2-2i\sqrt{3}$

79. $\frac{3}{2}, \frac{-3+3i\sqrt{3}}{4}, \frac{-3-3i\sqrt{3}}{4}$ **81.** 9 small, 4 large

83. $\frac{1}{3}$ **85.** $\frac{7}{12}$ **87.** $\frac{5}{12}$

Lesson 5-6

1. $\sqrt[4]{10}$ **3.** $15^{\frac{1}{3}}$ **5.** 7 **7.** 25 **9.** 13 ft **11.** $h^{\frac{3}{5}}$ **13.** $\sqrt{3g}$

15. $\frac{g-2g^{\frac{1}{2}}+1}{g-1}$ **17.** $\sqrt[7]{16}$ **19.** $\sqrt{x^9}$ **21.** $63^{\frac{1}{4}}$ **23.** $5x^{\frac{1}{2}}$

25. 4 **27.** $\frac{1}{3}$ **29.** about 2.64 cm **31.** $a^{\frac{25}{36}}$ **33.** $\frac{y^{\frac{1}{5}}}{y}$ **35.** $\sqrt{3}$

37. $\sqrt[3]{9}\cdot\sqrt{g}$ **39.** $\frac{x+4x^{\frac{3}{4}}+8x^{\frac{1}{2}}+16x^{\frac{1}{4}}+16}{x-16}$

41. $28.27\ x^{\frac{4}{3}}\ y^{\frac{2}{5}}\ z^4$ units^2 **43.** $6-2\cdot 4^{\frac{1}{3}}$ **45.** $x^{\frac{10}{3}}$ **47.** $y^{\frac{3}{20}}$

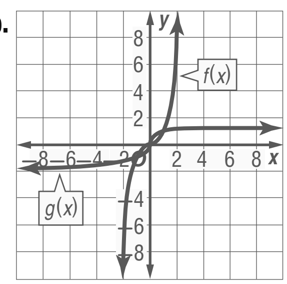
49. $\sqrt{6}$ **51.** $\frac{w^{\frac{1}{8}}}{w}$ **53.** $\frac{f^{\frac{7}{14}}}{4f}$ **55.** $c^{\frac{1}{2}}$ **57.** $23\sqrt[6]{23}$ **59.** 3

61. $\frac{ab\sqrt{c}}{c}$ **63.** $2\sqrt{6}-5$

65a.

x	$f(x)$	$g(x)$
−2	−8	1.26
−1	−1	−1
0	0	0
1	1	1
2	8	1.26

65b.



65c. It is a reflection in the line $y=x$.

67a. Sample answer:
$\sqrt[4]{(-16)^3}=\sqrt[4]{-4096}$; there is no real number that when raised to the fourth power results in a negative number.

67b. Sample answer: $\sqrt[4]{-1}$

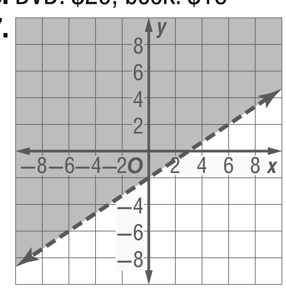
69. Sample answer: It may be easier to simplify an expression when it has rational exponents because all the properties of exponents apply. We do not have as many properties dealing directly with radicals. However, we can convert all radicals to rational exponents, and then use the properties of exponents to simplify.

71. B **73.** C **75.** $9\sqrt{3}$ **77.** $6y^2z\sqrt[3]{7}$ **79.** -6; $x+h-2$

81. -21; $6x+6h+3$ **83.** 20; $x^2+2xh+h^2-x-h$

85. DVD: \$20; book: \$15

87.



-4 if $x\leq -2$

89. $y = \begin{cases} -2x + 3 \text{ if } -2 < x < 1 \\ x - 5 \text{ if } x \geq 2 \\ -8 \text{ if } x \leq -2 \end{cases}$

91. $y = \begin{cases} x + 12 \text{ if } x \leq -6 \\ 8 \text{ if } -6 < x < 2 \\ -2.5x + 15 \text{ if } x \geq 2 \end{cases}$

93. $3x - 4$ **95.** $x - 8\sqrt{x} + 16$ **97.** $9x + 6\sqrt{x} + 1$

Lesson 5-7

1. 20 **3.** 13 **5.** 29 **7.** 2 **9.** 49 **11.** $\frac{27}{2}$

13a. about 9.5 seconds **13b.** about 324 ft

15. $-\frac{4}{3} \leq x \leq \frac{77}{3}$ **17.** $1 \leq y \leq 5$ **19.** $x > 1$ **21.** $x \leq -11$

23. 22 **25.** 3 **27.** no real solution **29.** $\frac{1}{4}$ **31.** 9 **33.** $\frac{81}{16}$

35. 1 m **37.** 3 **39.** 83 **41.** 61 **43.** 3 **45.** 18 **47.** 2

49. F **51.** $x \geq 43$ **53.** no real solution **55.** $d > -\frac{3}{4}$

57. $-\frac{5}{2} \leq y \leq 2$ **59.** $a > 8$ **61.** $0 \leq c < 3$ **63.** $M = \left(\frac{L}{0.46}\right)^2$

65. about 282 ft **67.** $\sqrt{x + 2} - 7 = -10$

69. never;

$$\frac{\sqrt{(x^2)^2}}{-x} = x$$

$$\frac{\sqrt{(x^2)^2}}{-x} = x$$

$$\frac{x^2}{-x} = x$$

$$x^2 = (x)(-x)$$

$$x^2 \neq -x^2$$

71. They are the same number. **73.** 3

75. Sometimes; sample answer: when the radicand is negative, then there will be extraneous roots. **77.** G **79.** A **81.** 81

83. $4x^2y^2\sqrt{5}$ **85.** $y^{-1} = \frac{-x - 3}{2}$

87. $y^{-1} = \pm\frac{1}{2}\sqrt{x} - \frac{3}{2}$

89a. $f(x) \to +\infty$ as $x \to +\infty$, $f(x) \to +\infty$ as $x \to -\infty$;

89b. even; **89c.** 0

91. $\frac{1}{6}$ **93.** $\frac{5}{8}$ **95.** 16 **97.** $2\frac{1}{2}$

Chapter 5 Study Guide and Review

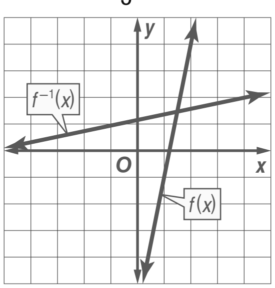
1. identity function **3.** composition of functions **5.** rationalizing the denominator **7.** inverse relations **9.** radical function

11. $[f \circ g](x) = x^2 - 14x + 50$ $[g \circ f](x) = x^2 - 6$

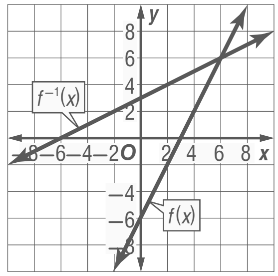
13. $[f \circ g](x) = 20x - 4$ $[g \circ f](x) = 20x - 1$

15. $[f \circ g](x) = x^2 + 4x$ $[g \circ f](x) = x^2 + 2x - 2$

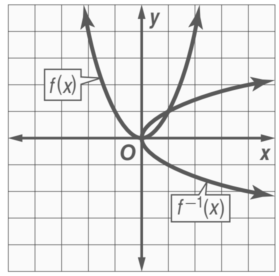
17. $f^{-1}(x) = \frac{x + 6}{5}$



19. $f^{-1}(x) = 2x - 6$

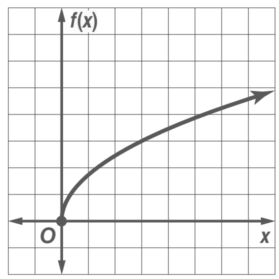


21. $f^{-1}(x) = \pm\sqrt{x}$



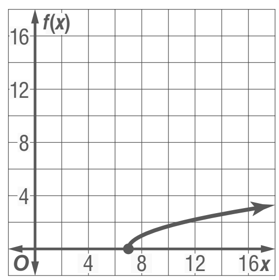
23. \$1200 **25.** yes **27.** no **29.** no

31.



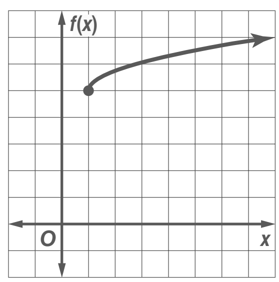
D = $\{x \mid x \geq 0\}$; R = $\{f(x) \mid f(x) \geq 0\}$

33.



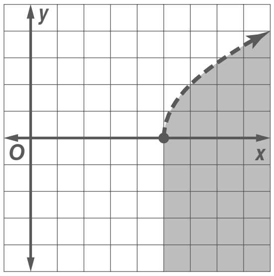
D = $\{x \mid x \geq 7\}$; R = $\{f(x) \mid f(x) \geq 0\}$

35.



D = $\{x \mid x \geq 1\}$; R = $\{f(x) \mid f(x) \geq 5\}$

37. about 9.8 in.

39.


41. ± 11 **43.** 6 **45.** $(x^2 + 2)^3$ **47.** $a^2|b^3|$ **49.** 10 m/s

51. $12ab^2\sqrt{ab}$ **53.** $80\sqrt{2}$ **55.** $\frac{m^2\sqrt{6}mp}{p^6}$

57. $-\sqrt{15} - 3\sqrt{2}$ **59.** $x^{\frac{7}{6}}$ **61.** $\frac{d^{\frac{5}{12}}}{d}$ **63.** 3

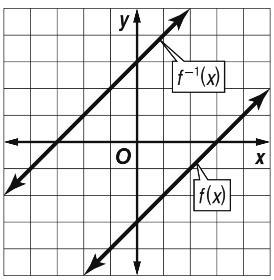
65. $4a^{\frac{2}{3}}b^{\frac{4}{5}}c^2\pi$ units^2 **67.** $\frac{100}{g}$ **69.** 2 **71.** no solution

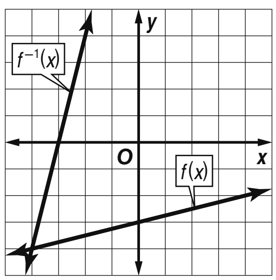
73. 3 **75.** $\frac{1}{3} \le x \le \frac{10}{3}$ **77.** $x \ge \frac{4}{3}$ **79.** no solution **81.** $x > \frac{5}{2}$

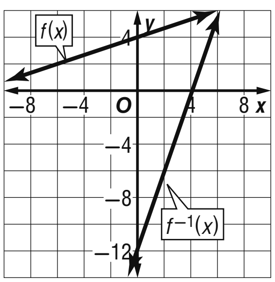
CHAPTER 6
Exponential and Logarithmic Functions and Relations

Chapter 6 Get Ready

1. a^{12} **3.** $\frac{-3x^6}{2y^3z^5}$ **5.** 5 g/cm^3

7. $f^{-1}(x) = x + 3$


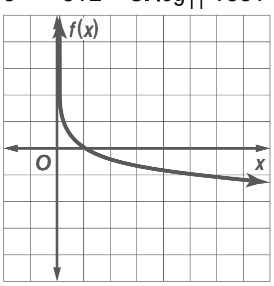
9. $f^{-1}(x) = 4x + 12$


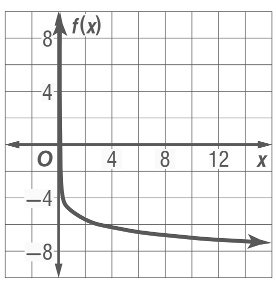
11. $f^{-1}(x) = 3x - 12$


13. no

Lesson 6-1

1. $8^3 = 512$ **3.** $\log_{11} 1331 = 3$ **5.** 2 **7.** 0

9.


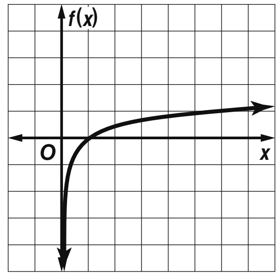
11


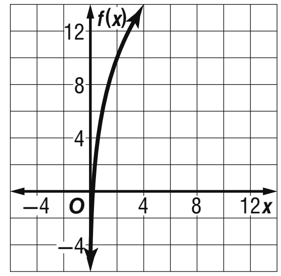
13. $2^4 = 16$ **15.** $9^{-2} = \frac{1}{81}$ **17.** $12^2 = 144$

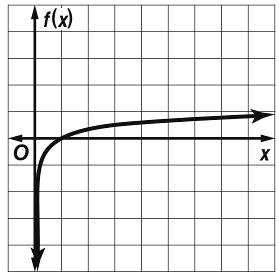
19. $\log_9 \frac{1}{9} = -1$ **21.** $\log_2 256 = 8$

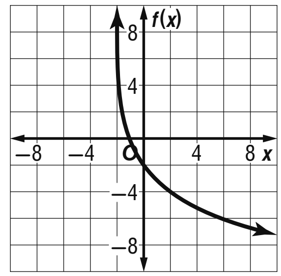
23. $\log_{27} 9 = \frac{2}{3}$ **25.** −2 **27.** 3 **29.** $\frac{1}{3}$ **31.** $\frac{1}{2}$ **33.** −5

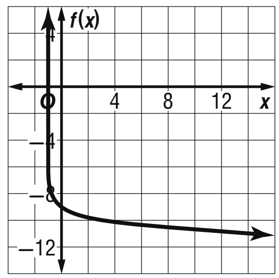
35. 4

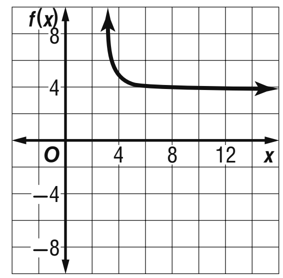
37.


39.


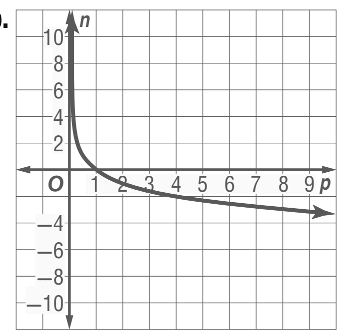
41.


43.


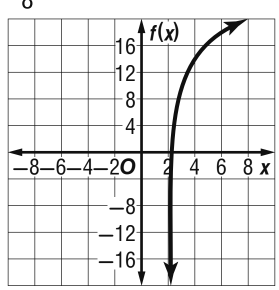
45.


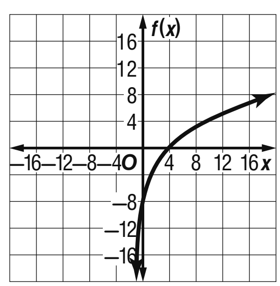
47.


49a. 2

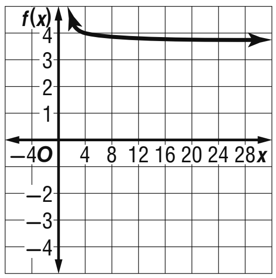
49b.


49c. $\frac{1}{8}$; less light

51.


53.


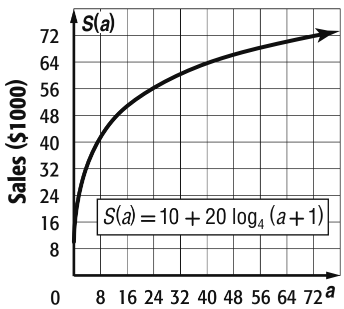
55.



57a. $S(3) = 30$, $S(15) = 50$, $S(63) = 70$

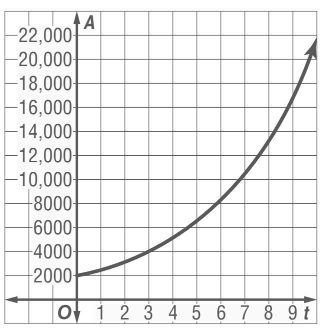
57b. If \$3000 is spent on advertising, \$30,000 is returned in sales. If \$15,000 is spent on advertising, \$50,000 is returned in sales. If \$63,000 is spent on advertising, \$70,000 is returned in sales.

57c. **Sales versus Money Spent on Advertising**



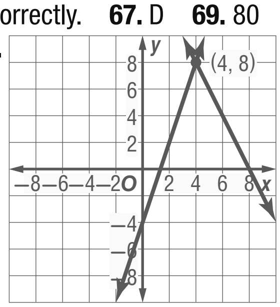
57d. Because eventually the graph plateaus, and no matter how much money you spend you are still returning about the same in sales.

59a.

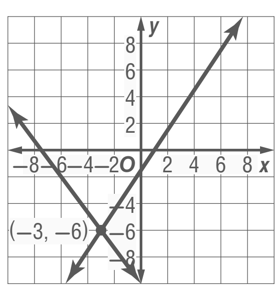


59b. ≈ 3 years **59c.** ≈ 4.5 years **61.** Never; if zero were in the domain, the equation would be $y = \log_b 0$. Then $b^y = 0$. However, for any real number b, there is no real power that would let $b^y = 0$. **63.** $\log_7 51$; sample answer: $\log_7 51$ equals a little more than 2. $\log_8 61$ equals a little less than 2. $\log_9 71$ equals a little less than 2. Therefore, $\log_7 51$ is the greatest.
65. No; Elisa was closer. She should have $-y = 2$ or $y = -2$ instead of $y = 2$. Matthew used the definition of logarithms incorrectly. **67.** D **69.** 80

71.



73.



75. −26 **77.** $\frac{27\sqrt{15}}{4}$ ft^2
79. batteries, \$74; spark plugs, \$58; wiper blades, \$48
81. −1 **83.** $\{x \mid x \leq -\sqrt{6} \text{ or } x \geq \sqrt{6}\}$

Lesson 6-2

1. 16 **3.** C **5.** $\left\{x \,\middle|\, 0 < x \leq \frac{1}{64}\right\}$ **7.** $\left\{x \,\middle|\, 2 > x > \frac{4}{3}\right\}$
9. 3125 **11.** −2 **13.** 9 **15.** 4 or −3 **17.** 5 **19.** −3
21. 318 mph **23.** $\{x \mid x \geq 256\}$ **25.** $\left\{x \,\middle|\, 0 < x \leq \frac{1}{4}\right\}$
27. $\left\{x \,\middle|\, 0 < x < \frac{1}{7}\right\}$ **29.** $\left\{x \,\middle|\, \frac{1}{2} < x \leq 1\right\}$
31. $\left\{x \,\middle|\, -\frac{5}{12} < x \leq 1\right\}$ **33.** $\{x \mid x \geq 8\}$ **35a.** 37 **35b.** 61
37a. 120 **37b.** 100
37c. Sample answer: The power of the logarithm only changes by 2. The power is the answer to the logarithm. That 2 is multiplied by the 10 before the logarithm. So we expect the decibels to change by 20.
39. $6\frac{17}{20}$
41. The logarithmic function of the form $y = \log_b x$ is the inverse of the exponential function of the form $y = b^x$. The domain of one of the two inverse functions is the range of the other. The range of one of the two inverse functions is the domain of the other.
43a. *less than* **43b.** *less than* **43c.** *no* **43d.** *infinitely many*
45. C **47.** B **49.** 4 **51.** 3 **53.** −3 **55.** 1 \$100, 3 \$50, and 6 \$20 checks **57.** about 20 ft^2 **59.** x^8 **61.** $8p^6n^3$
63. x^3y^4

Lesson 6-3

1. 2.085 **3.** 0.3685 **5.** Mt. Everest: 26,855.44 pascals; Mt. Trisuli: 34,963.34 pascals; Mt. Bonete: 36,028.42 pascals; Mt. McKinley: 39,846.22 pascals; Mt. Logan: 41,261.82 pascals **7.** 2.4182 **9.** 2 **11.** 13.4403 **13.** 2.1610
15. 0.2075 **17.** 1.5 **19.** 2.1606 **21.** 3.4818
23. 8 **25.** 2 **27a.** $d = \frac{1}{10^P - 1}$ **27b.** 4 **27c.** 30.1%
29. 2.1133 **31.** 0.1788 **33.** 1.7228 **35.** 2.0478
37. 3 **39.** 5 **41.** $85\frac{1}{3}$ **43.** $\left(\frac{x-2}{256}\right)^{\frac{1}{6}}$ **45.** $\sqrt{6}, -\sqrt{6}$
47. 5 **49.** 12 **51.** false **53.** false **55.** true **57.** false
59a. 10^{12} **59b.** 10^4 or about 10,000 times
61a. Sample answer: $\log_b \frac{xz}{5} = \log_b x + \log_b z - \log_b 5$
61b. Sample answer: $\log_b m^4p^6 = 4 \log_b m + 6 \log_b p$
61c. Sample answer: $\log_b \frac{j^8k}{h^5} = 8 \log_b j + \log_b k - 5 \log_b h$
63a. $\log_b 1 = 0$, because $b^0 = 1$.
63b. $\log_b b = 1$, because $b^1 = b$.
63c. $\log_b b^x = x$, because $b^x = b^x$.
65. $\log_b 24 \neq \log_b 20 + \log_b 4$; all other choices are equal to $\log_b 24$.

67. $x^{3\log_x 2 - \log_x 5} = x^{\log_x 2^3 - \log_x 5}$
$= x^{\log_x 8 - \log_x 5}$
$= x^{\log_x \frac{8}{5}}$
$= \frac{8}{5}$

69. D **71.** growing exponentially **73.** $\frac{1}{2}$, 1

75. no solution **77.** $2x$ **79.** 6.3 **81.** no **83.** $\frac{3}{5}$ **85.** 10

87. $\{x \mid x > 26\}$

Lesson 6-4

1. 0.6990 **3.** −0.3979 **5.** $3.55 \times 10_{24}$ ergs **7.** 0.8442

9. 9.1237 **11.** $\{p \mid p \leq 4.4190\}$ **13.** $\frac{\log 23}{\log 4} \approx 2.2618$

15. $\frac{\log 5}{\log 2} \approx 2.3219$ **17.** 1.0414 **19.** 0.9138 **21.** −1.3979

23. 1.7740 **25.** 5.9647 **27.** ±1.1691 **29.** $\{n \mid n > 0.6667\}$

31. $\{y \mid y \geq -3.8188\}$ **33.** $\frac{\log 18}{\log 7} \approx 1.4854$ **35.** $\frac{\log 16}{\log 2} = 4$

37. $\frac{\log 11}{\log 3} \approx 2.1827$ **39a.** 62,737 owners **39b.** 2022

41. 3.3578 **43.** −0.0710 **45.** 4.7393 **47.** $\{x \mid x \geq 2.3223\}$

49. $\{x \mid x \leq 0.9732\}$ **51.** $\{p \mid p \leq 2.9437\}$ **53.** $\frac{\log 12}{\log 4} \approx 1.7925$

55. $\frac{\log 2}{\log 8} = 0.3333$ **57.** $\frac{\log 7.29}{\log 5} \approx 1.2343$ **59a.** 113.03 cents

59b. about 218 Hz **61.** $\pm\sqrt{5} \approx \pm 2.2361$ **63.** 3.5

65. −3.8188 **67a.** The solution is between 1.8 and 1.9.

67b. (1.85, 13) **67c.** Yes; all methods produce the solution of 1.85. They all should produce the same result because you are starting with the same equation. If they do not, then an error was made.

69.

$\log_{\sqrt{a}} 3 = \log_a x$	Original equation
$\frac{\log_a 3}{\log_a \sqrt{a}} = \log_a x$	Change of Base Formula
$\frac{\log_a 3}{\frac{1}{2}} = \log_a x$	$\sqrt{a} = a^{\frac{1}{2}}$
$2\log_a 3 = \log_a x$	Multiply numerator and denominator by 2.
$\log_a 3^2 = \log_a x$	Power Property of Logarithms
$3^2 = x$	Property of Equality for Logarithmic Functions
$9 = x$	Simplify.

71. $\log_3 27 = 3$ and $\log_{27} 3 = \frac{1}{3}$; Conjecture: $\log_a b = \frac{1}{\log_b a}$

Proof:

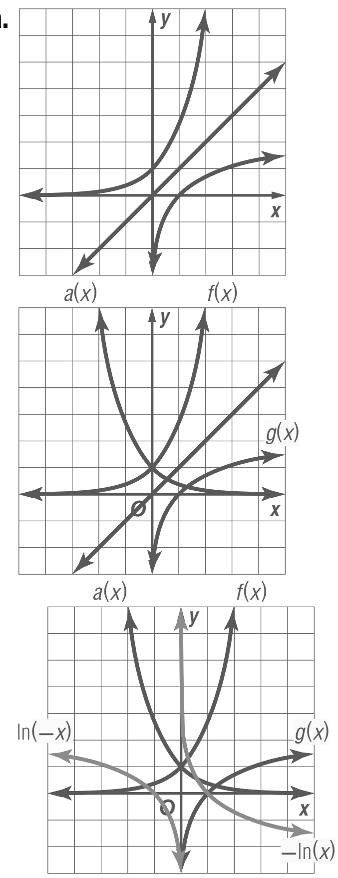
$\log_a b \stackrel{?}{=} \frac{1}{\log_b a}$	Original statement
$\frac{\log_b b}{\log_b a} \stackrel{?}{=} \frac{1}{\log_b a}$	Change of Base Formula
$\frac{1}{\log_b a} = \frac{1}{\log_b a}$	Inverse Property of Exponents and Logarithms

73. B **75.** G **77.** 14 **79.** 15 **81.** 2 **83.** −4, 3 **85.** $32x^3 + 8x^2 - 24x + 16$ **87.** $2^x = 5$ **89.** $5^2 = 25$ **91.** $6^4 = x$

Lesson 6-5

1. $\ln 30 = x$ **3.** $\ln x = 3$ **5.** 7 ln 2 **7.** ln 17496 **9.** 2.0794 **11.** 0.1352 **13.** 993.6527 **15.** $\{x \mid -25.0855 < x < 15.0855, x \neq -5\}$ **17.** $\{x \mid x > 3.3673\}$ **19.** about 58 min **21.** $\ln 0.1 = -5x$ **23.** $5.4 = e^x$ **25.** $e^{36} = x + 4$ **27.** $e^7 = e^x$ **29.** 7 ln 10 **31.** −2 ln 2 **33.** $\ln 81x^6$ **35.** 3.7955 **37.** 0.6931 **39.** −0.5596 **41.** $\{x \mid x \leq 2.1633\}$ **43.** $\{x \mid x > 8.0105\}$ **45.** $\{x \mid x < -239.8802 \text{ or } x > 239.8802\}$ **47a.** \$1001.86 **47b.** about 15.4 yr **47c.** about 7.7% **47d.** about \$5655.25 **49.** $4\ln 2 - 3\ln 5$ **51.** $\ln x + 4\ln y - 3\ln z$ **53.** −0.8340 **55.** 1.1301

57a.



57b. y-axis; $a(x) = -e^x$ **57c.** $\ln(-x)$ is a reflection across the y-axis. −ln x is a reflection across the x-axis. **57d.** Sample answer: no; These functions are reflections along $y = -x$, which indicates that they are not inverses.

59. Let $p = \ln a$ and $q = \ln b$. That means that $e^p = a$ and $e^q = b$.

$ab = e^p \times e^q$
$ab = e^{p + q}$
$\ln(ab) = (p + q)$
$\ln(ab) = \ln a + \ln b$

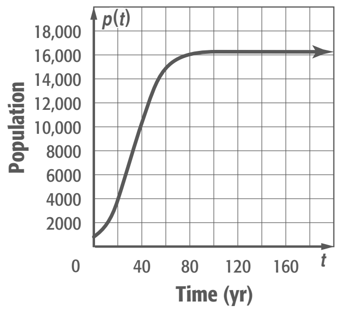
61. Sample answer: $e^{\ln 3}$ **63.** B **65.** G **67.** 5.7279 **69.** $x < 7.3059$ **71.** $x \geq 5.8983$ **73.** 10 decibels **75.** $x^2 + 2x + 3$

77. $\frac{2}{3}$ **79.** $-\frac{8}{3}$ **81.** $\frac{5}{3}0$

Lesson 6-6

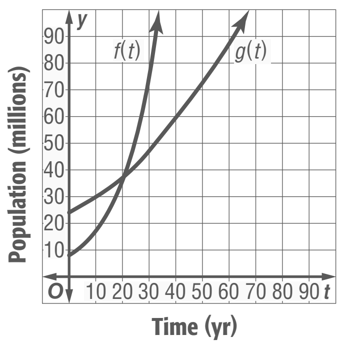
1a. 5.545×10^{-10} **1b.** 1,578,843,530 yr **1c.** about 30.48 mg **1d.** 3,750,120,003 yr

3a.



3b. $P(t) = 16{,}500$ **3c.** 16,500 **3d.** about 102 years **5a.** $k \approx 0.071$ **5b.** about 60.8 min **5c.** about 30.85 min **7.** about 1354 yr old **9.** about 14.85 billion yr **11.** about 20.1 yr

13a.



13b. The graphs intersect at $t = 20.79$. Sample answer: This intersection indicates the point at which both functions determine the same population at the same time.
13c. Sample answer: The logistic function $g(t)$ is a more accurate estimate of the country's population since $f(t)$ will continue to grow exponentially and $g(t)$ considers limitations on population growth such as food supply. **15.** $t \approx 113.45$ **17.** Sample answer: The spread of the flu throughout a small town. The growth of this is limited to the population of the town itself. **19.** C **21.** D

23. $\ln y = 7$ **25.** $5x^4 = e^9$ **27.** $\frac{1}{6}$ **29.** $\frac{5}{8}$ **31.** 16 **33.** $2\frac{1}{2}$

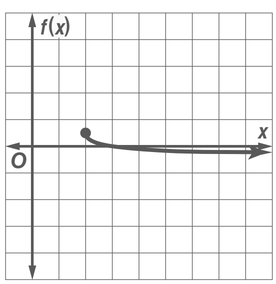
Chapter 6 Study Guide and Review

1. logarithm **3.** change of base formula

5. natural base exponential function **7.** natural base

9. $\log_{10} 100 = 2$ **11.** -3

13.



15. -6 **17.** $\left\{x \mid 0 < x < \frac{1}{125}\right\}$ **19.** -6 **21.** 1000

23. 2.5841 **25.** -1.2921 **27.** 30 **29.** $2\sqrt{3}$ **31.** 361.6 times

33. $x \approx \pm 1.3637$ **35.** $r \approx 4.6102$ **37.** $\{x \mid x \leq -6.3013\}$

39. 1.9459 **41.** 201.7144 **43.** $\{x \mid -3 < x < -0.2817\}$

45. about 17.2 years **47.** $\approx$5.8 days

CHAPTER 7

Rational Functions and Relations

Chapter 7 Get Ready

1. $x = \frac{15}{14}$ **3.** $k = \frac{32}{5}$ **5.** 27 gal **7.** $\frac{1}{18}$ **9.** $\frac{43}{6}$ **11.** $p = 27$
13. $k = 17.5$

Lesson 7-1

1. $\frac{x+3}{x+8}$ **3.** D **5.** $\frac{-x(a+b)}{y}$ **7.** $\frac{2x^2}{3aby^2}$ **9.** $\frac{(a-b)(a+1)}{12(a-1)}$

11. 4 **13.** $\frac{x(x+6)}{x+4}$ **15.** $\frac{(x+3)(x-z)}{4}$ **17.** $\frac{x(x+2)}{6(x+5)}$

19. J **21.** $\frac{x^2}{x+6}$ **23.** $-\frac{c+4}{c+5}$ **25.** $\frac{c}{4ab^2f^2}$

27. $\frac{32b}{3ac^3f^2}$ **29.** $\frac{5a^4c}{3b}$ **31.** $y + 5$ **33.** $\frac{(x+4)(x+2)}{2(x-5)}$

35. $\frac{(x-3)(x+1)}{6(x+7)}$ **37.** $\frac{-a^2(a+b)}{b^4}$ **39a.** $\frac{33}{121}$ **39b.** $\frac{33+m}{121+a}$

41a. $T(x) = \frac{0.4}{x+3}$ **41b.** about 3.9 mm thick

43. $\frac{1}{4}$ **45.** $\frac{x(x+2)(x-1)}{(x+3)(x-7)}$ **47.** $\frac{15y^3}{4a^2cxz}$ **49.** $\frac{2(4x+1)(2x+1)}{5(2x-1)(x+2)}$

51. $\frac{2x+1}{-9x(x+2)}$ **53.** $\frac{x(x-2)(x+8)}{2(2x-1)(3x+1)}$

55. $\frac{-2(x-8)(x+4)(x-2)(x+1)}{(2x+1)^2(x^2+2x-6)}$

57a. 5 tracks $\cdot \frac{2 \text{ miles}}{1 \text{ track}} \cdot \frac{5280 \text{ feet}}{1 \text{ mile}} \cdot \frac{1 \text{ car}}{75 \text{ feet}}$ **57b.** 704

57c. 70.4 h **59.** Sample answer: The two expressions are equivalent, except that the rational expression is undefined at $x = 3$. **61.** $x^2 + x - 6$ **63.** Sample answer: Sometimes; with a denominator like $x^2 + 2$, in which the denominator cannot equal 0, the rational expression can be defined for all values of x.
65. Sample answer: When the original expression was simplified, a factor of x was taken out of the denominator. If x were to equal 0, then this expression would be undefined. So, the simplified expression is also undefined for x. **67.** J **69.** 4π **71.** 0.2877

73. 0.2747 **75.** $10^{1.7}$ or about 50 times **77.** $2y\sqrt[3]{2}$

79. $2ab^2\sqrt{10a}$ **81.** $10a - 2b$ **83.** $-3y - 3y^2$

85. $x^2 + 9x + 18$

Lesson 7-2

1. $80x^3y^3$ **3.** $3y(y-3)(y-5)$ **5.** $\frac{48y^4 + 25x^2}{20xy^3}$

7. $\frac{21b^4 - 2}{36ab^3}$ **9.** $\frac{9x+15}{(x+3)(x+6)}$ **11.** $\frac{x-11}{3(x+2)(x-2)}$

13. $\frac{14x - 10}{(x + 1)(x - 2)}$ **15.** $\frac{3y + 2}{y + 3}$ **17.** $\frac{2a + 5b}{3b - 8a}$ **19.** $180x^2y^4z^2$

21. $6(x + 4)(2x - 1)(2x + 3)$ **23.** $\frac{28by^2z - 9bx}{105x^3y^4z}$

25. $\frac{20x^2y + 120y + 6x^2}{15x^3y}$ **27.** $\frac{15b^3 + 100ab^2 - 216a}{240ab^3}$

29. $\frac{10y - 4}{(y - 7)(y + 5)(y + 4)}$ **31.** $\frac{-10x - 10}{(2x - 1)(x + 6)(x - 3)}$

33. $\frac{2x^2 + 32x}{3(x - 2)(x + 3)(2x + 5)}$ **35.** $\frac{1000x + 800y}{x(x + 2y)}$ **37.** $\frac{13x + 21}{-3x + 73}$

39. $\frac{-x^2 + 33x + 16}{12x^2 + 11x - 27}$ **41.** $420x^5y^4z^3$

43. $(x + 4)(x - 4)\ (2x + 1)(x - 7)$ **45.** $\frac{360a^2 + 5a - 36}{60a^2}$

47. $\frac{42x + 41}{6(3x - 1)(x + 8)(2x + 3)}$ **49.** 0 **51.** $\frac{5a - 11}{6}$

53. $(x - 3)(x + 2)$ **55.** $-\frac{3}{2}$ **57.** -1 **59a.** $y = \frac{70x}{x - 70}$

59b. Sample answer: When the object is 70 mm away, y needs to be 0, which is impossible.

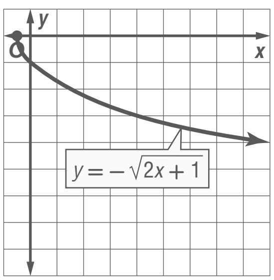
61a. $\frac{P_0s_0x - P_0s_0y}{(s_0 - x)(s_0 - y)}$ **61b.** about 55.2 Hz

63. $\frac{-3x^3 - 2x^2 + 16x - 5}{4x^3 + 18x^2 - 6x}$

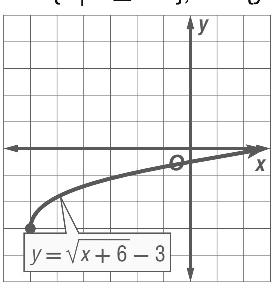
65. Sample answer: $20a^4b^2c$, $15ab^6$, $9abc$ **67.** D **69.** F

71. $-\frac{4bc}{33a}$ **73.** $(n + 3)(n - 6)$

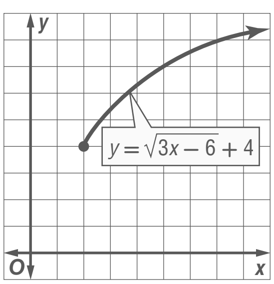
75. $D = \{x \mid x \geq -0.5\}$, $R = \{y \mid y \leq 0\}$



77. $D = \{x \mid x \geq -6\}$, $R = \{y \mid y \geq -3\}$

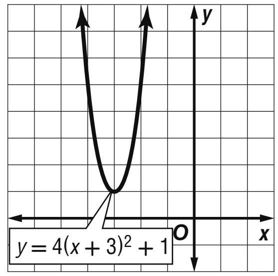


79. $D = \{x \mid x \geq 2\}$, $R = \{y \mid y \geq 4\}$

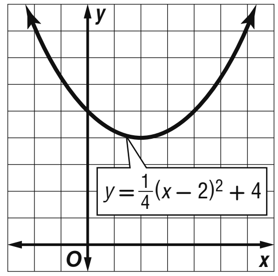


81. $-\frac{8}{3}$; 1 real **83.** 0, $3i$, $-3i$; 1 real, 2 imaginary

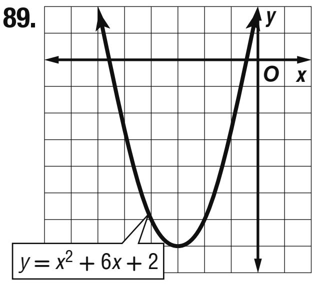
85.



87.



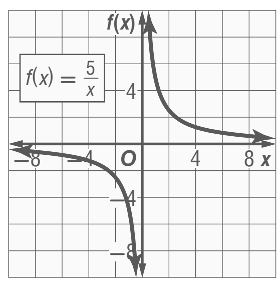
89.



Lesson 7-3

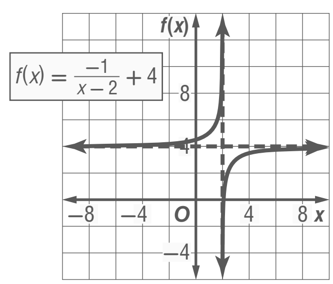
1. $x = 1$, $f(x) = 0$; $D = \{x | x \neq 1\}$; $R = \{f(x) | f(x) \neq 0\}$

3.



$D = \{x \mid x \neq 0\}$; $R = \{x(x) \mid f(x) \neq 0\}$

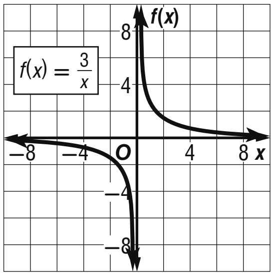
5.



$D = \{x \mid x \neq 2\}$; $R = \{f(x) \mid f(x) \neq 4\}$

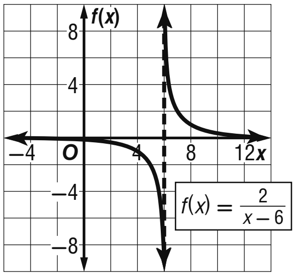
7. $x = -4$, $f(x) = 0$; $D = \{x | x \neq -4\}$; $R = \{f(x) | f(x) \neq 0\}$
9. $x = -6$, $f(x) = -2$; $D = \{x | x \neq -6\}$; $R = \{f(x) | f(x) \neq -2\}$

11.



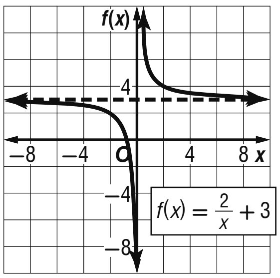
D = {x | $x \neq 0$}; R = {$f(x)$ | $f(x) \neq 0$}

13.



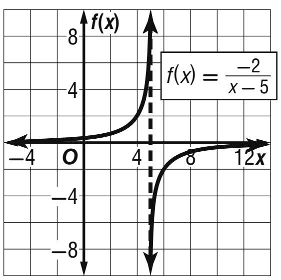
D = {x | $x \neq 6$}; R = {$f(x)$ | $f(x) \neq 0$}

15.



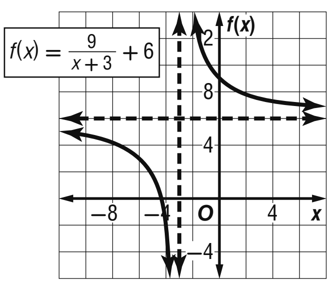
D = {x | $x \neq 0$}; R = {$f(x)$ | $f(x) \neq 3$}

17.



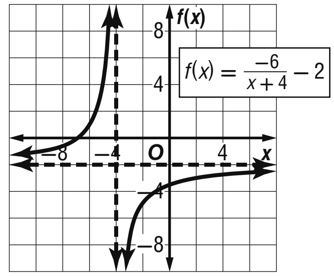
D = {x | $x \neq 5$}; R = {$f(x)$ | $f(x) \neq 0$}

19.



D = {x | $x \neq -3$}; R = {$f(x)$ | $f(x) \neq -3$}

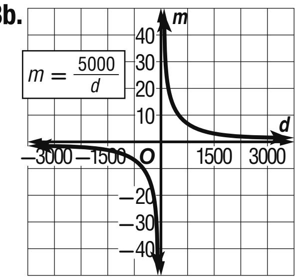
21.



D = {x | $x \neq -4$}; R = {$f(x)$ | $f(x) \neq -2$}

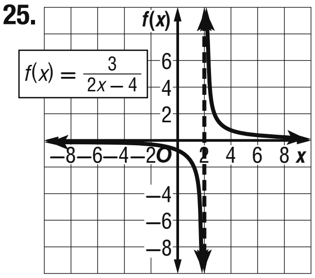
23a. $m = \frac{5000}{d}$

23b.



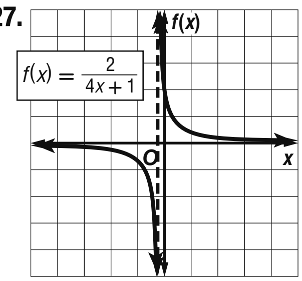
23c. 13.7 mi

25.



D = {x | $x \neq 2$}; R = {$f(x)$ | $f(x) \neq 0$}

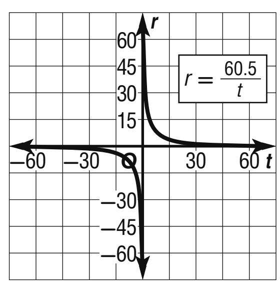
27.



D = $\left\{x \middle| x \neq -\frac{1}{4}\right\}$; R = {$f(x)$ | $f(x) \neq 0$}

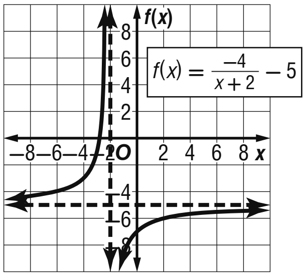
29a. $r = \frac{60.5}{t}$

29b.



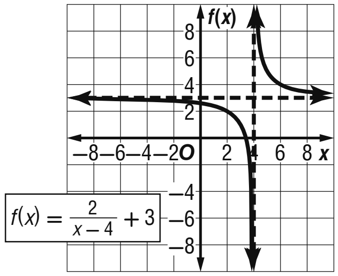
29c. 126 ft/s

31.



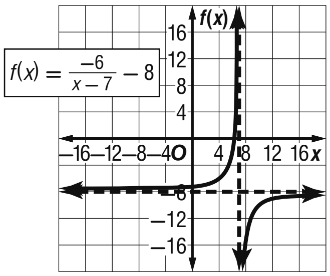
$D = \{x \mid x \neq -2\}$; $R = \{f(x) \mid f(x) \neq -5\}$; $x = -2$, $f(x) = -5$

33.



$D = \{x \mid x \neq 4\}$; $R = \{f(x) \mid f(x) \neq 3\}$; $x = 4$, $f(x) = 3$

35.

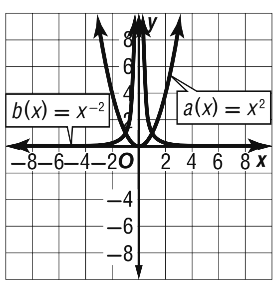


$D = \{x \mid x \neq 7\}$; $R = \{f(x) \mid f(x) \neq -8\}$; $x = 7$, $f(x) = -8$

37a.

x	$a(x) = x^2$	$b(x) = x^{-2}$	$c(x) = x^3$	$d(x) = x^{-3}$
−4	16	$\frac{1}{16}$	−64	$-\frac{1}{64}$
−3	9	$\frac{1}{9}$	−27	$-\frac{1}{27}$
−2	4	$\frac{1}{4}$	−8	$-\frac{1}{8}$
−1	1	1	−1	−1
0	0	undefined	0	undefined
1	1	1	1	1
2	4	$\frac{1}{4}$	8	$\frac{1}{8}$
3	9	$\frac{1}{9}$	27	$\frac{1}{27}$
4	16	$\frac{1}{16}$	64	$\frac{1}{64}$

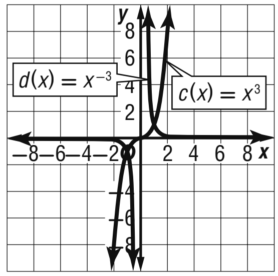
37b.



37c. $a(x)$: D = {all real numbers}, R = $\{a(x) \mid a(x) \geq 0\}$; as $x \to -\infty$, $a(x) \to \infty$, as $x \to \infty$, $a(x) \to \infty$; At $x = 0$, $a(x) = 0$, so there is a zero at $x = 0$.

$b(x)$: $D = \{x \mid x \neq 0\}$, R $\{b(x) \mid b(x) > 0\}$; as $x \to -\infty$, $a(x) \to 0$, as $x \to \infty$, $a(x) \to 0$; At $x = 0$, $b(x)$ is undefined, so there is an asymptote at $x = 0$.

37d.



37e. $c(x)$: D = {all real numbers}, R = {all real numbers}; as $x \to -\infty$, $a(x) \to -\infty$, as $x \to \infty$, $a(x) \to \infty$; At $x = 0$, $a(x) = 0$, so there is a zero at $x = 0$.
$d(x)$: $D = \{x \mid x \neq 0\}$, $R = \{b(x) \mid b(x) \neq 0\}$; as $x \to -\infty$, $a(x) \to 0$, as $x \to \infty$, $a(x) \to 0$; At $x = 0$, $b(x)$ is undefined, so there is an asymptote at $x = 0$.

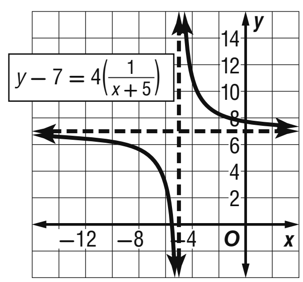
37f. For two power functions $f(x) = ax^n$ and $g(x) = ax^{-n}$, for every x, $f(x)$ and $g(x)$ are reciprocals. The domains are similar except that for $g(x)$, $x \neq 0$. Additionally, wherever $f(x)$ has a zero, $g(x)$ is undefined.

39a. The first graph has a vertical asymptote at $x = 0$ and a horizontal asymptote at $y = 0$. The second graph is translated 7 units up and has a vertical asymptote at $x = 0$ and a horizontal asymptote at $y = 7$.

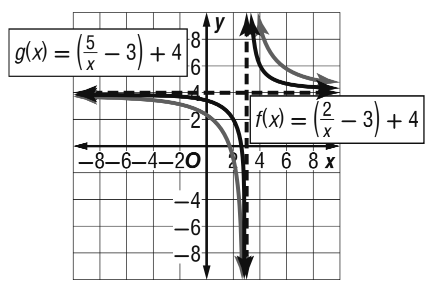
39b. Both graphs have a vertical asymptote at $x = 0$ and a horizontal asymptote at $y = 0$. The second graph is stretched by a factor of 4.

39c. The first graph has a vertical asymptote at $x = 0$ and a horizontal asymptote at $y = 0$. The second graph is translated 5 units to the left and has a vertical asymptote at $x = -5$ and a horizontal asymptote at $y = 0$.

39d.



41. Sample answer $= f(x) = \frac{2}{x-3} + 4$ and $g(x) = \frac{5}{x-3} + 4$



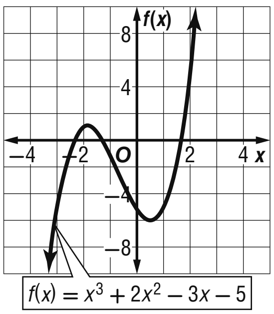
43. 4 **45.** B **47.** B **49.** $-2p$ **51.** $\frac{2x+y}{2x-y}$

53. (8, 3, 1)

55. $(f+g)(x) = 2x$; $(f-g)(x) = 18$; $(f \cdot g)(x) = x^2 - 81$; $\left(\frac{f}{g}\right)(x) = \frac{x+9}{x-9}, x \neq 9$

57. $(f+g)(x) = 2x^2 - x + 8$; $(f-g)(x) = 2x^2 + x - 8$; $(f \cdot g)(x) = -2x^3 + 16x^2$; $\left(\frac{f}{g}\right)(x) = \frac{2x^2}{8-x}, x \neq 8$

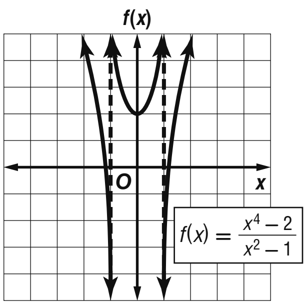
59.



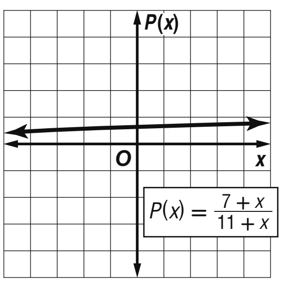
rel. max. at $x = -2$, rel. min. at $x = 0.5$; D = {all real numbers}, R = {all real numbers}

Lesson 7-4

1.



3a.

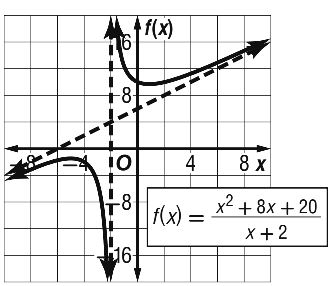


3b. the part in the first quadrant

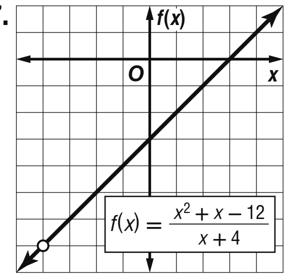
3c. It represents his original field goal percentage of 63.6%.

3d. y = 1; this represents 100% which he cannot achieve because he has already missed 4 field goals.

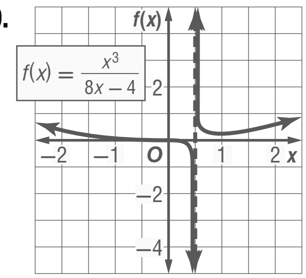
5.



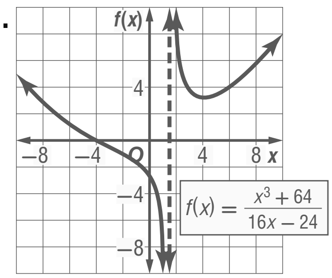
7.



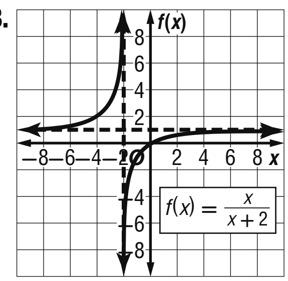
9.



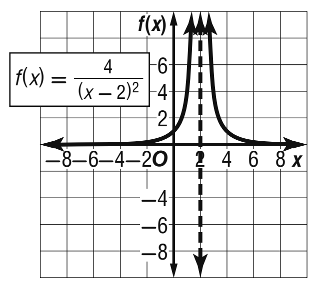
11.



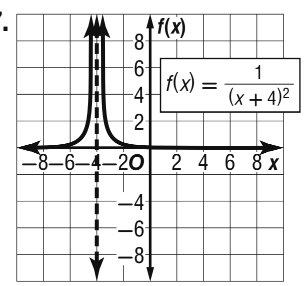
13.



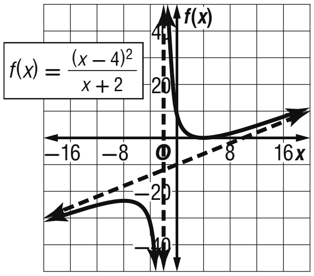
15.



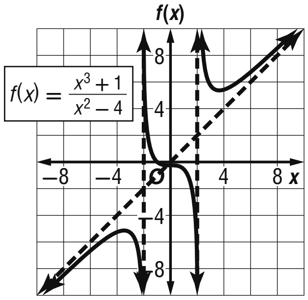
17.



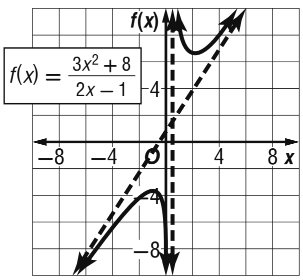
19.



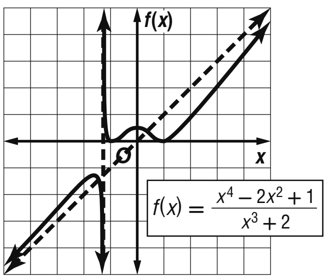
21.



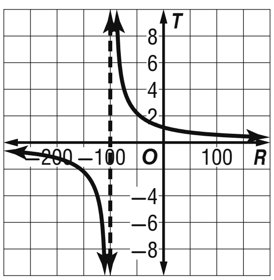
23.



25.

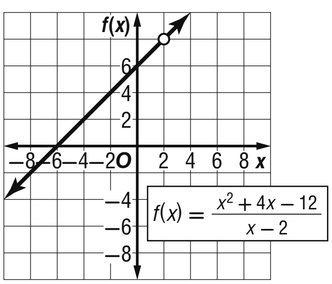


27a.

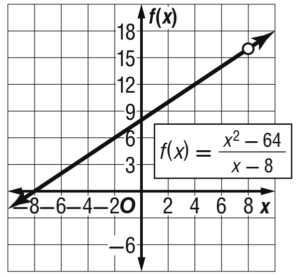


27b. $R_1 = -100$; no R_1-intercept; 1.2 **27c.** 0.5 amperes
27d. $R_1 \geq 0$ and $0 < I \leq 1.2$

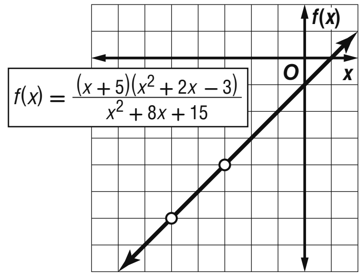
29.



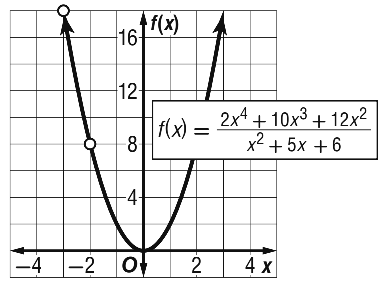
31.



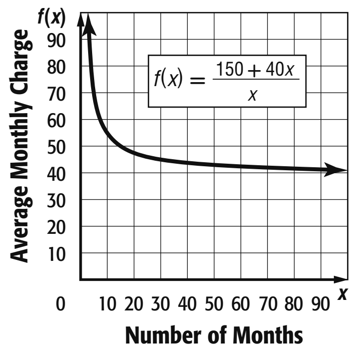
33.



35.

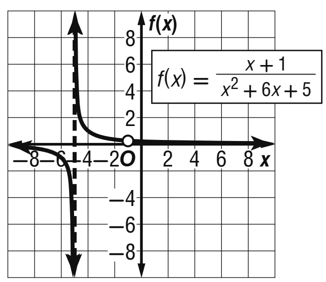


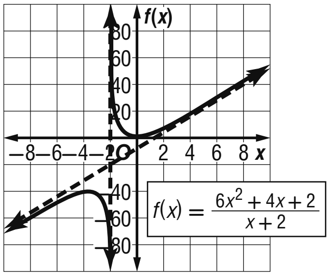
37a. $f(x) = \frac{150 + 40x}{x}$



37b. $x = 0$ and $f(x) = 40$ **37c.** Sample answer: The number of months and the average cost cannot have negative values.
37d. 30

39.

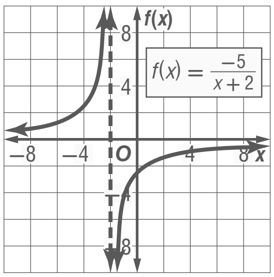


41.


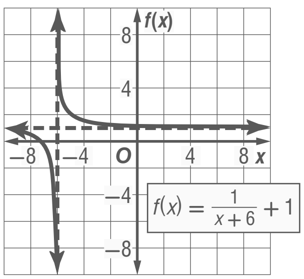
43. Similarities: Both have vertical asymptotes at $x = 0$. Both approach 0 as x approaches $-\infty$ and approach 0 as x approaches ∞. Differences: $f(x)$ has holes at $x = 1$ and $x = -1$, while $g(x)$ has vertical asymptotes at $x = \sqrt{2}$ and $x = -\sqrt{2}$. $f(x)$ has no zeros, but $g(x)$ has at zeros at $x = 1$ and $x = -1$.

45. $f(x) = \frac{x}{a - b} + \frac{c(a - b)}{(a - b)} \rightarrow \frac{x + ca - cb}{a - b}$

47. C **49.** 4

51.


D = $\{x \mid x \neq -2\}$, R = $\{f(x) \mid f(x) \neq 0\}$

53.


D = $\{x \mid x \neq -6\}$, R = $\{f(x) \mid f(x) \neq 1\}$

55. $\frac{y(y - 9)}{(y + 3)(y - 3)}$ **57.** $\frac{-8d + 20}{(d - 4)(d + 4)(d - 2)}$ **59.** x^3

61. $a^{\frac{1}{9}}$

Lesson 7-5

1. 11 **3.** 7 **5.** 8 **7.** 14

9a.

	Pounds	Price per Pound	Total Price
Dried Fruit	10	\$6.25	6.25(10)
Mixed Nuts	m	\$4.50	$4.5m$
Trail Mix	$10 + m$	\$5.00	$5(10 + m)$

9b. $62.5 + 4.5m = 50 + 5m$ **9c.** 25

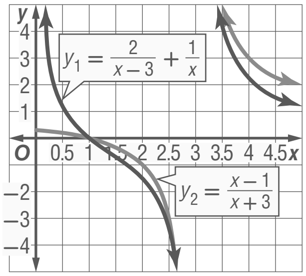
11a. $\frac{1}{60}$ **11b.** $\frac{x}{60}$ **11c.** $\frac{1}{80}$ **11d.** $\frac{x}{80}$ **11e.** $\frac{x}{60} + \frac{x}{80} = 1$

11f. about 34.3 min **13.** $c < 0$, or $\frac{13}{18} < c$

15. $b < 0$, or $\frac{35}{12} < b$ **17.** 2 **19.** 1 **21.** ∅ **23.** 1.2 lb

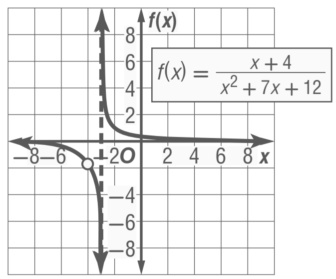
25. $x < 0$ or $x > 1.75$ **27.** $x < -2$, or $2 < x < 14$

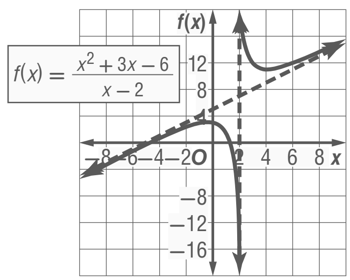
29. $x < -5$ or $4 < x < \frac{17}{3}$ **31.** 55.56 mph **33a.** 1; yes; 3

33b.


33c. 1; no **33d.** Graph both sides of the equation. Where the graphs intersect, there is a solution. If they do not, then the possible solution is extraneous. **35.** ∅ **37.** all real numbers except 5, −5, 0 **39.** Sample answer: Multiplying each side of a rational equation or inequality by the LCD can result in extraneous solutions. Therefore, you should check all solutions to make sure that they satisfy the original equation or inequality.

41. J **43.** all of the points **45.** direct

47.


49.


51a. $I = \begin{bmatrix} 290 & 165 & 210 \\ 175 & 240 & 190 \\ 110 & 75 & 0 \end{bmatrix}, C = \begin{bmatrix} 22 \\ 25 \\ 18 \end{bmatrix}$

51b. $\begin{bmatrix} 14{,}285 \\ 13{,}270 \\ 4295 \end{bmatrix}$ **51c.** \$31,850 **53.** yes

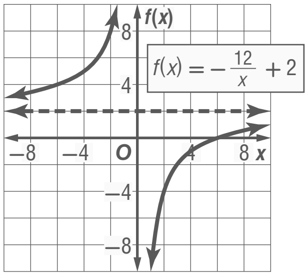
Chapter 7 Study Guide Review

1. complex fraction **3.** rational equations **5.** rational expression

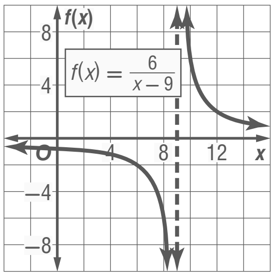
7. $\frac{10yv^2}{9x}$ **9.** $\frac{x - 1}{x - 2}$ **11.** $\frac{x - 3}{x + 1}$ **13.** $\frac{27b + 10a^2}{12ab^2}$

15. $\frac{3xy^3 + 8y^3 - 5x}{6x^2y^2}$ **17.** $\frac{12x2 - 10x + 6}{2(x + 2)(3x - 4)(x + 1)}$

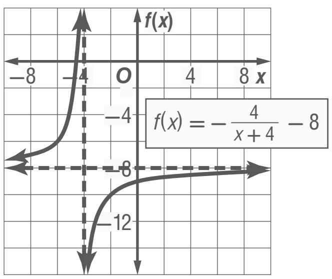
19. $\frac{10x + 20}{(x + 6)(x + 1)}$

21.


D = $\{x \mid x \neq 0\}$, R = $\{f(x) \mid f(x) \neq 2\}$

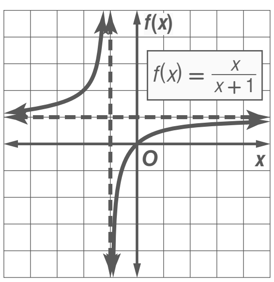
23.


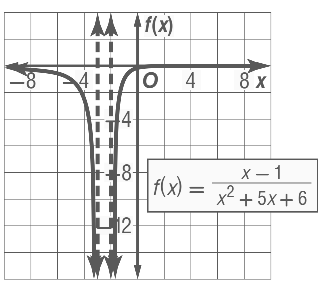
D = $\{x \mid x \neq 9\}$, R = $\{f(x) \mid f(x) \neq 0\}$

25.


D = $\{x \mid x \neq -4\}$, R = $\{f(x) \mid f(x) \neq -8\}$

27. $x = -4$, $x = 0$ **29.** $x = 8$**;** hole: $x = -3$

31.


33.


35. $x = \frac{46}{17}$ **37.** $x = -7$ **39.** $x = 8$ **41.** $-\frac{9}{10} < x < 0$

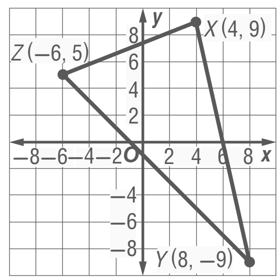
CHAPTER 8
Conic Sections

Chapter 8 Get Ready

1. $\{-7, -1\}$ **3.** $\{3, 5\}$ **5.** $\left\{-5, \frac{3}{2}\right\}$ **7.** $\left\{\frac{3}{4} \pm \sqrt{2}\right\}$ **9.** (2, 5)
11. (−5, 6)
13. $15x + 10y = 180$
$12x + 9y = 150$
number of registrations = 8
number of T-shirts = 6

Lesson 8-1

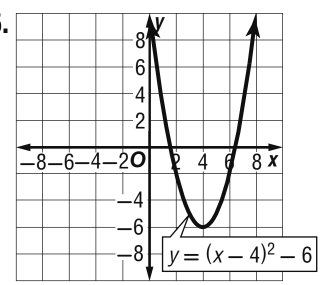
1. $\left(-\frac{1}{2}, 8\right)$ **3.** (14.5, 9.75) **5.** 11.662 units **7.** 3.335 units
9. A **11.** (−4, −1) **13.** (7.3, 1) **15.** (−7.75, −4.5)
17. 16.279 units **19.** 16.125 units **21.** 21.024 units
23. 55.218 units **25.** (−1.5, 0); 185.443 units
27. (−5.5, −50.5); 148.223 units **29.** (8, 15); 136.953 units
31. (−0.43, −2.25); 9.624 units **33.** (−4.458, −1); 8.193 units
35. (−4.719, 0.028); 17.97 units **37.** 14.53 km **39.** 109 mi

41a.


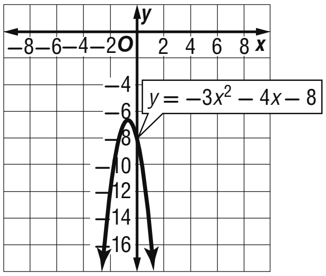
41b. midpoint of $\overline{XY}$ = (6, 0); midpoint of $\overline{YZ}$ = (1, −2); midpoint of $\overline{XZ}$ = (−1, 7) **41c.** The perimeter of $\triangle XYZ$ is $2\sqrt{29} + 14\sqrt{2} + 2\sqrt{85}$ units. perimeter = $\sqrt{29} + 7\sqrt{2} + \sqrt{85}$ **41d.** The perimeter of $\triangle XYZ$ is twice the perimeter of the smaller triangle. **43.** a circle and its interior with center at (5, 6) and radius 3 units **45.** See students' graphs; the distance from *A* to *B* equals the distance from *B* to *A*. Using the Distance Formula, the solution is the same no matter which ordered pair is used first. **47.** $8.91
49. G **51.** −6, −2 **53.** $\frac{3}{2}$ **55.** 4.8362 **57.** 8.0086
59. $\{p \mid p \leq 1.9803\}$ **61.** −20 **63.** $\frac{1}{3}$ **65.** $y = (x - 3)^2 - 8$; (3, −8); $x = 3$; up

Lesson 8-2

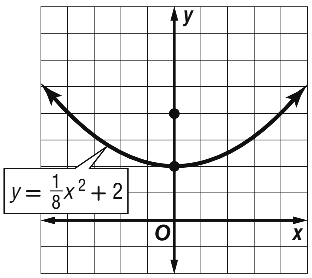
1. $y = 2(x - 6)^2 - 32$; vertex (6, −32); axis of symmetry: $x = 6$; opens upward **3.** $x = (y - 4)^2 - 27$; vertex (−27, 4); axis of symmetry: $y = 4$; opens right

5.


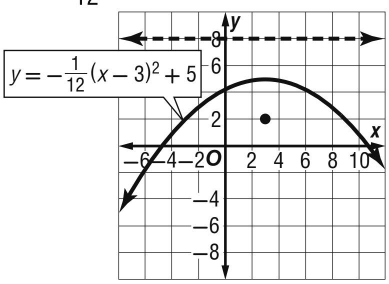
7.



9. $y = \frac{1}{8}x^2 + 2$

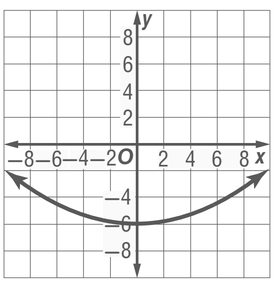


11. $y = -\frac{1}{12}(x - 3)^2 + 5$



13a. $y = \frac{1}{24}x^2 - 6$

13b.

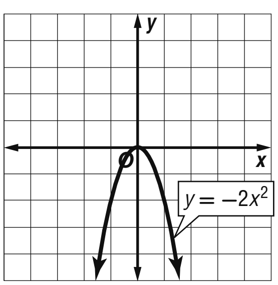


15. $y = 3(x + 7)^2 + 2$; vertex $= (-7, 2)$; axis of symmetry: $x = -7$; opens upward

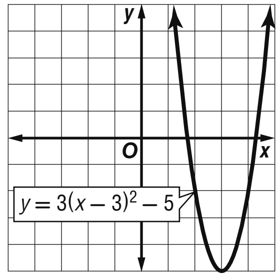
17. $y = -3\left(x + \frac{3}{2}\right)^2 + \frac{3}{4}$; vertex $= \left(-\frac{3}{2}, \frac{3}{4}\right)$; axis of symmetry: $x = -\frac{3}{2}$; opens downward

19. $x = \frac{2}{3}(y - 3)^2 + 6$; vertex $= (6, 3)$; axis of symmetry: $y = 3$; opens right

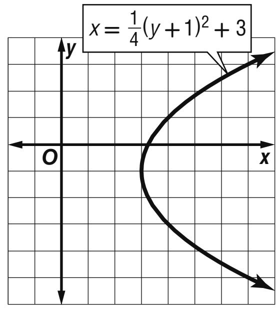
21.



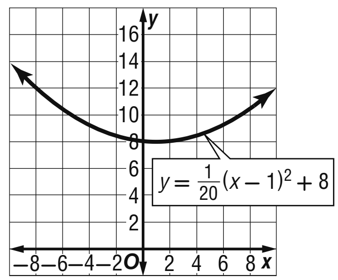
23.



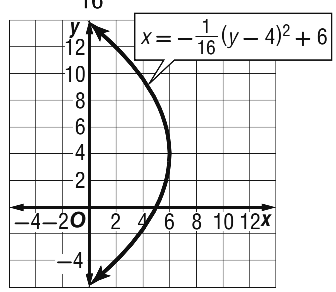
25.



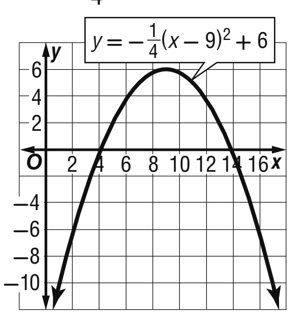
27. $y = \frac{1}{20}(x - 1)^2 + 8$



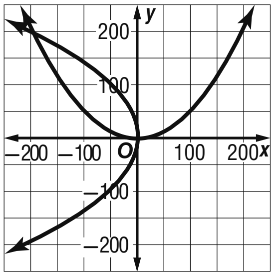
29. $x = -\frac{1}{16}(y - 4)^2 + 6$



31. $y = -\frac{1}{4}(x - 9)^2 + 6$



33a.



33b. $y = \dfrac{x^2}{192}$ and $x = \dfrac{y^2}{-192}$

33c. Sample answer: No; except for the direction in which the graphs are identical. they open. **35.** 3 units **37.** Rewrite it as $y = (x - h)^2$, where $h > 0$. **39.** Russell; the parabola should open to the left rather than to the right. **41.** C **43.** D

45. $5\sqrt{2} + 3\sqrt{10}$ units **47.** 1.7183 **49.** $x > 0.4700$ **51.** 0.5

53. z^2 **55.** $\pm1, \pm2, \pm3, \pm6$ **57.** $\pm1, \pm\frac{1}{3}, \pm\frac{1}{9}, \pm3, \pm9, \pm27$

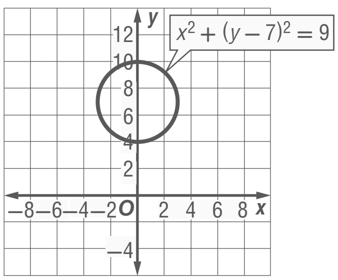
59. $3\sqrt{5}$ **61.** $16\sqrt{2}$

Lesson 8-3

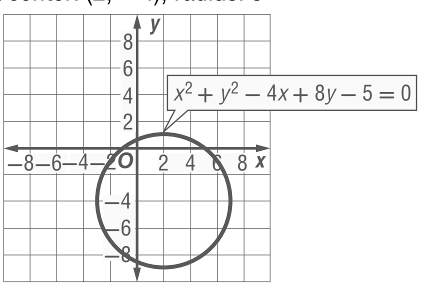
1. $(x - 72)^2 + (y - 39)^2 = 10{,}000$ **3.** $(x - 1)^2 + (y + 5)^2 = 9$

5. $(x + 5)^2 + (y + 3)^2 = 90$ **7.** $x^2 + (y + 4)^2 = 20$

9. center: (0, 7); radius: 3



11. center: (2, −4); radius: 5



13. $(x + 3)^2 + (y - 1)^2 = 16$ **15.** $(x + 2)^2 + (y + 1)^2 = 81$

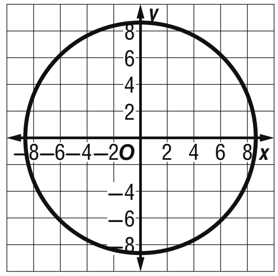
17. $x^2 + (y + 6)^2 = 35$ **19.** $(x - 1)^2 + (y - 1)^2 = 4$

21. $x^2 + (y + 6)^2 = 53$ **23.** $(x - 2)^2 + \left(y + \frac{3}{2}\right)^2 = \frac{25}{4}$

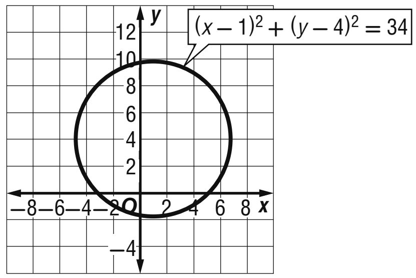
25. $\left(x - \frac{3}{2}\right)^2 + (y + 8)^2 = \frac{53}{4}$ **27.** $(x - 4)^2 + (y + 1)^2 = 20$

29a. $x^2 + y^2 = 400$ **29b.** approximately 1256.64 units^2

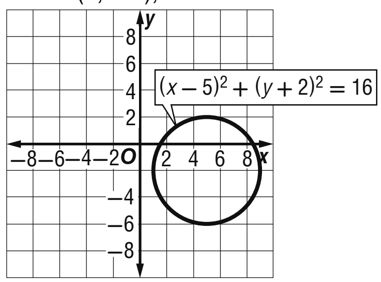
31. center: (0,0); radius: $5\sqrt{3}$



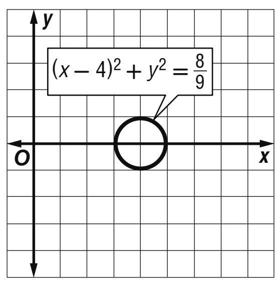
33. center: (1, 4); radius: $\sqrt{34}$



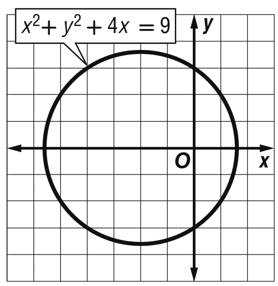
35. center: (5, −2); radius: 4



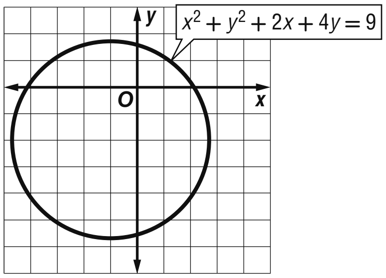
37. center: (4, 0); radius: $\dfrac{\sqrt{8}}{3}$



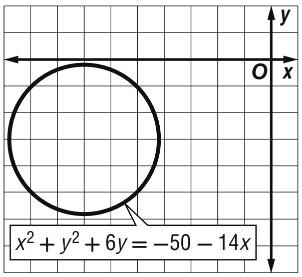
39. center: (−2, 0); radius: $\sqrt{13}$



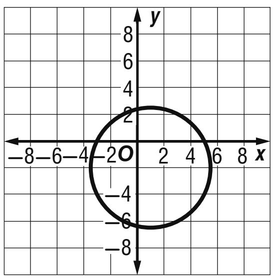
41. center: $(-1, -2)$; radius: $\sqrt{14}$



43. center: $(-7, -3)$; radius: $2\sqrt{2}$ units

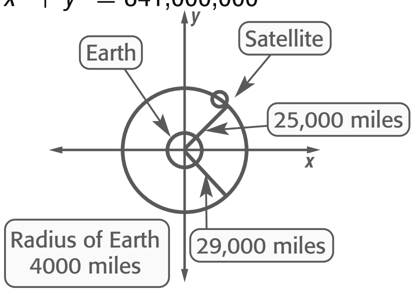


45. center: $(1, -2)$; radius: $\sqrt{21}$



47a. $x^2 + y^2 = 841{,}000{,}000$

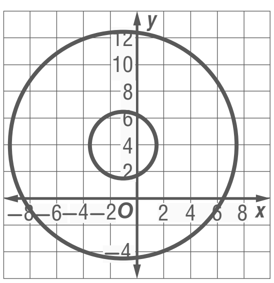
47b.



49a. $(x + 1)^2 + (y - 4)^2 = 36 + 16\sqrt{5}$

49b. $(x + 1)^2 + (y - 4)^2 = 24 - 8\sqrt{5}$

49c.

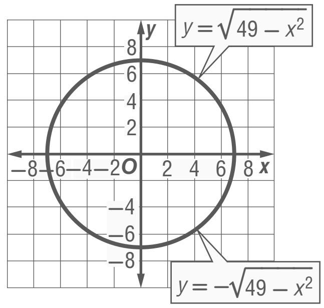


51. $(x - 9)^2 + (y + 8)^2 = 1000$ **53.** $(x - 8)^2 + (y + 9)^2 = 64$

55. $(x - 2.5)^2 + (y - 2.5)^2 = 6.25$ **57a.** circle

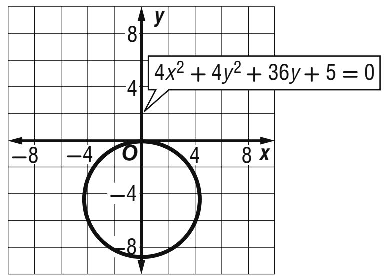
57b. $x^2 + y^2 = 9$

57c. Solve the equation for y: $y = \pm\sqrt{49 - x^2}$. Then graph the positive and negative answers.

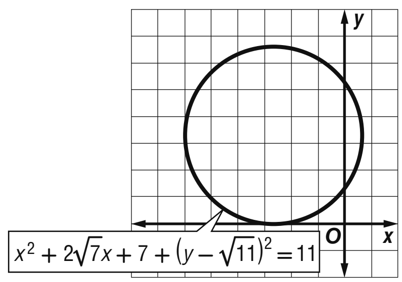


57d. $y = \pm\sqrt{4 - (x - 2)^2} - 1$; When you solve for y you must take the square root resulting in both a positive and negative answer, so you have to enter the positive equation as Y1 and the negative equation as Y2. **57e.** See students' work.

59. center: $\left(0, -\frac{9}{2}\right)$; radius: $\sqrt{19}$

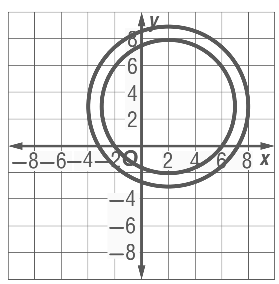


61. center: $(-\sqrt{7}, \sqrt{11})$; radius: $\sqrt{11}$

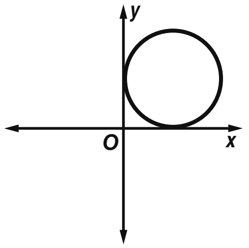


63. See students' work; circles with a radius of 8 and centers on the graph of $x = 3$.

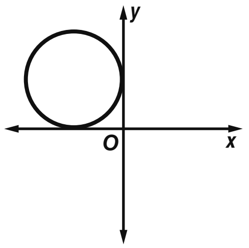
65. Sample answer: $(x - 2)^2 + (y - 3)^2 = 25$ and $(x - 2)^2 + (y - 3)^2 = 36$



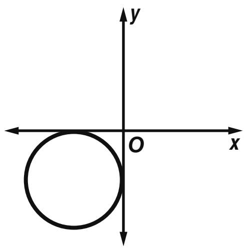
67. Quadrant I
$a > 0, b > 0, a = b, r > 0$



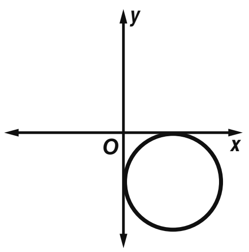
Quadrant II
$a < 0, b > 0, a = -b, r > 0$



Quadrant III
$a < 0, b < 0, a = b, r > 0$



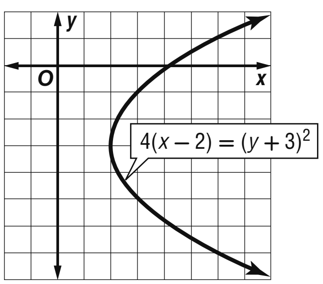
Quadrant IV
$a > 0, b < 0, a = -b, r > 0$



Sample answer: The circle is rotated 90° about the origin from one quadrant to the next.

69. A **71.** C

73.



75. $\left(1, \frac{7}{22}\right)$; $\sqrt{65}$ units **77.** (0, 3); $\sqrt{29}$ units **79.** 64 **81** $\frac{5}{2}$

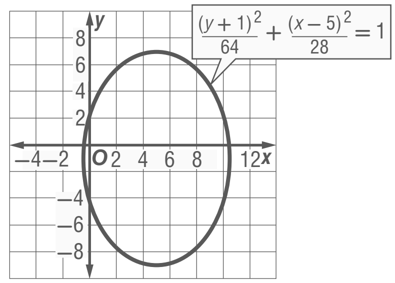
83. −4 **85a.** The square root of a difference is not the difference of the square roots. **85b.** 34.1 ft/s **87.** $\left(3 \pm \frac{\sqrt{33}}{4}\right)$

Lesson 8-4

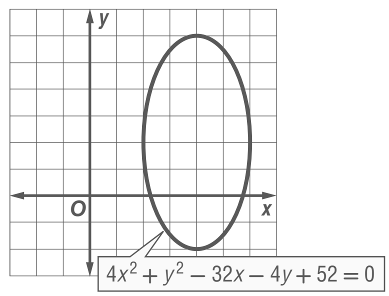
1. $\frac{y^2}{25} + \frac{x^2}{9} = 1$ **3.** $\frac{(y+1)^2}{25} + \frac{(x+2)^2}{9} = 1$

5a. $a = 240$, $b = 160$ **5b.** $\frac{x^2}{57{,}600} + \frac{y^2}{25{,}600} = 1$

5c. about (179, 0) and (−179, 0) **7.** center (5, −1); foci (5, 5) and (5, −7); major axis: 16; minor axis: ≈10.58



9. center (4, 2); foci (4, 5.46) and (4, −1.46); major axis: 8; minor axis: 4



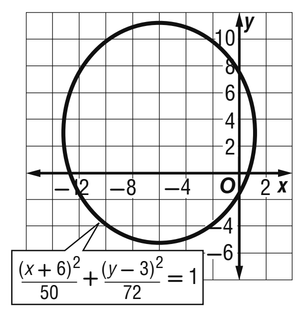
11. $\frac{y^2}{100} + \frac{x^2}{36} = 1$ **13.** $\frac{(x+5)^2}{49} + \frac{(y+4)^2}{25} = 1$

15. $\frac{(y-1)^2}{64} + \frac{(x+5)^2}{16} = 1$ **17.** $\frac{(x-3)^2}{81} + \frac{(y-4)^2}{64} = 1$

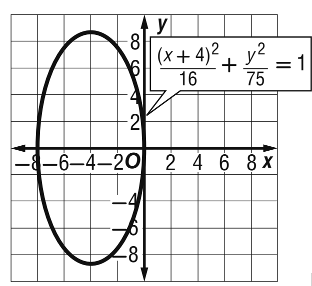
19. $\frac{(y-6)^2}{100} + \frac{(x+2)^2}{9} = 1$ **21.** $\frac{(y-4)^2}{64} + \frac{(x-4)^2}{9} = 1$

23. $\frac{y^2}{73.96} + \frac{x^2}{53.29} = 1$

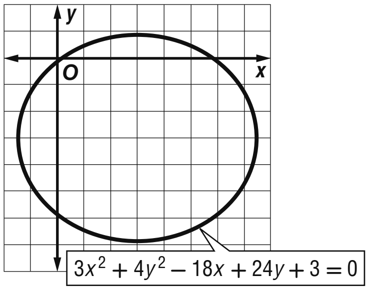
25. center (−6, 3); foci (−6, 7.69) and (−6, −1.69); major axis: ≈16.97; minor axis: ≈14.14



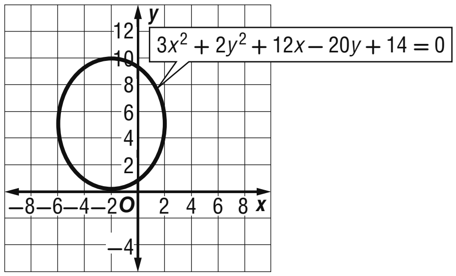
27. center (−4, 0); foci (−4, 7.68) and (−4, −7.68); major axis: ≈17.32; minor axis: 8



29. center (3, −3); foci (5.24, −3) and (0.76, −3); major axis: ≈8.94; minor axis: ≈7.75



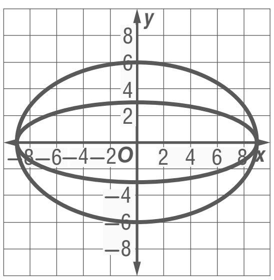
31. center (−2, 5); foci (−2, 7.83) and (−2, 2.17); major axis: ≈9.80; minor axis: 8



33. $\frac{(y+2)^2}{25} + \frac{(x+5)^2}{9} = 1$ **35.** $\frac{(x-2)^2}{20} + \frac{(y-8)^2}{4} = 1$

37. $\frac{x^2}{29.7025} + \frac{y^2}{19.36} = 1$ or $\frac{y^2}{29.7025} + \frac{x^2}{19.36} = 1$

39a.



39b. Sample answer: The first graph is more circular than the second graph. **39c.** first graph: 0.745; second graph: 0.943 **39d.** Sample answer: The closer the eccentricity is to 0, the more circular the ellipse.

41. Sample answer: $\frac{(x+4)^2}{40} + \frac{y^2}{24} = 1$ **43.** $\frac{y^2}{9} + \frac{(x-2)^2}{3} = 1$

45. For any point on an ellipse, the sum of the distances from that point to the foci is constant by the definition of an ellipse. So, if (2, 14) is on the ellipse, then the sum of the distances from it to the foci will be a certain value consistent with every other point on the ellipse. The distance between (−7, 2) and (2, 14) is $\sqrt{(-7-2)^2 + (2-14)^2}$ or 15. The distance between (18, 2) and (2, 14) is $\sqrt{(18-2)^2 + (2-14)^2}$ or 20. The sum of these two distances is 35. The distance between (−7, 2) and (2, −10) is $\sqrt{(-7-2)^2 + [2-(-10)]^2}$ or 15. The distance between (18, 2) and (2, −10) is $\sqrt{(18-2)^2 + [2-(-10)]^2}$ or 20. The sum of these distances is also 35. Thus, (2, −10) also lies on the ellipse.

47. B **49.** 7 **51.** $(x-8)^2 + (y+9)^2 = 1130$

53. $(x+5)^2 + (y-4)^2 = 25$ **55.** $\frac{5d+16}{(d+2)^2}$

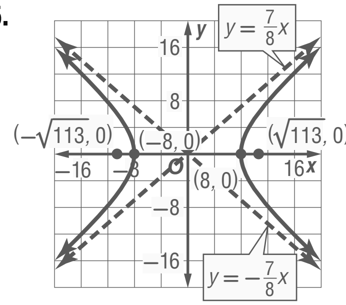
57. $\frac{x^2 - 5x + 3}{(x-5)(x+1)}$ **59.** 4 **61.** $15a^3b^3 - 30a^4b^3 + 15a^5b^6$

63. $4x^2 - 3xy - 6y^2$ **65.** $y = -\frac{4}{5}x + \frac{17}{5}$ **67.** $y = -\frac{3}{5}x + \frac{16}{5}$

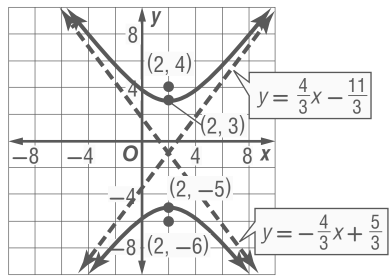
Lesson 8-5

1. $\frac{y^2}{36} - \frac{x^2}{28} = 1$ **3.** $\frac{x^2}{64} - \frac{y^2}{25} = 1$

5.



7.

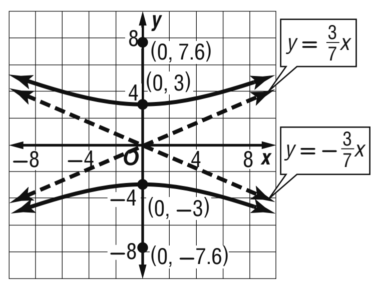


9. $\frac{x^2}{900} - \frac{y^2}{5500} = 1$

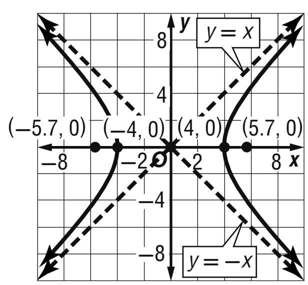
11. $\frac{(y-4)^2}{16} - \frac{(x+8)^2}{48} = 1$

13. $\frac{(x+1)^2}{9} - \frac{(y-6)^2}{49} = 1$

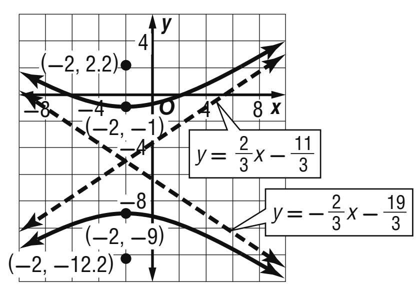
15.



17.



19.



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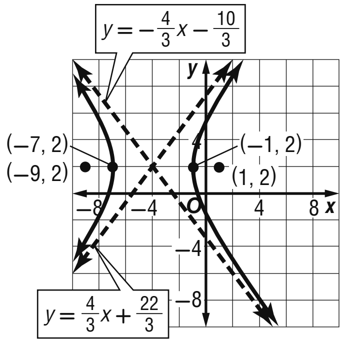
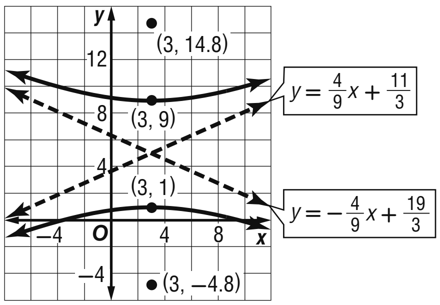


23.

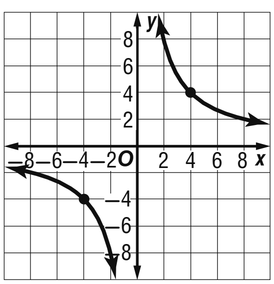


25. hyperbola **27.** ellipse **29.** ellipse **31.** $\frac{x^2}{100} - \frac{y^2}{1250} = 1$

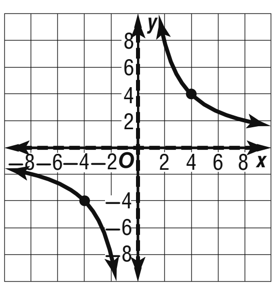
33a.

x	y
−12	−1.33
−10	−1.6
−8	−2
−6	−2.67
−4	−4
−2	−8
0	undef
2	8
4	4
6	2.67
8	2
10	1.6
12	1.33

33b.



33c. The asymptotes are $y = 0$ and $x = 0$.



33d. They are perpendicular. **33e.** For $xy = 25$, the vertices will be at (5, 5) and (−5, −5), and for $xy = 36$, they will be at (−6, −6) and (6, 6).

35. $\frac{x^2}{2{,}722{,}500} - \frac{y^2}{1{,}277{,}500} = 1$ **37.** $\frac{x^2}{64} - \frac{y^2}{100} = 1$

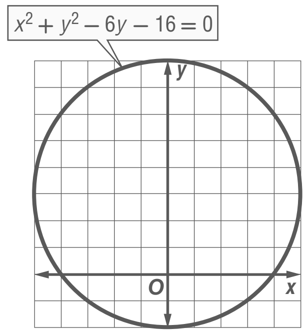
39. $\frac{(x-2)^2}{16} - \frac{(y+2)^2}{48} = 1$ **41.** $\frac{x^2}{25} - \frac{y^2}{4} = 1$

43. (2308, 826) **45.** $\frac{(x-3)^2}{5} - \frac{(y+2)^2}{5} = 1$

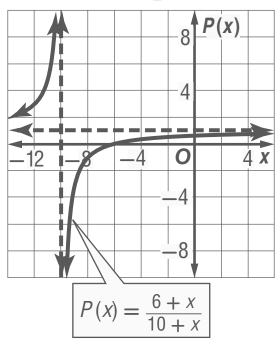
47. Sample answer: When 36 changes to 9, the vertical hyperbola widens (splits out from the *y*-axis faster). This is due to a smaller value of *y* being needed to produce the same value to *x*. The vertices are moved closer together due to the value of a decreasing from 6 to 3. The foci moved father from the vertices because the difference between *c* and *a* increased.

49. Sample answer: Conic sections can be used to model phenomena that can't be modeled using functions. For example, parabolas can be used to model paths of comets and ellipses can be used to model planetary orbits. **51.** J **53.** E

55. $\frac{y^2}{100} + \frac{x^2}{36} = 1$ **57.** (0, 3), 5 units

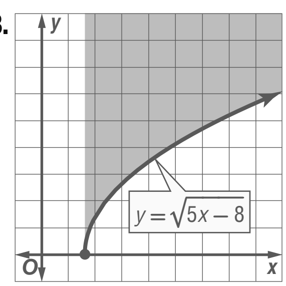


59a.

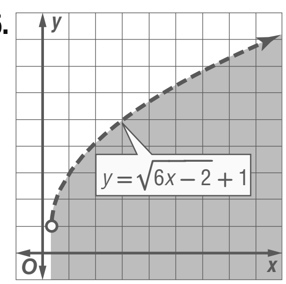


59b. the part in the first quadrant **59c.** It represents her original free-throw percentage of 60%. **59d.** $P(x) = 1$; this represents 100%, which she cannot achieve because she has already missed 4 free throws. **61.** (−4, −1)

63.



65.

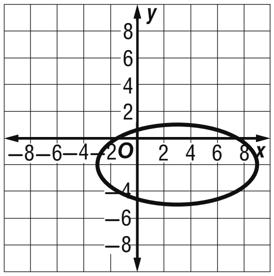


67. $y = \frac{4}{3}(x+3)^2 - 4$

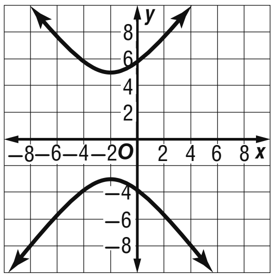
Selected Answers and Solutions

Lesson 8-6

1. $\frac{(x-3)^2}{36} + \frac{(y+2)^2}{9} = 1$; ellipse

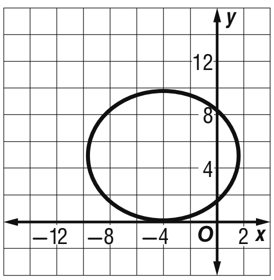


3. $\frac{(y-1)^2}{16} - \frac{(x+2)^2}{9}$; hyperbola

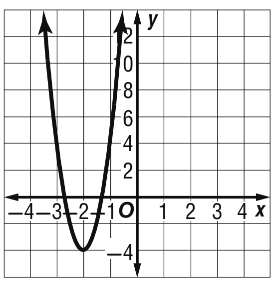


5. ellipse **7.** circle **9.** hyperbola **11.** ellipse
13a. parabola; $y = -0.024(x - 660)^2 + 10{,}500$ **13b.** about 1321 ft **13c.** 10,500 ft

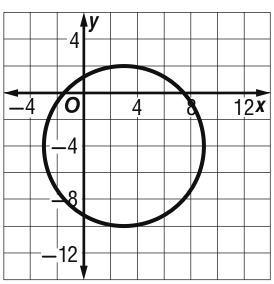
15. $\frac{(x+4)^2}{32} + \frac{(y-5)^2}{24} = 1$; ellipse



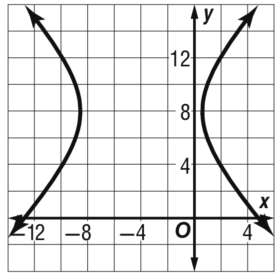
17. $y = 8(x + 2)^2 - 4$; parabola



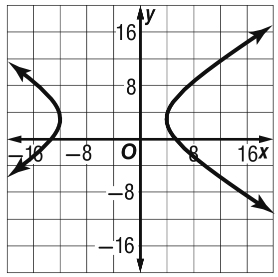
19. $(x - 3)^2 + (y + 4)^2 = 36$; circle



21. $\frac{(x+4)^2}{21} - \frac{(y-8)^2}{24} = 1$; hyperbola



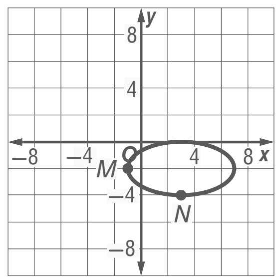
23. $\frac{(x+4)^2}{64} - \frac{(y-3)^2}{25} = 1$; hyperbola



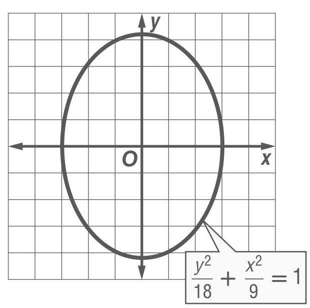
25. circle **27.** ellipse **29.** hyperbola **31.** hyperbola
33. hyperbola **35.** c **37.** b **39.** b **41.** c

43a. $\frac{(x-3)^2}{16} + \frac{(y+2)^2}{4} = 1$ **43b.** $x^2 + 4y^2 - 6x + 16y + 9 = 0$

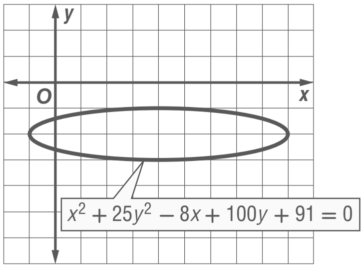
43c.



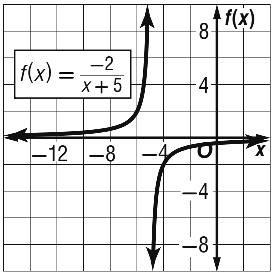
43d. $N(5, -2)$; 90° counterclockwise **45.** Sample answer: Always; when a conic is vertical, $B = 0$. When this is true and $A = C$, the conic is a circle. **47.** Sample answer: An ellipse is a flattened circle. Both circles and ellipses are enclosed regions while hyperbolas and parabolas are not. A parabola has one branch, which is a smooth curve that never ends, and a hyperbola has two such branches that are reflections of each other. In standard form and when there is no *xy*-term: an equation for a parabola consists of only one squared term, an equation for a circle has values for *A* and *C* that are equal, an equation for an ellipse has values for *A* and *C* that are the same sign but not equal, and an equation for a hyperbola has values of *A* and *C* that have opposite signs. **49.** J **51.** B
53. (0, 0); (0, ±3); $6\sqrt{2}$; 6



55. $(4, -2)$; $\left(4 \pm 2\sqrt{6}, -2\right)$; 10; 2



57.



59a. Decay; the exponent is negative. **59b.** about 33.5 watts

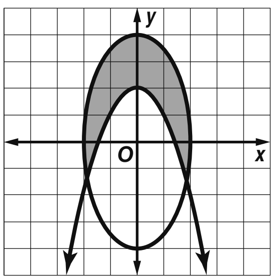
59c. about 402 days **61.** $\left(-\frac{1}{2}, \frac{3}{2}\right)$

Lesson 8-7

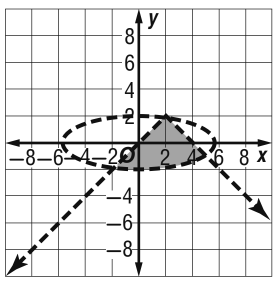
1. $(4, -5), (-4, 5)$ **3.** $(3, 6), (6, 42)$ **5.** no solution

7. $(-1, 3), (1, 3), \left(-\sqrt{17}, -5\right), \left(\sqrt{17}, -5\right)$ **9.** $(40, 30)$

11.



13.

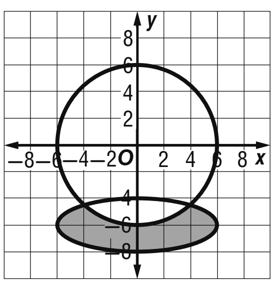


15. no solution **17.** $(-3, -6), (3, 6)$ **19.** $(-1, -3), (8, 5)$

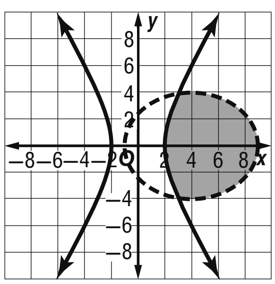
21. $\left(1, -\sqrt{15}\right), \left(1, \sqrt{15}\right)$ **23.** $\left(-\sqrt{2}, 4\right), \left(\sqrt{2}, 4\right)$

25. $(5, -6), (5, 6), (-3, -2), (-3, 2)$

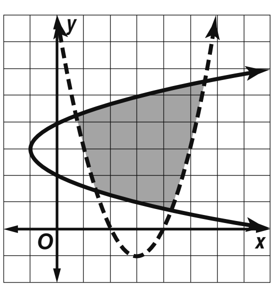
27.



29.



31.



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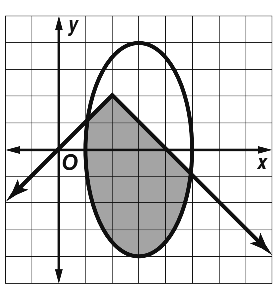
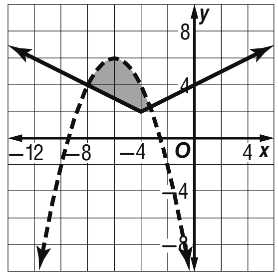


35.



37. no solution

39a. $y = \pm 900\sqrt{1 - \frac{x^2}{(300)^2}}$; $y = \pm 690\sqrt{1 - \frac{x^2}{(600)^2}}$

39b. Sample answer: (209, 647), (−209, 647), (−209, −647), (209, −647) **39c.** Sample answer: The orbit of the satellite modeled by the second equation is closer to a circle than the other orbit. The distance on the *x*-axis is twice as great for one satellite as the other.

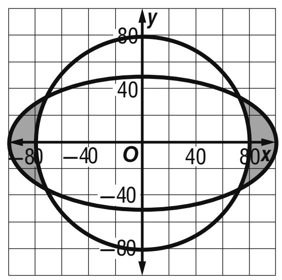
41. 440 ft from home plate, 60 ft above the playing surface

43. Sample answer: $\frac{x^2}{16} + \frac{y^2}{36} = 1$ and $(x + 10)^2 + y^2 = 36$

45. Sample answer: $x^2 + y^2 = 1$ and $\frac{x^2}{16} - \frac{y^2}{36} = 1$

47. Sample answer: $\frac{x^2}{64} + \frac{y^2}{100} = 1$ and $x^2 - y^2 = 1$

49. Sample answer: No; if one player is in one of the shaded areas and the other player is in the other shaded area, they will not be able to hear each other.

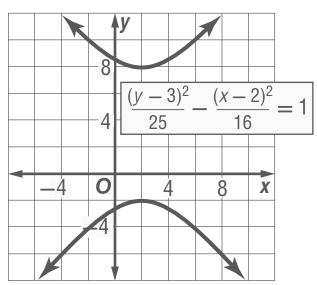


51. $k = a$ or $k = b$

53. Sample answer: $\frac{y^2}{128} + \frac{x^2}{32} = 1$ and $\frac{x^2}{8} - \frac{y^2}{64} = 1$

55. $(-3, -4), (3, 4)$ **57.** F **59.** b **61.** c

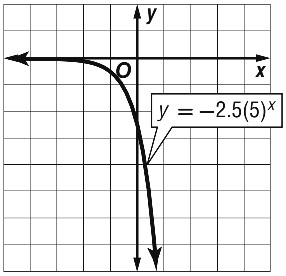
63. $(2, -2), (2, 8)$; $\left(2, 3 \pm \sqrt{41}\right)$; $y - 3 = \pm\frac{5}{4}(x - 2)$



65. $\frac{p+5}{p+1}$ **67.** $\frac{3(r+4)}{r+3}$

Selected Answers and Solutions

69. D = {all real numbers}, R = $\{y \mid y < 0\}$



71. $\frac{d}{t} = r$ **73.** $\frac{3V}{\pi r^2} = h$

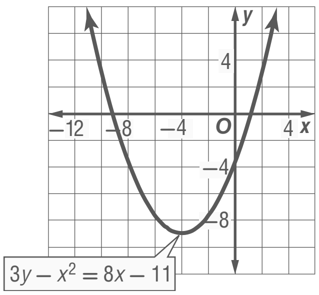
Chapter 8 Study Guide and Review

1. false, center **3.** false, vertices **5.** true **7.** false, circle

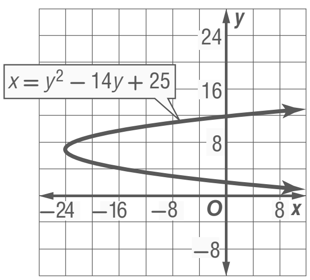
9. true **11.** $\left(-\frac{5}{2}, 5\right)$ **13.** $\left(\frac{5}{24}, \frac{11}{24}\right)$ **15.** $\sqrt{85}$ **17.** $\frac{\sqrt{34}}{4}$

19a. $\sqrt{89} \approx 9.4$ miles **19b.** $\left(4, -\frac{5}{2}\right)$

21.



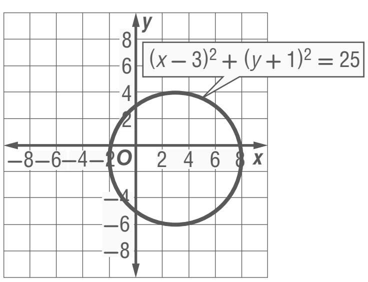
23.



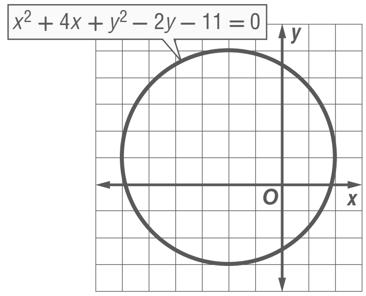
25. $y = 4(x-2)^2 - 7$; vertex: $(2, -7)$; axis of symmetry: $x = 2$; opens: upward **27.** $x = (y+7)^2 - 29$; vertex $= (-29, -7)$; axis of symmetry $y = -7$; opens to the right

29. $(x+1)^2 + (y-6)^2 = 9$ **31.** $(x-1)^2 + (y+4)^2 = 13$

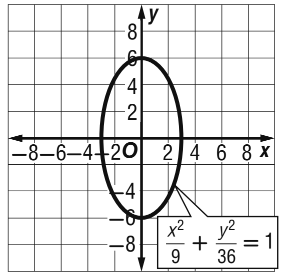
33. $(3, -1)$; $r = 5$



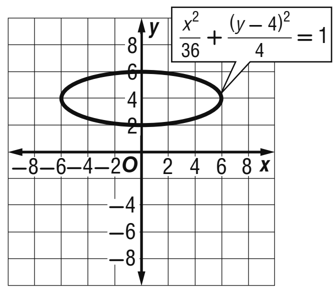
35. $(-2, 1)$; $r = 4$



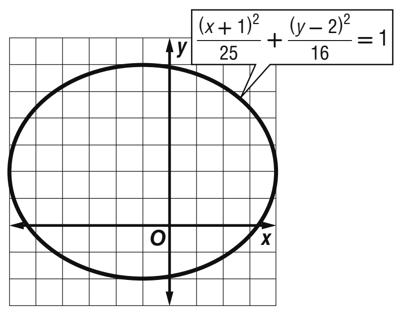
37. $(0, 0)$; $(0, \pm 3\sqrt{3})$; 12; 6



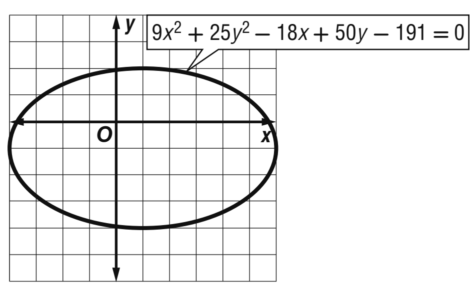
39. $(0, 4)$; $(\pm 4\sqrt{2})$, 4; 12; 4



41. $(-1, 2)$; $(-4, 2)$, $(2, 2)$; 10; 8

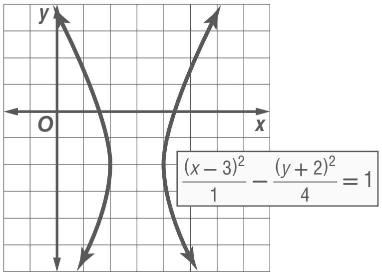


43. $(1, -1)$; $(-3, -1)$, $(5, -1)$; 10; 6

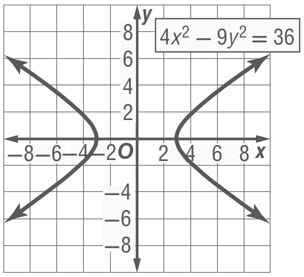


45. $\frac{x^2}{64} + \frac{y^2}{25} = 1$

47. $(2, -2), (4, -2); (3 \pm \sqrt{5}, -2); y + 2 = \pm 2(x - 3)$

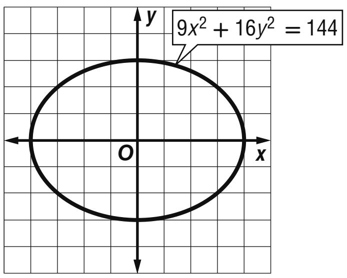


49. $(\pm 3, 0); \left(\pm\sqrt{13}, 0\right); y = \pm\frac{2}{3}x$

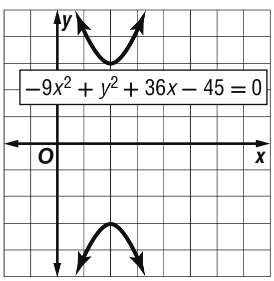


51. $\left(\frac{40 - 24\sqrt{5}}{5}, \frac{45 - 12\sqrt{5}}{5}\right)$

53. $\frac{x^2}{16} + \frac{y^2}{9} = 1$; ellipse

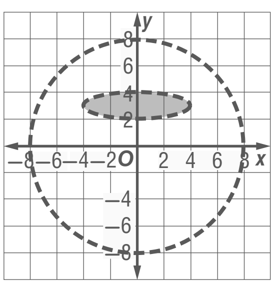


55. $\frac{y^2}{9} - \frac{(x-2)^2}{1} = 1$; hyperbola

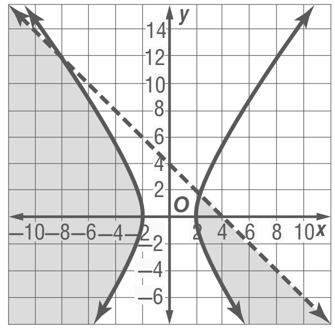


57. hyperbola **59.** circle **61.** $(2, -2), (-2, 2)$ **63.** $(4, 0)$
65. $(1, \pm 5), (-1, \pm 5)$ **67a.** 1.5 seconds **67b.** 109 ft

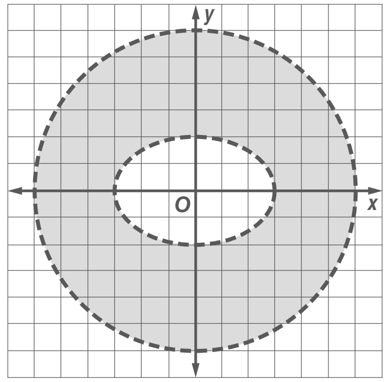
69.



71.



73.

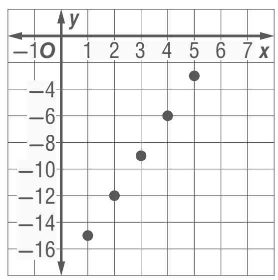


CHAPTER 9
Sequences and Series

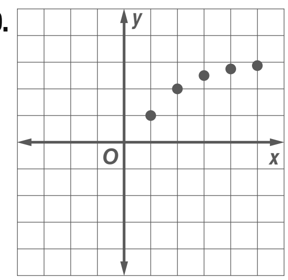
Chapter 9 Get Ready

1. $x = -12$ **3.** $x = 3$ **5.** 9 rows

7.



9.

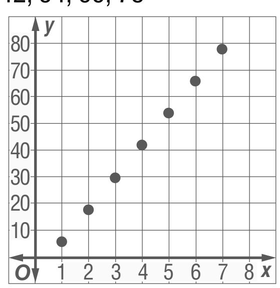


11. -30 **13.** $-\frac{2}{729}$

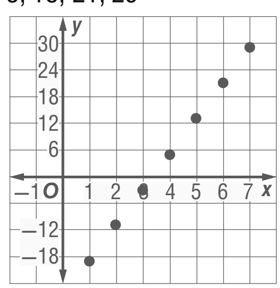
Lesson 9-1

1. yes **3.** no

5. 42, 54, 66, 78

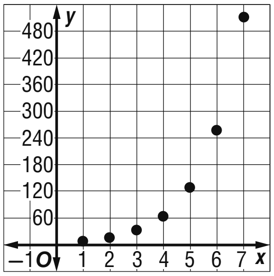


7. 5, 13, 21, 29

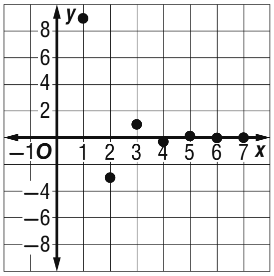


9a. $850 **9b.** 24 wk **11.** yes **13.** no

15. 128, 256, 512

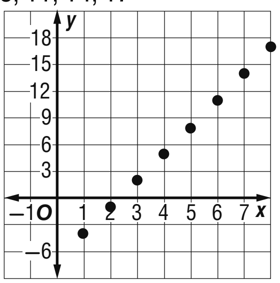


17. $\frac{1}{9}, \frac{-1}{27}, \frac{1}{81}$

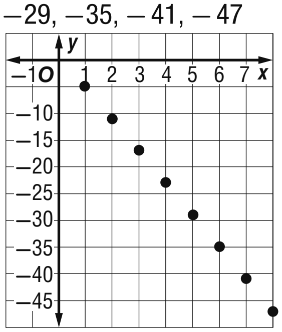


19. Geometric; the common ratio is $-\frac{1}{2}$. **21.** no **23.** no

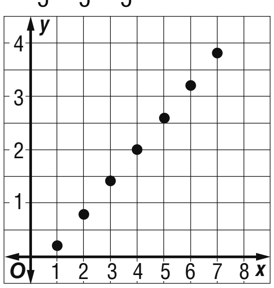
25. 8, 11, 14, 17



27. −29, −35, −41, −47

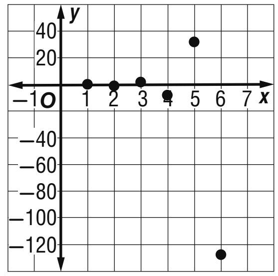


29. 2, $\frac{13}{5}, \frac{16}{5}, \frac{19}{5}$

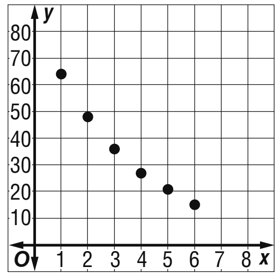


31. 74 **33.** no **35.** yes **37.** no

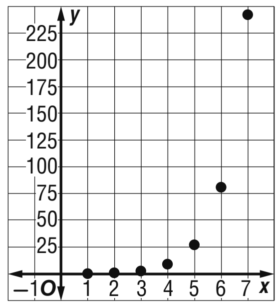
39. −8, 32, −128



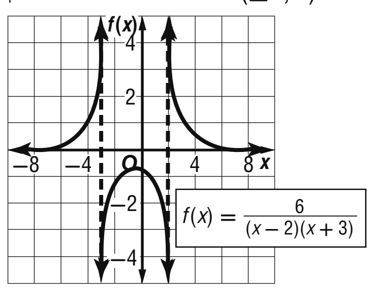
41. 27, $\frac{81}{4}, \frac{243}{16}$



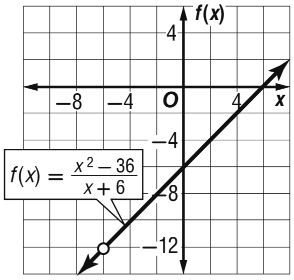
43. 27, 81, 243



45. Neither; there is no common difference or ratio.
47. Geometric; the common ratio is 3.
49. Arithmetic; the common difference is $\frac{1}{2}$.
51. 86 pg/day **53.** about 13,744 km **55.** Sample answer: A babysitter earns $20 for cleaning the house and $8 extra for every hour she watches the children. **57.** Sample answer: Neither; the sequence is both arithmetic and geometric. **59.** Sample answer: If a geometric sequence has a ratio r such that $|r| < 1$, as n increases, the absolute value of the terms will decrease and approach zero because they are continuously being multiplied by a fraction. When $|r| \geq 1$, the absolute value of the terms will increase and approach infinity because they are continuously being multiplied by a value greater than 1.
61. $421.85 **63.** H **65.** (±4, 5) **67.** no solution
71.



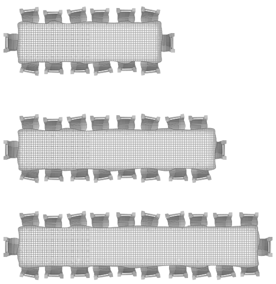
73.



75. $y = 0.5x + 1$ **77.** $y = 3x - 6$ **79.** $y = -\frac{1}{2}x + \frac{7}{2}$

Lesson 9-2

1. 104 **3.** $a_n = 6n + 7$ **5.** 15, 24, 33 **7.** 1275 **9.** 4500
11. 8, 12, 16 **13.** C **15.** 248 **17.** –103 **19.** 14
21. $a_n = -14n + 45$ **23.** $a_n = 5n - 14$ **25.** $a_n = 4.5n - 21$
27. $a_n = 9n - 32$ **29.** $a_n = \frac{2}{3}n - 3$ **31.** $a_n = \frac{1}{2}n - \frac{23}{10}$
33. 19, 14, 9, 4 **35.** –21, –14, –7, 0
37. –21, –30, –39, –48, –57 **39.** 10,100 **41.** 10,000
43. 696 **45.** 1272 **47.** $4400 **49.** 48, 60, 72 **51.** –15, –6, 3
53. –44, –30, –16 **55.** –33, –21, –9 **57.** 512 **59.** 324
61. $2250 **63.** $a_n = 13n - 1055$ **65.** $a_n = 9n - 88$
67a. 14, 18, 22

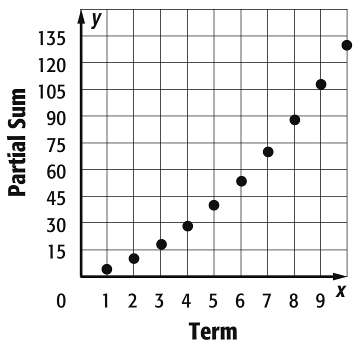


67b. $p_n = 4n + 2$ **67c.** No; there is no whole number n for which $4n + 2 = 100$. **69.** the 19th year

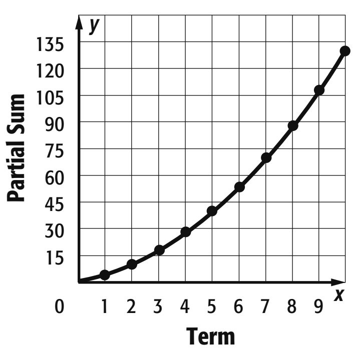
71a.

n	S_n
1	4
2	10
3	18
4	28
5	40
6	54
7	70
8	88
9	108
10	130

71b.



71c.

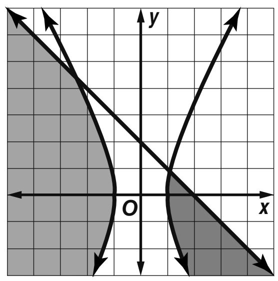


71d. Sample answer: The graphs cover the same range. The domain of the series is the natural numbers, while the domain of the quadratic function is all real numbers, $0 \leq x \leq 10$.
71e. Sample answer: For every partial sum of an arithmetic series, there is a corresponding quadratic function that shares the same range.
71f. $\sum_{k=1}^{x} 2k + 7$ **73.** 16 **75.** $4b - 3a$
77. $S_n = nx + y\left(\frac{n^2 + n}{2}\right)$
79. Sample answer: An arithmetic sequence is a list of terms such that any pair of successive terms has a common difference. An arithmetic series is the sum of the terms of an arithmetic sequence.

81.

$S_n = (a_1 + a_n) \cdot \left(\frac{n}{2}\right)$	General sum formula
$a_n = a_1 + (n - 1)d$	Formula for *nth* term
$a_n - (n - 1)d = a_1$	Subtract $(n - 1)d$ from both sides.
$S_n = [a_n - (n - 1)d + a_n] \cdot \left(\frac{n}{2}\right)$	Substitution
$S_n = [2a_n - (n - 1)d] \cdot \left(\frac{n}{2}\right)$	Simplify.

83. C **85.** A **87.** yes **89.** no
91.



93a. 4.8 cm/g **93b.** 24 cm; The answer is reasonable. The object would stretch the first spring 60 cm and would stretch the second spring 40 cm. The object would have to stretch the combined springs less than it would stretch either of the springs individually.

95. $\frac{xyz^{\frac{2}{3}}}{z}$ **97.** 2.4550 **99.** 0.4341

Lesson 9-3

1. 2046 **3.** $a_n = 18\left(\frac{1}{3}\right)^{n-1}$ **5.** $a_n = \frac{4}{3}(3)^{n-1}$
7. $a_n = 12(-8)^{n-1}$ **9.** 1, 5, 25 or –1, 5, –25 **11.** 4095
13. $\frac{1}{16}$ **15.** 512 **17.** 93 in. **19.** 25 **21.** 512
23. $a_n = (-3)(-2)^{n-1}$ **25.** $a_n = (-1)(-1)^{n-1}$
27. $a_n = 8 \cdot \left(\frac{1}{4}\right)^{n-1}$ **29.** $a_n = 7(2)^{n-1}$
31. $a_n = \frac{1}{15{,}552}(6)^{n-1}$ **33.** $a_n = 648\left(\frac{1}{3}\right)^{n-1}$
35. 270, 90, 30 or –270, 90, –30
37. $\frac{7}{3}, \frac{14}{9}, \frac{28}{27}$ or $-\frac{7}{3}, \frac{14}{9}, -\frac{28}{27}$ **39.** 15, 75 **41.** 99.99%
43. 31.9375 **45.** 9707.82 **47.** 2188 **49.** –87, 381 **51.** –8
53. 64 **55.** 0.25 **57.** 193.75 ft **59.** 524,288
61. about 471 cm **63a.** $11.79, $30.58, $205.72
65. $S_n = \frac{a_1 - a_n r}{1 - r}$ (Alternate sum formula)

$a_n = a_1 \cdot r^{n-1}$ (Formula for *nth* term)

$\frac{a_n}{r^{n-1}} = a_1$ (Divide each side by r^{n-1}.)

$S_n = \frac{\frac{a_n}{r^{n-1}} - a_n r}{1 - r}$ (Substitution.)

$= \frac{\frac{a_n 1}{r^{n-1}} - \frac{a_n r \cdot r^{n-1}}{r^{n-1}}}{1 - r}$ $\left(\text{Multiply by } \frac{\frac{r^{n-1}}{r^{n-1}}}{1}.\right)$

$= \frac{\frac{a_n(1 - r^n)}{r^{n-1}}}{1 - r}$ (Simplify.)

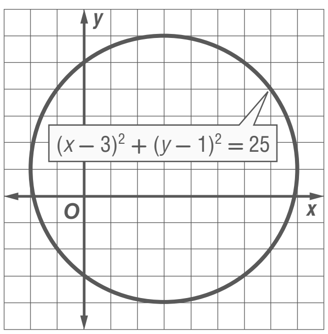
$= \frac{a_n(1 - r^n)}{r^{n-1}(1 - r)}$ (Divide by $(1 - r)$).

$= \frac{a_n(1 - r^n)}{r^{n-1} - r^n}$ (Simplify.)

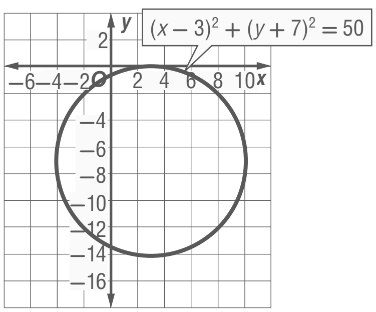
67. Sample answer: $n - 1$ needs to change to n, and the 10 needs to change to a 9. When this happens, the terms for both series will be identical (a_1 in the first series will equal a_0 in the second series, and so on), and the series will be equal to each other.

69. 234 **71.** Sample answer: 4 + 8 + 16 + 32 + 64 + 128 **73.** B **75.** \$32,000 **77.** \$1550 **79.** Arithmetic; the common difference is $\frac{1}{50}$.

81. (3, 1), 5 units



83. (3, −7), $5\sqrt{2}$ units



85. $\frac{1}{6}$ **87.** 36

Lesson 9-4

1. $c^5 + 5c^4d + 10c^3d^2 + 10c^2d^3 + 5cd^4 + d^5$
3. $x^6 - 24x^5 + 240x^4 - 1280x^3 + 3840x^2 - 6144x + 4096$
5. $x^5 + 15x^4 + 90x^3 + 270x^2 + 405x + 243$
7. $\frac{3}{32}$ or 0.09375 **9.** $5670x^4y^4$ **11.** $-108{,}864c^3d^5$ **13.** $243a^5$
15. $a^6 - 6a^5b + 15a^4b^2 - 20a^3b^3 + 15a^2b^4 - 6ab^5 + b^6$
17. $x^6 + 36x^5 + 540x^4 + 4320x^3 + 19{,}440x^2 + 46{,}656x + 46{,}656$ **19.** $16a^4 + 128a^3b + 384a^2b^2 + 512ab^3 + 256b^4$
21. $\frac{120}{1024} = \frac{15}{128} \approx 0.117$ **23.** $84x^5z^2$ **25.** $7168a^2b^6$
27. $32{,}256x^5$ **29.** 29. $x^5 + \frac{5}{2}x^4 + \frac{5}{2}x^3 + \frac{5}{4}x^2 + \frac{5}{16}x + \frac{1}{32}$
31. $32b^5 + 20b^4 + 5b^3 + \frac{5}{8}b^2 + \frac{5}{128}b + \frac{1}{1024}$ **33a.** 0.121
33b. 0.121 **33c.** 0.309 **35.** Sample answer: While they have the same terms, the signs for $(x + y)^n$ will all be positive, while the signs for $(x - y)^n$ will alternate.
37. Sample answer: $\left(x + \frac{6}{5}y\right)^5$ **39.** A **41.** G **43.** 8
45. $x \geq 21$ **47.** $d > -\frac{3}{4}$
49a. $\frac{150}{x}$; $\frac{130}{x - 10}$ **49b.** $\frac{150}{x}$; $\frac{130}{x - 10} = 4$; 75 mph, 65 mph
51. true; 3(1) + 5 = 8, which is even

Lesson 9-5

1. Step 1: When $n = 1$, the left side of the given equation is 1. The right side is 1^2 or 1, so the equation is true for $n = 1$.
Step 2: Assume that $1 + 3 + 5 + \ldots + (2k - 1) = k^2$ for some natural number k. Step 3: $1 + 3 + 5 + \ldots +$
$(2k - 1) + (2(k + 1) - 1)$
$= k^2 + (2(k + 1) - 1)$
$= k^2 + (2k + 2 - 1)$
$= k^2 + 2k + 1$
$= (k + 1)^2$
The last expression is the right side of the equation to be proved, where $n = k + 1$. Thus, the equation is true for $n = k + 1$. Therefore, $1 + 3 + 5 + \ldots + (2n - 1) = n^2$ for all natural numbers n.

3a. 3, 6, 10, 15, 21 **3b.** $a_n = \frac{n(n + 1)}{2}$

3c. Step 1: When $n = 1$, the left side of the given equation is $\frac{1(1 + 1)}{2}$ or 1. The right side is $\frac{1(1 + 1)(1 + 2)}{6}$ or 1, so the equation is true for $n = 1$.
Step 2: Assume that $1 + 3 + 6 + \ldots + \frac{k(k + 1)}{2} = \frac{k(k + 1)(k + 2)}{6}$ for some natural number k.
Step 3: $1 + 3 + 6 + \ldots + \frac{k(k + 1)}{2} + \frac{(k + 1)(k + 1 + 1)}{2}$
$= \frac{k(k + 1)(k + 2)}{6} + \frac{(k + 1)(k + 1 + 1)}{2}$
$= \frac{k(k + 1)(k + 2)}{6} + \frac{3(k + 1)(k + 2)}{6}$
$= \frac{(k + 1)(k + 2)(k + 3)}{6}$
$= \frac{(k + 1)[(k + 1) + 1]\,[(k + 1) + 2]}{6}$
The last expression is the right side of the equation to be proved, where $n = k + 1$. Thus, the equation is true for $n = k + 1$. Therefore, $1 + 3 + 6 + \ldots + \frac{n(n + 1)}{2} = \frac{n(n + 1)(n + 2)}{6}$ for all natural numbers n.

5. Step 1: $4^1 - 1 = 3$, which is divisible by 3. The statement is true for $n = 1$.
Step 2: Assume that $4^k - 1$ is divisible by 3 for some natural

number k. This means that $4^k - 1 = 3r$ for some whole number r.

Step 3: $4^k - 1 = 3r$

$$4^k = 3r + 1$$
$$4^{k+1} = 12r + 4$$
$$4^{k+1} - 1 = 12r + 3$$
$$4^{k+1} - 1 = 3(4r + 1)$$

Since r is a whole number, $4r + 1$ is a whole number. Thus, $4^{k+1} - 1$ is divisible by 3, so the statement is true for $n = k + 1$. Therefore, $4^n - 1$ is divisible by 3 for all natural numbers n. **7.** $n = 1$

9. Step 1: When $n = 1$, the left side of the given equation is 2. The right side is $\frac{1[3(1) + 1]}{2}$ or 2, so the equation is true for $n = 1$.

Step 2: Assume that $2 + 5 + 8 + \ldots + (3k - 1) = \frac{k(3k + 1)}{2}$ for some natural number k.

Step 3: $2 + 5 + 8 + \ldots + (3k - 1) + [3(k + 1) - 1]$

$$= \frac{k(3k + 1)}{2} + [3(k + 1) - 1]$$
$$= \frac{k(3k + 1) + 2[3(k + 1) - 1]}{2}$$
$$= \frac{3k^2 + k + 6k + 6 - 2}{2}$$
$$= \frac{3k^2 + 7k + 4}{2}$$
$$= \frac{(k + 1)(3k + 4)}{2}$$
$$= \frac{(k + 1)[3(k + 1) + 1]}{2}$$

The last expression is the right side of the equation to be proved, where $n = k + 1$. Thus, the equation is true for $n = k + 1$. Therefore, $2 + 5 + 8 + \ldots + (3n - 1) = \frac{n(3n + 1)}{2}$ for all natural numbers n.

11. Step 1: When $n = 1$, the left side of the given equation is 1. The right side is $1[2(1) - 1]$ or 1, so the equation is true for $n = 1$.

Step 2: Assume that $1 + 5 + 9 + \ldots + (4k - 3) = k(2k - 1)$ for some natural number k.

Step 3: $1 + 5 + 9 + \ldots + (4k - 3) + [4(k + 1) - 3]$

$$= k(2k - 1) + [4(k + 1) - 3]$$
$$= 2k^2 - k + 4k + 4 - 3$$
$$= 2k^2 + 3k + 1$$
$$= (k + 1)(2k + 1)$$
$$= (k + 1)[2(k + 1) - 1]$$

The last expression is the right side of the equation to be proved, where $n = k + 1$. Thus, the equation is true for $n = k + 1$. Therefore, $1 + 5 + 9 + \ldots + (4n - 3) = n(2n - 1)$ for all natural numbers n.

13. Step 1: When $n = 1$, the left side of the given equation is $4(1) - 1$ or 3. The right side is $2(1)^2 + 1$ or 3, so the equation is true for $n = 1$.

Step 2: Assume that $3 + 7 + 11 + \ldots + (4k - 1) = 2k^2 + k$ for some natural number k.

Step 3: $3 + 7 + 11 + \ldots + (4k - 1) + [4(k + 1) - 1]$

$$= 2k^2 + k + [4(k + 1) - 1]$$
$$= 2k^2 + k + 4k + 3$$
$$= 2k^2 + 5k + 3$$
$$= 2k^2 + 4k + 2 + k + 1$$
$$= [2(k + 1)^2] + (k + 1)$$

The last expression is the right side of the equation to be proved, where $n = k + 1$. Thus, the equation is true for $n = k + 1$. Therefore, $3 + 7 + 11 + \ldots + (4n - 1) = 2n^2 + n$ for all natural numbers n.

15. Step 1: When $n = 1$, the left side of the given equation is 1^2 or 1. The right side is $\frac{1[2(1) - 1][2(1) + 1]}{3}$ or 1, so the equation is true for $n = 1$.

Step 2: Assume that $1^2 + 3^2 + 5^2 + \ldots + (2k - 1)^2 = \frac{k(2k - 1)(2k + 1)}{3}$ for some natural number k.

Step 3: $1^2 + 3^2 + 5^2 + \ldots + (2k - 1)^2 + [2(k + 1) - 1]^2$

$$= \frac{k(2k - 1)(2k + 1)}{3} + [2(k + 1) - 1]^2$$
$$= \frac{k(2k - 1)(2k + 1) + 3(2k + 1)^2}{3}$$
$$= \frac{(2k + 1)[k(2k - 1) + 3(2k + 1)]}{3}$$
$$= \frac{(2k + 1)(2k^2 - k + 6k + 3)}{3}$$
$$= \frac{(2k + 1)(2k^2 + 5k + 3)}{3}$$
$$= \frac{(2k + 1)(k + 1)(2k + 3)}{3}$$
$$= \frac{(k + 1)[2(k + 1) - 1][2(k + 1) + 1]}{3}$$

The last expression is the right side of the equation to be proved, where $n = k + 1$. Thus, the equation is true for $n = k + 1$. Therefore, $1^2 + 3^2 + 5^2 + \ldots + (2n - 1)^2 = \frac{n(2n - 1)(2n + 1)}{3}$ for all natural numbers n.

17. Step 1: $5^1 + 3 = 8$, which is divisible by 4. The statement is true for $n = 1$.

Step 2: Assume $5^k + 3$ is divisible by 4 for some natural number k. This means that $5^k + 3 = 4r$ for some natural number r.

Step 3: $5^k + 3 = 4r$

$$5^k = 4r - 3$$
$$5^{k+1} = 20r - 15$$
$$5^{k+1} + 3 = 20r - 12$$
$$5^{k+1} + 3 = 4(5r - 3)$$

Since r is a natural number, $5r - 3$ is a natural number. Thus, $5^{k+1} + 3$ is divisible by 4, so the statement is true for $n = k + 1$. Therefore, $5^n + 3$ is divisible by 4 for all natural numbers n.

19. Step 1: $12^1 + 10 = 22$, which is divisible by 11. The statement is true for $n = 1$.

Step 2: Assume that $12^k + 10$ is divisible by 11 for some natural number k. This means that $12^k + 10 = 11r$ for some natural number r.

Step 3: $12^k + 10 = 11r$

$$12^k = 11r - 10$$

$$12^{k+1} = 132r - 120$$
$$12^{k+1} + 10 = 132r - 110$$
$$12^{k+1} + 10 = 11(12r - 10)$$

Since r is a natural number, $12r - 10$ is a natural number. Thus, $12^{k+1} + 10$ is divisible by 11, so the statement is true for $n = k + 1$. Therefore, $12^n + 10$ is divisible by 11 for all natural numbers n.

21. $n = 2$ **23.** $n = 1$

25. Step 1: When $n = 1$, the left side of the given equation is f_1. The right side is $f_3 - 1$. Since $f_1 = 1$ and $f_3 = 2$ the equation becomes $1 = 2 - 1$ and is true for $n = 1$.

Step 2: Assume that $f_1 + f_2 + \ldots + f_k = f_{k+2} - 1$ for some natural number k.

Step 3: $f_1 + f_2 + \ldots + f_k + f_{k+1} = f_{k+2} - 1 + f_{k+1}$

$= f_{k+1} + f_{k+2} - 1$

$= f_{k+3} - 1$, since Fibonacci numbers are produced by adding the two previous Fibonacci numbers.

The last expression is the right side of the equation to be proved, where $n = k + 1$. Thus, the equation is true for $n = k + 1$. Therefore, $f_1 + f_2 + \ldots + f_n = f_{n+2} - 1$ for all natural numbers n.

27. Step 1: $18^1 - 1 = 17$, which is divisible by 17. The statement is true for $n = 1$.

Step 2: Assume that $18^k - 1$ is divisible by 17 for some natural number k. This means that $18^k - 1 = 17r$ for some natural number r.

Step 3: $18^k - 1 = 17r$
$$18^k = 17r + 1$$
$$18^{k+1} = 18(17r + 1)$$
$$18^{k+1} = 306r + 18$$
$$18^{k+1} - 1 = 306r + 17$$
$$18^{k+1} - 1 = 17(18r + 1)$$

Since r is a natural number, $18r + 1$ is a natural number. Thus, $18^{k+1} - 1$ is divisible by 17, so the statement is true for $n = k + 1$. Therefore, $18^n - 1$ is divisible by 17 for all natural numbers n.

29. $n = 3$

31. Step 1: When $n = 1$, the left side of the given equation is $\frac{1}{1(1+1)(1+2)}$ or $\frac{1}{6}$. The right side is $\frac{1(1+3)}{4(1+1)(1+2)}$ or $\frac{1}{6}$, so the equation is true for $n = 1$.

Step 2: Assume that $\frac{1}{1 \cdot 2 \cdot 3} + \frac{1}{2 \cdot 3 \cdot 4} + \frac{1}{3 \cdot 4 \cdot 5} + \ldots + \frac{1}{k(k+1)(k+2)} = \frac{k(k+3)}{4(k+1)(k+2)}$ for some natural number k.

Step 3:
$$\frac{1}{1 \cdot 2 \cdot 3} + \frac{1}{2 \cdot 3 \cdot 4} + \ldots + \frac{1}{k(k+1)(k+2)} + \frac{1}{(k+1)(k+2)(k+3)}$$
$$= \frac{k(k+3)}{4(k+1)(k+2)} + \frac{1}{(k+1)(k+2)(k+3)}$$
$$= \frac{k(k+3)(k+3)}{4(k+1)(k+2)(k+3)} + \frac{4}{4(k+1)(k+2)(k+3)}$$
$$= \frac{k^3 + 6k^2 + 9k + 4}{4(k+1)(k+2)(k+3)}$$
$$= \frac{(k+1)(k^2 + 5k + 4)}{4(k+1)(k+2)(k+3)}$$
$$= \frac{(k+1)(k+4)}{4(k+2)(k+3)}$$
$$= \frac{(k+1)[(k+1)+3]}{4[(k+1)+1][(k+1)+2]}$$

The last expression is the right side of the equation to be proved, where $n = k + 1$. Thus, the equation is true for $n = k + 1$. Therefore, $\frac{1}{1 \cdot 2 \cdot 3} + \frac{1}{2 \cdot 3 \cdot 4} + \frac{1}{3 \cdot 4 \cdot 5} + \ldots + \frac{1}{n(n+1)(n+2)} = \frac{n(n+3)}{4(n+1)(n+2)}$ for all natural numbers n.

33. $n(n + 1)$

Step 1: When $n = 1$, the left side of the given equation is 2(1) or 2. The right side is $1(1 + 1)$ or 2, so the equation is true for $n = 1$.

Step 2: Assume that $2 + 4 + 6 + \ldots + 2k = k(k + 1)$ for some natural number k.

Step 3: $2 + 4 + 6 + \ldots + 2k + 2(k + 1)$
$$= k(k+1) + 2(k+1)$$
$$= (k+1)(k+2)$$
$$= (k+1)[(k+1)+1]$$

The last expression is the right side of the equation to be proved, where $n = k + 1$. Thus, the equation is true for $n = k + 1$. Therefore, $2 + 4 + 6 + \ldots + n^2 = n(n + 1)$ for all natural numbers n.

35. Sample answer: False; assume $k = 2$, just because a statement is true for $n = 2$ and $n = 3$ does not mean that it is true for $n = 1$. **37.** $x = 3$ **39.** Sample answer: When dominoes are set up, after the first domino falls, the rest will fall as well. With induction, once it is proved that the statement is true for n = 1 (the first domino), $n = k$ (the second domino), and $n = k + 1$ (the next domino), it will be true for any integer value (any domino).
41. B **43.** 96 **45.** $160x^3y^3$ **47.** $-84x^6y^3$
49. (6, −8), (12, −16) **51.** 56 **53.** 665,280 **55.** 70
57. 132 **59.** 28 **61.** 24

Chapter 9 Study Guide and Review

1. true **3.** true **5.** false arithmetic means **7.** 48 **9.** −22
11. −7, −2, 3 **13.** 8, 4, 0, −4 **15.** $480 **17.** 1040
19. −245 **21.** 629 **23.** −99 **25.** 99 **27.** $\frac{2187}{8}$
29. ±24, 72, ±216 **31.** $1823.26 **33.** 12,285 **35.** 363
37. $-\frac{6305}{2187}$ **39.** $a^3 + 3a^2b + 3ab^2 + b^3$
41. $-32z^5 + 240z^4 - 720z^3 + 1080z^2 - 810z + 243$
43. $x^5 - \frac{5}{4}x^4 + \frac{5}{8}x^3 - \frac{5}{32}x^2 + \frac{5}{256}x - \frac{1}{1024}$
45. $193{,}536\, x^2 y^5$

47. Step 1: When $n = 1$, the left side of the equation is equal to 2. The right side of the equation is also equal to 2. So the equation is true for $n = 1$.

Selected Answers and Solutions

Step 2: Assume that $2 + 6 + 12 + \ldots + k(k+1) = \frac{k(k+1)(k+2)}{3}$ for some positive integer k.

Step 3: $1 \cdot 2 + 2 \cdot 3 + \ldots + k(k+1) + (k+1)(k+2)$

$$= \frac{k(k+1)(k+2)}{3} + (k+1)(k+2)$$
$$= \frac{k(k+1)(k+2)}{3} + \frac{3(k+1)(k+2)}{3}$$
$$= \frac{(k+1)[k(k+2) + 3(k+2)]}{3}$$
$$= \frac{(k+1)(k+2)(k+3)}{3}$$
$$= \frac{(k+1)[(k+1)+1][(k+1)+2]}{3}$$

The last expression is the right side of the equation to be proved, where $n = k + 1$. Thus, the equation is true for $n = k + 1$. Therefore, $2 + 6 + 12 + \ldots + n(n+1) = \frac{n(n+1)(n+2)}{3}$ for all positive integers n.

49. Step 1: When $n = 1$, $5^1 - 1 = 5 - 1$ or 4. Since 4 divided by 4 is 1, the statement is true for $n = 1$.

Step 2: Assume that $5^k - 1$ is divisible by 4 for some positive integer k. This means that $5^k - 1 = 4r$ for some whole number r.

Step 3:

$$5^k - 1 = 4r$$
$$5^k = 4r + 1$$
$$5^{k+1} = 20r + 5$$
$$5^{k+1} - 1 = 20r + 5 - 1$$
$$5^{k+1} - 1 = 20r + 4$$
$$5^{k+1} - 1 = 4(5r + 1)$$

Since r is a whole number, $5r + 1$ is a whole number. Thus, $5^{k+1} - 1$ is divisible by 4, so the statement is true for $n = k + 1$. Therefore, $5^n - 1$ is divisible by 4 for all positive integers n.

51. $n = 2$ **53.** $n = 1$

CHAPTER 10
Statistics and Probability

Chapter 10 Get Ready

1. 89 customers, 88 customers, no mode
3. 7.7 touchdowns, 8 touchdowns, 10 touchdowns
5. $\frac{1}{4}$ **7.** $a^4 - 8a^3 + 24a^2 - 32a + 16$
9. $16b^4 - 32b^3x + 24b^2x^2 - 8bx^3 + x^4$
11. $243x^5 - 810x^4y + 1080x^3y^2 - 720x^2y^3 + 240xy^4 - 32y^5$
13. $\frac{a^5}{32} + \frac{5a^4}{8} + 5a^3 + 20a^2 + 40a + 32$

Lesson 10-1

1. survey; sample: the students in the study; population: the student body **3.** Observation study; sample answer: The scores of the participants are observed and compared without them being affected by the study. **5.** unbiased **7.** objective: to determine how many people in the U.S. are interested in purchasing a hybrid vehicle; population: the people surveyed; sample survey questions: Do you currently own a hybrid vehicle? Are you planning on purchasing a hybrid vehicle? **9.** objective: to determine whether the protein shake helps athletes recover from exercise; population: all athletes; experiment group: athletes given the protein shake; control group: athletes given a placebo; sample procedure: The researchers could randomly divide the athletes into two groups: an experimental group given the protein shake and a control group given the placebo. Next, they could have the athletes exercise and then drink the protein shake or placebo. Later, the researchers could interview the athletes to see how they feel.
11. observational study; sample: physics students selected; population: all college students that take a physics course **13.** survey; sample: people that receive the questionnaire; population: all viewers **15.** Survey; sample answer: The data will be obtained from opinions given by members of the sample population. **17.** Experiment; sample answer: Metal samples will need to be tested, which means that the members of the sample will be affected by the study. **19.** Biased; sample answer: The question only gives two options, and thus encourages a certain response.
21. Biased; sample answer: The question encourages a certain response. The phrase “don’t you agree” suggests that the people surveyed should agree. **23.** Sample answer: The flaw is that the experimental group consists of stores in the Midwest, and the control group consists of stores in Arizona. On average, the temperature is higher in Arizona than in the Midwest, and people use more sunscreen. Therefore, the sunscreen sales in stores located in those regions would likely be different and should not be compared in an experiment. **25a.** sample: the 8- to 18-year-olds surveyed; population: all 8- to 18-year-olds in the U.S. **25b.** average time **25c.** Sample answer: The 8- to 10-year-old group talked for about 10 minutes a day and did not text at all. The 11- to 14-year-old group talked for about 30 minutes a day and texted for about 70 minutes a day. The 15- to 18-year-old group talked for about 40 minutes a day and texted for about 110 minutes a day. **25d.** Sample answer: A cell phone company might use a report like this to determine which age group to target in their ads. **27a.** See students’ work.
27b. Sample answer for Product A: ≈63.3%

Product A	
Number	**Frequency**
0–6	卌 卌 卌 ||||
7–9	卌 卌 |

Sample answer for Product B: ≈76.7%

Product B	
Number	**Frequency**
0–7	卌 卌 卌 卌 |||
8–9	卌 ||

27c. Sample answer: Yes; the probability that Product B is effective is 14.4% higher than that of Product A. **27d.** Sample answer: It depends on what the product is and how it is being used. For example, if the product is a pencil sharpener, then the lower price may be more important than the effectiveness, and therefore,

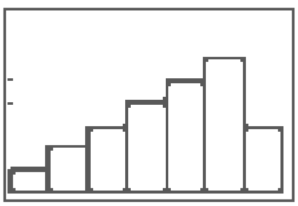
might not justify the price difference. However, if the product is a life-saving medicine, the effectiveness may be more important than the price, and therefore, might justify the price difference.
29. true **31.** Sample answer: the sampling method used, the type of sample that was selected, the type of study performed, the survey question(s) that were asked or procedures that were used
33. C **35.** G
37. Step 1: $9^1 - 1 = 8$, which is divisible by 8. The statement is true for $n = 1$.
Step 2: Assume that $9^k - 1$ is divisible by 8 for some natural number k. This means that $9^k - 1 = 8r$ for some natural number r.
Step 3:

$$\begin{aligned} 9^k - 1 &= 8r \\ 9^k &= 8r + 1 \\ 9^{k+1} &= 72r + 9 \\ 9^{k+1} - 1 &= 72r + 8 \\ 9^{k+1} - 1 &= 8(9r + 1) \end{aligned}$$

Since r is a natural number, $9r + 1$ is a natural number. Thus, $9^{k+1} - 1$ is divisible by 8, so the statement is true for $n = k + 1$. Therefore, $9^n - 1$ is divisible by 8 for all natural numbers n.
39. $\left(\frac{3}{2}, \frac{9}{2}\right)$, $(-1, 2)$ **41.** no solution **43.** $(\pm 8, 0)$
45. $3\sqrt{17}$ units **47.** 25 units **49.** $\sqrt{70.25}$ units **51.** $5c^5d^3$
53. *an* **55.** $-y^3z^2$ **57.** $\frac{y^{\frac{3}{5}}}{y}$ **59.** $3x^{\frac{5}{3}} + 4x^{\frac{8}{3}}$ **61.** 63

Lesson 10-2

1a.

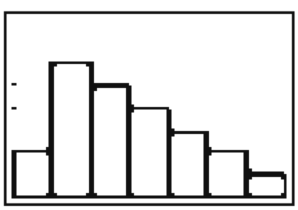


[4, 32] scl: 4 by [0, 8] scl: 1

negatively skewed

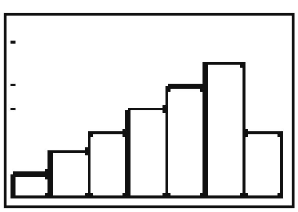
1b. Sample answer: The distribution is skewed, so use the five-number summary. The times range from 7 to 30 minutes. The median is 22.5 minutes, and half of the data are between 15.5 and 26 minutes.

3a. Mrs. Johnson's Class



[5, 40] scl: 5 by [0, 8] scl: 1

Mr. Edmunds' Class

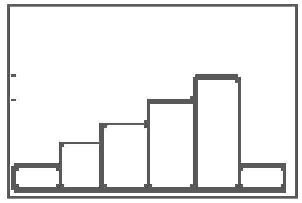


[5, 40] scl: 5 by [0, 8] scl: 1

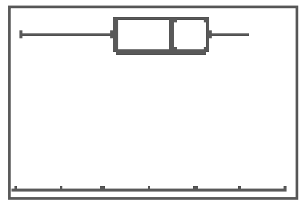
Mrs. Johnson's class, positively skewed; Mr. Edmunds' class, negatively skewed

3b. Sample answer: The distributions are skewed, so use the five-number summaries. The range for both classes is the same. However, the median for Mrs. Johnson's class is 17 and the median for Mr. Edmunds' class is 28. The lower quartile for Mr. Edmunds' class is 20. Since this is greater than the median for Mrs. Johnson's class, this means that 75% of the data from Mr. Edmunds' class is greater than 50% of the data from Mrs. Johnson's class. Therefore, we can conclude that the students in Mr. Edmunds' class had slightly higher sales overall than the students in Mrs. Johnson's class.

5a.



[50, 200] scl: 25 by [0, 8] scl: 1

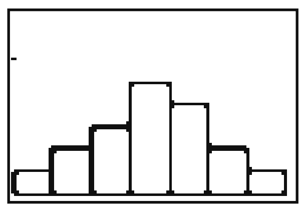


[50, 200] scl: 25 by [0, 5] scl: 1

negatively skewed

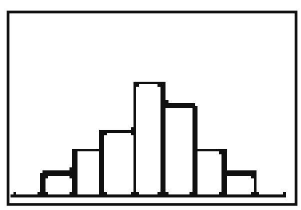
5b. Sample answer: The distribution is skewed, so use the five-number summary. The points range from 53 to 179. The median is 138.5 points, and half of the data are between 106.5 and 157 points.

7a. Sophomore Year



[1200, 1900] scl: 100 by [0, 8] scl: 1

Junior Year

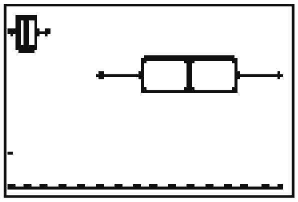


[1300, 2200] scl: 100 by [0, 8] scl: 1

both symmetric

7b. Sample answer: The distributions are symmetric, so use the means and standard deviations. The mean score for sophomore year is about 1552.9 with standard deviation of about 147.2. The mean score for junior year is about 1753.8 with standard deviation of about 159.1. We can conclude that the scores and the variation of the scores from the mean both increased from sophomore year to junior year.

9a.

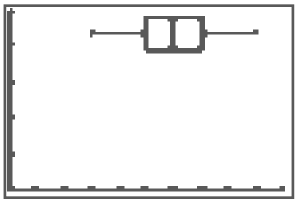


[3000, 18,000] scl: 1000 by [0, 5] scl: 1

both symmetric

9b. Sample answer: The distributions are symmetric, so use the means and standard deviations. The mean for the public colleges is \$4037.50 with standard deviation of about \$621.93. The mean for private colleges is about \$12,803.11 with standard deviation of about \$2915.20. We can conclude that not only is the average cost of private schools far greater than the average cost of public schools, but the variation of the costs from the mean is also much greater.

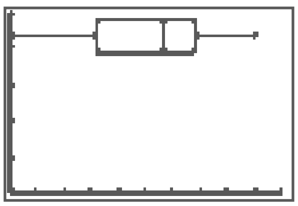
11a.



[0, 30] sc: 3 by [0, 5] scl: 1

Sample answer: The distribution is symmetric, so use the mean and standard deviation. The mean of the data is 18 with sample standard deviation of about 5.2 points.

11b.



[0, 30] sc: 3 by [0, 5] scl: 1

mean: 14.6; median: 17

11c. Sample answer: Adding the scores from the first four games causes the shape of the distribution to go from being symmetric to being negatively skewed. Therefore, the center and spread should be described using the five-number summary.

13a. Sample answer: mean = 14; median = 10

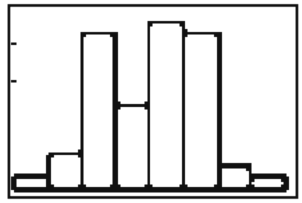
13b. Sample answer: mean = 20; median = 24

13c. Sample answer: mean = 17; median = 17

15. Sample answer: The heights of the players on the Pittsburgh Steelers roster appear to represent a normal distribution.

Heights of the Players on the 2009 Pittsburgh Steelers Roster (inches)							
75	74	71	70	74	75	77	72
71	72	70	70	75	78	71	75
77	71	69	70	77	75	74	73
77	71	73	76	76	74	72	75
75	70	70	74	73	76	79	73
71	69	70	77	77	80	75	77
67	74	69	76	77	76		

The mean of the data is about 73.61 in. or 6 ft 1.61 in. The standard deviation is about 2.97 in.



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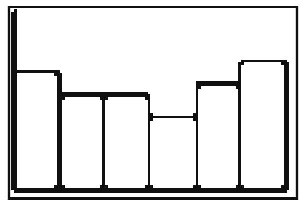
The birth months of the players do not display central tendency.

Birth Months of the Players on the 2009 Pittsburgh Steelers Roster							
1	12	10	3	11	1	10	5
4	8	9	11	1	1	11	5
8	6	11	4	3	4	8	5
3	7	2	1	11	4	3	2
1	1	6	1	6	8	11	9
3	3	1	6	9	1	9	9
6	5	10	11	11	12		



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17. D **19.** H **21.** unbiased **23.** Biased; sample answer: The question encourages a certain response. The phrase “Don’t you hate” encourages you to agree that gas prices are too high.
25a. $(39.2, \pm 4.4)$ **25b.** No; the comet and Pluto may not be at either point of intersection at the same time.
25c. $\left(-\frac{5}{3}, -\frac{7}{3}\right)$, (1, 3) **25d.** $(3, \pm 4)$, $(-3, \pm 4)$
27. combination; 28 **29.** permutation; 120

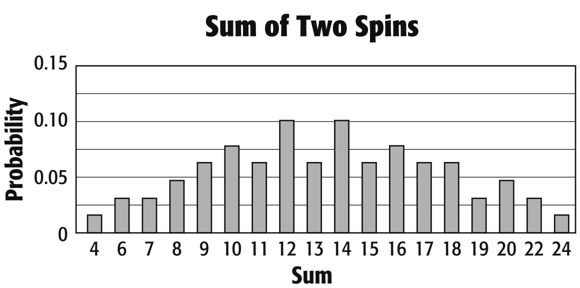
Lesson 10-3

1. The random variable X is the number of pages linked to a Web page. The pages are countable, so X is discrete.
3. The random variable X is the amount of precipitation in a city per month. Precipitation can be anywhere within a certain range. Therefore, X is continuous.

5a.

Sum	Frequency	Relative Frequency
4	1	$\frac{1}{64}$
6	2	$\frac{1}{32}$
7	2	$\frac{1}{32}$
8	3	$\frac{3}{64}$
9	4	$\frac{1}{16}$
10	5	$\frac{5}{64}$
11	4	$\frac{1}{16}$
12	7	$\frac{7}{64}$
13	4	$\frac{1}{16}$
14	7	$\frac{7}{64}$
15	4	$\frac{1}{16}$
16	5	$\frac{5}{64}$
17	4	$\frac{1}{16}$
18	4	$\frac{1}{16}$
19	2	$\frac{1}{32}$
20	3	$\frac{3}{64}$
22	2	$\frac{1}{32}$
24	1	$\frac{1}{64}$

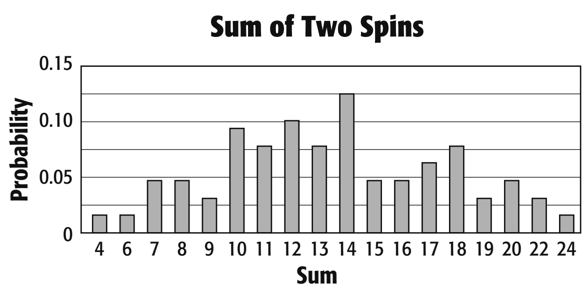
5b.



5c.

Sum	Frequency	Relative Frequency
4	1	$\frac{1}{64}$
6	1	$\frac{1}{64}$
7	3	$\frac{3}{64}$
8	3	$\frac{3}{64}$
9	2	$\frac{1}{32}$
10	6	$\frac{3}{32}$
11	5	$\frac{5}{64}$
12	7	$\frac{7}{64}$
13	5	$\frac{5}{64}$
14	8	$\frac{1}{8}$
15	3	$\frac{3}{64}$
16	3	$\frac{3}{64}$
17	4	$\frac{1}{16}$
18	5	$\frac{5}{64}$
19	2	$\frac{1}{32}$
20	3	$\frac{3}{64}$
22	2	$\frac{1}{32}$
24	1	$\frac{1}{64}$

5d.

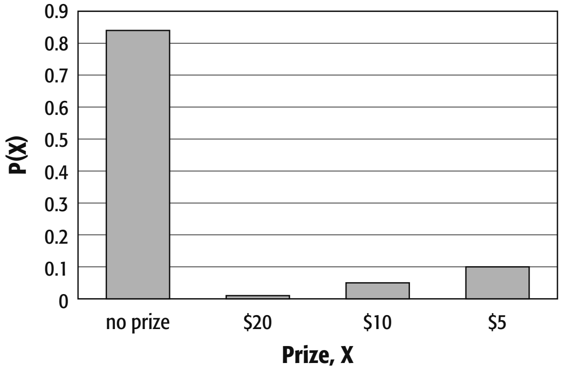


5e. 13.5 **5f.** 4.29

7. The random variable *X* is the number of diggs for a web page. The diggs are countable, so *X* is discrete.

9. The random variable *X* is the number of files infected by a computer virus. The files are countable, so *X* is discrete. **11.** 3.34

13a. **Probability to Win Each Prize**

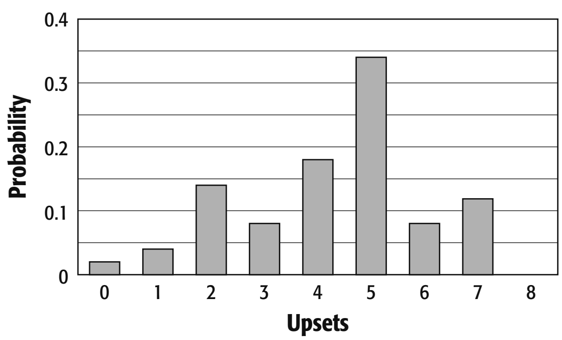


13b. $1.20 **13c.** Sample answer: The expected value is positive, so a person buying a ticket can expect to win $0.20 even after the cost of the ticket is considered. Thus, a person would want to participate in this raffle. On the other hand, this raffle is guaranteed to lose money for the organizers and they should change the distribution of prizes or not do the raffle.
15a. 4.34; Sample answer: The expected number is 4.34, so we can expect there to be 4 upsets. We cannot have 0.34 upsets, so we round to the nearest whole number. **15b.** 1.90

15c.

Number of Upsets, *X*	Frequency	Relative Frequency
0	1	0.02
1	2	0.04
2	7	0.14
3	4	0.08
4	9	0.18
5	17	0.34
6	4	0.08
7	6	0.12
8	0	0

15d. **Number of Upsets**

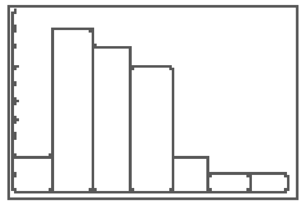


17. Sample answer: The expected value of Funds A and B is $595 and $540, respectively. The standard deviation for Fund A is about 951.6, while the standard deviation for Fund B is about 941.5. Since the standard deviations are about the same, the funds have about the same amount of risk. Therefore, with a higher expected value, Fund A is the better investment.
19. Sample answer: Liana; Shannon didn't consider every scenario in determining the total probability. For example, in calculating the probability of a sum of 5, she considered spinning a 3 then a 2, but not a 2 then a 3. **21.** Sample answer: A spinner with 5 equal-sided areas shaded red, blue, yellow, green, and brown.

Color	red	blue	yellow	green	brown
Probability	0.2	0.2	0.2	0.2	0.2

23. Sample answer: A discrete probability distribution can be the uniform distribution of the roll of a die. In this type of distribution, there are only a finite number of possibilities. A continuous probability distribution can be the distribution of the lives of 400 batteries. In this distribution, there are an infinite number of possibilities. **25.** 2.4 **27.** H

29. Peter's Articles



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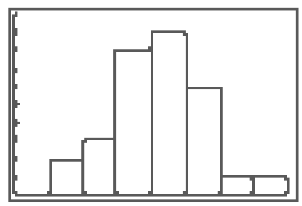
Paul's Articles



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Peter's articles, positively skewed; Paul's articles, symmetric
29b. Sample answer: One of the distributions is symmetric and the other is skewed, so use the five-number summaries. The range for Peter's articles is 64, and the range for Paul's articles is 53. However, the upper quartile for Peter's is 33, while the lower quartile for Paul's is 34. This means that 75% of Paul's articles have more likes (and are more popular) than 75% of Peter's articles. Therefore, we can conclude that Paul's articles are more popular overall. **31.** Sample answer: This situation calls for a survey because the data will be collected from responses from members of a sample of the population. **33.** 0.5, 1.25, 3.125, 7.8125, 19.53125

35. 12, 4, $\frac{4}{3}$, $\frac{4}{9}$, $\frac{4}{27}$ **37.** 80, 100, 125, $\frac{625}{4}$, $\frac{3125}{16}$ **39.** 27

41. 3 **43.** $m^4 + 4m^3n + 6m^2n^2 + 4mn^3 + n^4$

Lesson 10-4

1. This experiment cannot be reduced to a binomial experiment because there are more than two possible outcomes.
3. This experiment can be reduced to a binomial experiment. Success is yes, failure is no, a trial is asking a student, and the random variable is the number of yeses; $n = 30$, $p = 0.72$, $q = 0.28$. **5.** D **7.** This experiment can be reduced to a binomial experiment. Success is a day that it rains, failure is a day it does not rain, a trial is a day, and the random variable *X* is the number of days it rains; $n =$ the number of days in the month,

$p = 0.35$, $q = 0.65$. **9.** This experiment cannot be reduced to a binomial experiment because the events are not independent. The probability of choosing the hat that covers the ball changes after each selection.

11. Sample answer:

Step 1: A trial is pulling out a marble. The simulation will consist of 20 trials.

Step 2: A success is pulling out a red marble. The probability of success is $\frac{5}{12}$ and the probability of failure is $\frac{7}{12}$.

Step 3: The random variable X represents the number of red marbles pulled out in 20 trials.

Step 4: Use a random number generator. Let 0–4 represent pulling out a red marble. Let 5–11 represent all other outcomes. Make a frequency table and record the results as you run the generator.

Outcome	Tally	Frequency
Red Marble	𝍸𝍸	10
Other Outcomes	𝍸𝍸	10

The experimental probability is $\frac{10}{20}$ or 50%. This is greater than the theoretical probability of $\frac{5}{12}$ or about 41.7%.

13. Sample answer:

Step 1: A trial is drawing a card from a deck. The simulation will consist of 20 trials.

Step 2: A success is drawing a face card. The probability of success is $\frac{3}{13}$ and the probability of failure is $\frac{10}{13}$.

Step 3: The random variable X represents the number of face cards drawn in 20 trials.

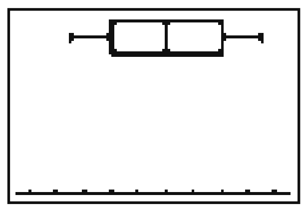
Step 4: Use a random number generator. Let 0–2 represent drawing a face card. Let 3–12 represent all other outcomes. Make a frequency table and record the results as you run the generator.

Outcome	Tally	Frequency
Face Card	||	2
Other Cards	𝍸𝍸𝍸|||	18

The experimental probability is $\frac{2}{20}$ or 10%. This is less than the theoretical probability of $\frac{3}{13}$ or about 23.1%.

15. 0.183 or 18.3% **17.** 0.096 or 9.6% **19.** 0.25 or 25%
21a. 0 own a laptop, 0.0006 or 0.06%; 1 owns a laptop, 0.007 or 0.7%, 2 own a laptop, 0.0343 or 3.43%; 3 own a laptop, 0.0991 or 9.91%; 4 own a laptop, 0.1878 or 18.78%; 5 own a laptop, 0.2441 or 24.41%; 6 own a laptop, 0.2204 or 22.04%; 7 own a laptop, 0.1364 or 13.64%; 8 own a laptop, 0.0554 or 5.54%; 9 own a laptop, 0.0133 or 1.33%; 10 own a laptop, 0.0014 or 0.14%
21b. about 7% **21c.** 5
23a. 0 own vinyl records, 0.001 or 0.1%;
1 owns vinyl records, 0.012 or 1.2%;
2 own vinyl records, 0.058 or 5.8%;
3 own vinyl records, 0.152 or 15.2%;
4 own vinyl records, 0.253 or 25.3%;
5 own vinyl records, 0.268 or 26.8%;
6 own vinyl records, 0.178 or 17.8%;
7 own vinyl records, 0.067 or 6.7%;
8 own vinyl records, 0.011 or 1.1%
23b. 0.256 or 25.6% **23c.** 5 **25.** 0.015 or 1.5%
27a. about 7.8% **27b.** Sample answer: They can roll a six-sided die. **29.** 5 **31.** 5 **33.** 7 **35.** 0.603 or 60.3%
37. 0.322 or 32.2% **39.** 0.99 or 99% **41.** 0.889 or 88.9%
43. Sample answer: You should consider the type of situation for which the binomial distribution is being used. For example, if a binomial distribution is being used to predict outcomes regarding an athletic event, the probabilities of success and failure could change due to other variables such as weather conditions or player health. So, binomial distributions should be used cautiously when making decisions involving events that are not completely random. **45.** Sample answer: A full binomial distribution can be determined by expanding the binomial, which itself utilizes Pascal's triangle. **47a.** 0.003 or 0.3% **47b.** 0.00003 or 0.003%
47c. 0.056 or 5.6% **47d.** 0.25 or 25%
49. H **51.** The random variable X is the number of customers at an amusement park. The customers are finite and countable, so X is discrete. **53.** The random variable X is the number of hot dogs sold at a sporting event. The hot dogs are finite and countable, so X is discrete.

55a.



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symmetric

55b. Sample answer: The distribution is symmetric, so use the mean and standard deviation. The mean is about \$16.02 with standard deviation of about \$4.52.
57. 6 **59.** −57 **61.** 20 **63.** $-x = \ln 5$ **65.** $e^1 = e$
67. $x + 1 = \ln 9$ **69.** $e^{2x} = \frac{7}{3}$
71a. 0.36 **71b.** 0.42 **71c.** 0.05

Lesson 10-5

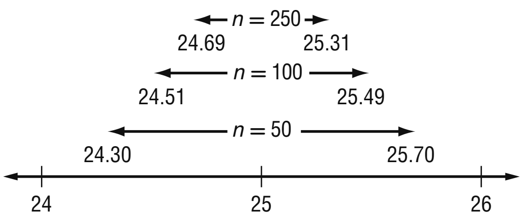
1. $251 < X < 581$ **3a.** about 386 teens **3b.** 84%
5. 2.05; 2.05 standard deviations greater than the mean
7. 3.08; 2.40 standard deviations less than the mean
9. $X < 15.9$ or $X > 42.7$ **11a.** about 509 members **11b.** 0.15%
13. −1.33; 1.33 standard deviations less than the mean
15. 177.7; 1.73 standard deviations greater than the mean
17a. about 7000 batteries **17b.** about 4200 batteries **17c.** 17.0%
19a. between \$714 and \$944 **19b.** 62 **19c.** Sample answer: I would expect people with several traffic citations to lie to the far right of the distribution where insurance costs are highest, because I think insurance companies would charge them more. **19d.** Sample answer: As the probability of an accident occurring increases, the more an auto insurance company is going to charge. I think auto insurance companies would charge younger people more than older people because they have not been driving

as long. I think they would charge more for expensive cars and sports cars and less for cars that have good safety ratings. I think they would charge a person less if they have a good driving record and more if they have had tickets and accidents. **21.** Sample answer: Hiroko; Monica's solution would work with a uniform distribution. **23.** Sample answer: True; according to the Empirical Rule, 99% of the data lie within 3 standard deviations of the mean. Therefore, only 1% will fall outside of three sigma. An infinitesimally small amount will fall outside of six-sigma. **25.** Sample answer: The scores per team in each game of the first round of the 2010 NBA playoffs. The mean is 96.56 and the standard deviation is 11.06. The middle 68% of the distribution is $85.50 < X < 107.62$. The middle 95% is $74.44 < X < 118.68$. The middle 99.7% is $63.38 < X < 129.74$. **27.** D **29.** 32.5 **31.** 17.3% **33.** The random variable X is the amount of precipitation in a city per month. Precipitation can be anywhere within a certain range. Therefore, X is continuous.
35. greatest integer **37.** constant

Lesson 10-6

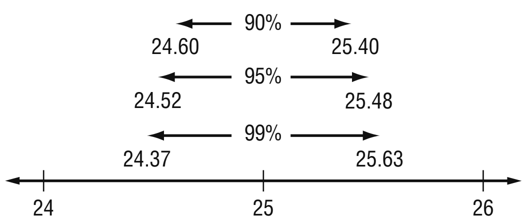
1. 0.096 **3.** H_0: $\mu \geq 2$; H_a: $\mu < 2$ (claim)
5. H_0: $\mu \geq 20$ (claim); H_a: $\mu < 20$ **7.** H_0: $\mu \geq 84$ (claim), H_a: $\mu < 84$; Do not reject H_0; The manufacturer's claim that the discs can hold at least 84 minutes cannot be rejected. **9.** 1.17
11. H_0: $\mu \geq 6$ (claim); H_a: $\mu < 6$ **13.** H_0: $\mu \leq 2$ (claim); H_a: $\mu > 2$
15. H_0: $\mu \geq 30$; H_a: $\mu < 30$ (claim); Do not reject H_0; There is not enough evidence to support the pizza chain's claim of a delivery time of less than 30 minutes cannot be rejected.
17. H_0: $\mu = 12$; H_a: $\mu \neq 12$; The mean of the sample data is 12.9 with a standard deviation of about 1.08. The z-statistic is about 5.27, which falls in the critical region at 1% significance. Therefore, the null hypothesis is rejected and the company should not make the claim on the label.

19a.



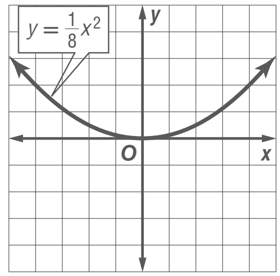
19b. Sample answer: With everything else held constant, increasing the same size will decrease the size of the confidence interval.

19c.



19d. Sample answer: With everything else held constant, increasing the confidence level will increase the size of the confidence interval.
19e. Sample answer: Expanding the confidence interval reduces the accuracy of the estimate. So decreasing the size of the confidence interval increases the accuracy of the estimate.

21. 44 **23.** Sample answer: You can use a statistical test to help you to determine the strength of your decision. **25.** C
27. B **29.** 27 students **31.** 729 **33.** 1
35. parabola

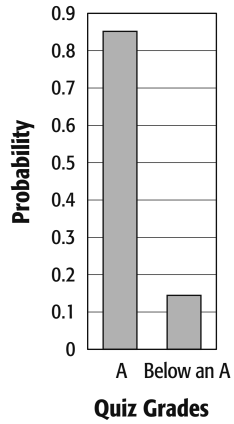


37. $y = 0.8x$ **39.** $y = -4$ **41.** 25

Lesson 10-7

1. Sample answer: Use a spinner that is divided into two sectors, one containing 80% or 288° and the other containing 20% or 72°. Do 20 trials and record the results in a frequency table.

Outcome	Frequency
A	17
Below an A	3
Total	20



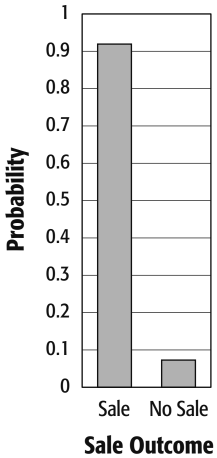
The probability of Clara getting an A on her next quiz is .85. The probability of earning any other grade is $1 - 0.85$ or 0.15.
3a. 36 **3b.** Sample answer: Use a random number generator to generate integers 1 through 25 where 1–16 represents 25 points, 17–24 represents 50 points, and 25 represents 100 points. Do 50 trials and record the results in a frequency table.

Outcome	Frequency
25	29
50	21
100	0

The average value is 35.5.

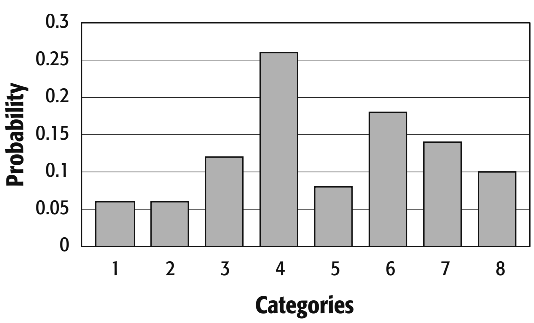
3c. Sample answer: The expected value and average value are very close.
5. Sample answer: Use a spinner that is divided into two sectors, one containing 95% or 342° and the other containing 5% or 18°. Do 50 trials and record the results in a frequency table.

Outcome	Frequency
Sale	46
No Sale	4
Total	50



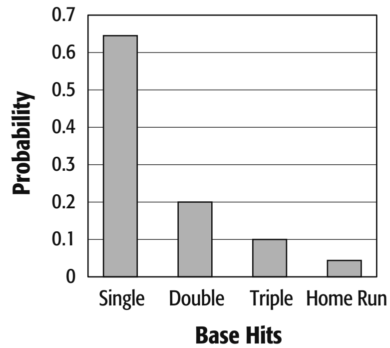
The probability of Ian selling a game is 0.92. The probability of not selling a game is 1 − 0.92 or 0.08.
7. Sample answer: Use a spinner that is divided into 8 equal sectors, each 45°. Do 50 trials and record the results in a frequency table.

Outcome	Frequency
Category 1	3
Category 2	3
Category 3	6
Category 4	13
Category 5	4
Category 6	9
Category 7	7
Category 8	5
Total	50



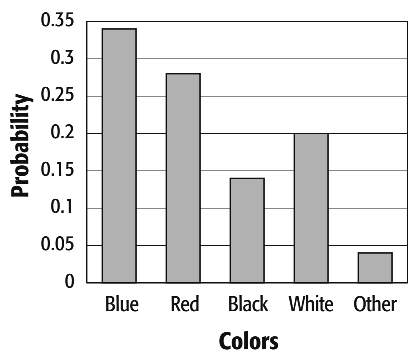
The probability of landing on Categories 1 and 2 is 0.06, Category 3 is 0.12, Category 4 is 0.26, Category 5 is 0.08, Category 6 is 0.18, Category 7 is 0.14, and Category 8 is 0.1.
9. Sample answer: Use a random number generator to generate integers 1 through 20, where 1–12 represents a single, 13–17 represents a double, 18–19 represents a triple, and 20 represents a home run. Do 20 trials and record the results in a frequency table.

Outcome	Frequency
single	13
double	4
triple	2
home run	1
Total	20



The probability of the baseball player hitting a single is 0.65, a double is 0.2, a triple is 0.1, and a home run is 0.05.
11. Sample answer: Use a random number generator to generate integers 1 through 20, where 1–7 represents blue, 8-13 represents red, 14–16 represents white, 17–19 represents black, and 20 represents all other colors. Do 50 trials and record the results in a frequency table.

Outcome	Frequency
blue	17
red	14
black	7
white	10
other	2
Total	50



The probability of a customer buying a blue car is 0.34, buying a red car is 0.28, buying a black car is 0.14, buying a white car is 0.2, and any other color is 0.04.

13. $E(Y) = 38.1$

Sample answer:

Outcome	Frequency
red	7
blue	29
white	21
total	50

Average value = 35.5; the expected value is greater than the average value.

15a. 0.75

15b. Sample answer: Use a random number generator to generate integers 1 through 20, where 1–7 represents 0 points, 8–19 represents 1 point, and 20 represents 3 points. Do 50 trials and record the results in a frequency table.

Outcome	Frequency
0	16
1	32
3	2

average value = 0.76

15c. Sample answer: The two values are almost equal.

17a. There is a $\frac{1}{6}$ or 16.7% probability of throwing a strike in each box.

17b. Sample answer:

Strike Area	Accuracy (%)
1	15
2	17
3	19
4	22
5	19
6	8
Total	100

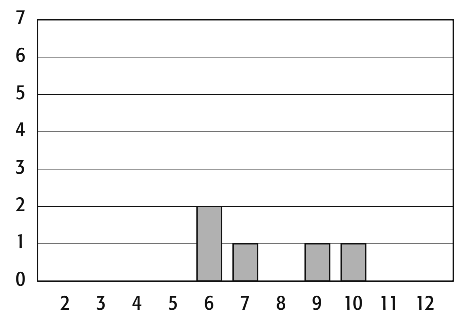
17c. Sample answer: Some of the values are higher or lower, but most are very close to 16.7%. **19a.** Sample answer: 9, 10, 6, 6, 7, 9, 5, 9, 7, 6, 5, 7, 3, 9, 7, 6, 7, 8, 7 **19b.** Sample answer: 4, 10, 5, 10, 6, 7, 12, 3, 7, 4, 7, 9, 3, 6, 4, 11, 5, 7, 5, 3

19c. Sample answer:

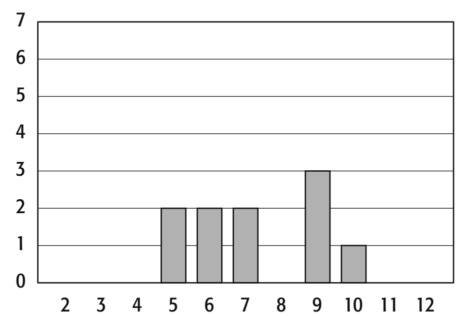
Trial	Sum of Die Roll	Sum of Output from Random Number Generator
1	9	4
2	10	10
3	6	5
4	6	10
5	7	6
6	9	7
7	5	12
8	9	3
9	5	7
10	7	4
11	6	7
12	5	9
13	7	3
14	3	6
15	9	4
16	7	11
17	6	5
18	7	7
19	8	5
20	7	3

19d. Sample answer:

Dice – 5 Rolls

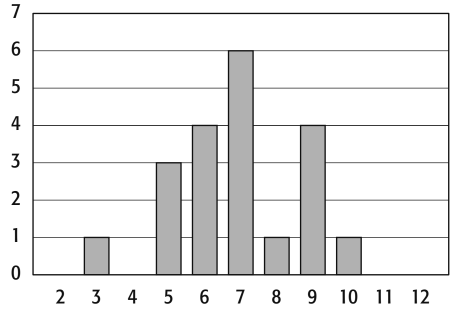


Dice – 10 Rolls



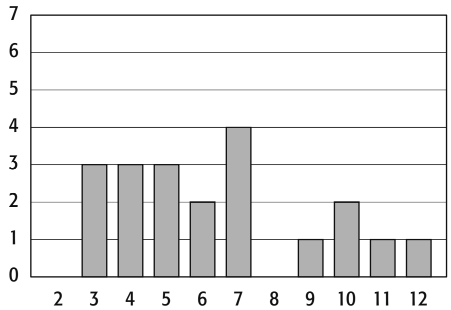
Selected Answers and Solutions

Dice – 20 Rolls



19e. Sample answer: The bar graph has more data points at the middle sums as more trials are added.
19f. Sample answer:

Random Number Generator

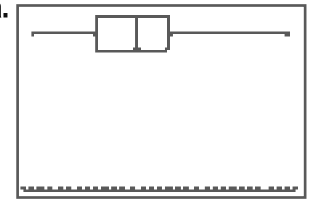


21. Sometimes; sample answer: Flipping a coin can be used to simulate and experiment with two possible outcomes when both of the outcomes are equally likely. If the probabilities of the occurrence of the two outcomes are different, flipping a coin is not an appropriate simulation. **23.** Sample answer: We assume that the object lands within the target area, and that it is equally likely that the object will land anywhere in the region. These are needed because in the real world it will not be equally likely to land anywhere in the region. **25.** Sample answer: To design a simulation, first you have to determine all of the possible outcomes and the theoretical probability associated with each of those outcomes. When you know each outcome and the probability of each outcome, you should state any assumptions you are making. Next, you choose the model that you want to use in your simulation, define each outcome in terms of your model, and determine how many trials you will do. When your simulation is planned, you run the number of trials that you have determined will provide a good set of data, recording the data for each trial. Finally, you analyze the data to determine the experimental probability of one or more of the outcomes.
27. H **29.** B **31.** 4 **33.** 3 **35.** 1.4469 **37.** 0.8914

Chapter 10 Study Guide and Review

1. probability distribution **3.** parameter **5.** observational study
7. survey; sample: every tenth shopper; population: all potential shoppers **9.** survey; sample: every fifth person; population: student body

11a.



[300, 330] scl: 1 by [0, 5] scl: 1

positively skewed
11b. Sample answer: The distribution is skewed, so use the five-number summary. Kelly's times range from 301 to 329 seconds. The median is 311, and half of the data are between 307 and 316 seconds. **13.** The random variable X is the time it takes to run the race. Time can be anywhere within a certain range. Therefore, X is continuous. **15.** 1.88 snow days **17.** This experiment cannot be reduced to a binomial experiment because there are more than two possible outcomes. **19.** 34.3%
23. $63.5 \leq x - \leq 65.1$ **25.** H_0: $\mu \geq 45$ (claim)2 ; H_a: $\mu < 45$
27. Sample answer: Use a spinner that is divided into two sectors, one containing 35% or 126° and the other containing 65% or 234°. Perform 50 trials and record the results in a frequency table. Use the results to determine the probability of Max scoring in the next match. **29.** Sample answer: Use a spinner that is divided into 4 sectors, 226.8°, 87.48°, 28.08°, and 17.64°. Perform 50 trials and record the results in a frequency table. The results can be used to determine the probability for what a certain amount of oil would be used.

CHAPTER 11
Trigonometric Functions

Chapter 11 Get Ready

1. 11.7 **3.** 20.5 **5.** $x = 9$, $y = 9\sqrt{2}$ **7.** $x = 12$, $y = 12\sqrt{3}$

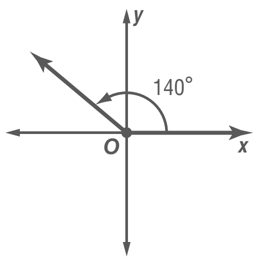
Lesson 11-1

1. $\sin B = \frac{4}{5}$; $\cos B = \frac{3}{5}$; $\tan B = \frac{4}{3}$;
$\csc B = \frac{5}{4}$; $\sec B = \frac{5}{3}$; $\cot B = \frac{3}{4}$
3. $\sin A = \frac{\sqrt{33}}{7}$, $\tan A = \frac{\sqrt{33}}{4}$,
$\csc A = \frac{7\sqrt{33}}{33}$, $\sec A = \frac{7}{4}$, $\cot A = \frac{4\sqrt{33}}{33}$
5. 25.4 **7.** 8.3 **9.** 25.4 **11.** about 274.7 ft
13. $\sin \theta = \frac{12}{13}$; $\cos \theta = \frac{5}{13}$; $\tan \theta = \frac{12}{5}$; $\csc \theta = \frac{13}{12}$;
$\sec \theta = \frac{13}{5}$; $\cot \theta = \frac{5}{12}$
15. $\sin \theta = \frac{\sqrt{51}}{10}$; $\cos \theta = \frac{7}{10}$; $\tan \theta = \frac{\sqrt{51}}{7}$; $\csc \theta = \frac{10\sqrt{51}}{51}$;
$\sec \theta = \frac{10}{7}$; $\cot \theta = \frac{7\sqrt{51}}{51}$
17. $\sin A = \frac{8}{17}$, $\cos A = \frac{15}{17}$, $\csc A = \frac{17}{8}$, $\sec A = \frac{17}{15}$, $\cot A = \frac{15}{8}$
19. $\sin B = \frac{3\sqrt{10}}{10}$, $\cos B = \frac{\sqrt{10}}{10}$, $\csc B = \frac{\sqrt{10}}{3}$, $\sec B = \sqrt{10}$,
$\cot B = \frac{1}{3}$

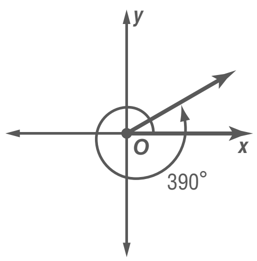
21. 12.7 **23.** 10.4 **25.** 8.7 **27.** 132.5 ft **29.** 30
31. 36.9 **33.** 32.5 **35.** 25.3 ft **37.** $x = 21.9$, $y = 20.8$
39. $x = 19.3$, $y = 70.7$ **41.** 54.9 **43.** 20.5 **45.** 11.5
47. 48 ft **49a.** about 647.2 ft **49b.** about 239.4 ft
51. $m\angle A = 59°$, $a = 31.6$, $c = 36.9$ **53.** $m\angle A = 38.7°$, $m\angle B = 51.3°$, $b = 7.5$, $c = 9.6$
55. True; $\sin \theta = \frac{\text{opp}}{\text{hyp}}$ and the values of the opposite side and the hypotenuse of an acute triangle are positive, so the value of the sine function is positive. **57.** Sample answer: The slope describes the ratio of the vertical rise to the horizontal run of the roof. The vertical rise is opposite the angle that the roof makes with the horizontal. The horizontal run is the adjacent side. So, the tangent of the angle of elevation equals the ratio of the rise to the run, or the slope of the roof; $\theta = 33.7°$. **59.** 24 **61.** G
63. H_0: $\mu = 3$ (claim); H_a: $\mu \neq 3$ **65a.** 99.85% **65b.** 2.5%
65c. 64% **67.** 22,704 ft **69.** 35 dollars **71.** $216\frac{2}{3}$ cm

Lesson 11-2

1.

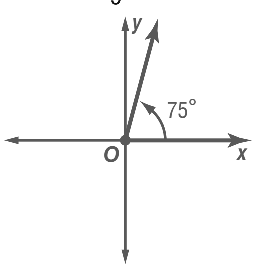


3.

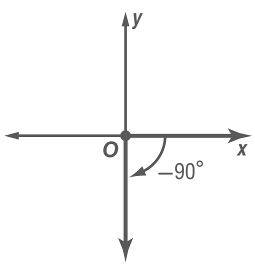


5. Sample answer: 535°, −185°
7. 45° **9.** $-\frac{2\pi}{9}$

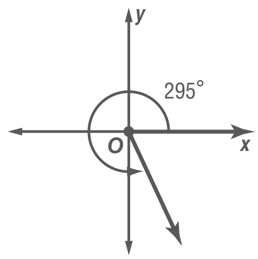
11.



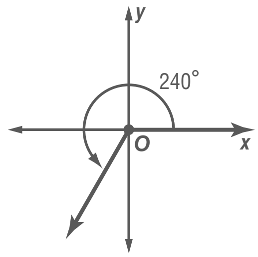
13.



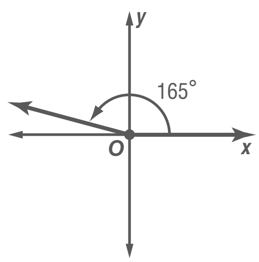
15.



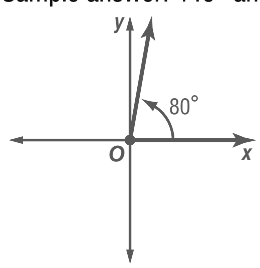
17.



19. 410°, −310° **21.** 565°, −155° **23.** 280°, −440° **25.** $\frac{11\pi}{6}$
27. −60° **29.** $\frac{19\pi}{18}$ **31.** about 12.6 ft **33.** 6.7 cm
35. 1 h 15 min **37.** 260°, −100° **39.** $\frac{5\pi}{4}$, $-\frac{11\pi}{4}$
41a.



41b. $\frac{11\pi}{12}$ **41c.** 18.7 ft
41d. The arc length would double. Since $s = r\theta$, if r is doubled and θ remains unchanged, then the value of s is also doubled.
43. 472.5° **45.** $-\frac{10\pi}{9}$ **47a.** $\frac{\pi}{6}$ **47b.** 2.1 ft **49.** $x = 2$
51. Sample answer: 440° and –280°



53. One degree represents an angle measure that equals $\frac{1}{360}$ rotation around a circle. One radian represents the measure of an angle in standard position that intercepts an arc of length r. To change from degrees to radians, multiply the number of degrees by $\frac{\pi \text{ radians}}{180°}$. To change from radians to degrees, multiply the number of radians by $\frac{180°}{\pi \text{ radians}}$. **55.** A **57.** B
59. $\sin \theta = \frac{\sqrt{259}}{22}$, $\cos \theta = \frac{15}{22}$, $\tan \theta = \frac{\sqrt{259}}{15}$, $\csc \theta = \frac{22}{\sqrt{259}}$ or $\frac{22\sqrt{259}}{259}$, $\sec \theta = \frac{22}{15}$, $\cot \theta = \frac{15}{\sqrt{259}}$ or $\frac{15\sqrt{259}}{259}$

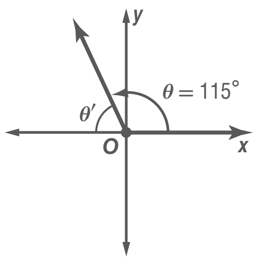
61. H_0: $\mu \geq 8$ (claim); H_a: $\mu < 8$
63a. 50% **63b.** 815 **63c.** 25 **65.** $3\sqrt{41}$ **67.** $\sqrt{317}$

Lesson 11-3

1. $\sin\theta = \frac{2\sqrt{5}}{5}$, $\cos\theta = \frac{\sqrt{5}}{5}$, $\tan\theta = 2$, $\csc\theta = \frac{\sqrt{5}}{2}$, $\sec\theta = \sqrt{5}$, $\cot\theta = \frac{1}{2}$

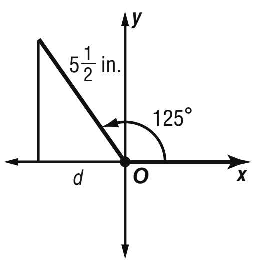
3. $\sin\theta = -1$, $\cos\theta = 0$, $\tan\theta =$ undefined, $\csc\theta = -1$, $\sec\theta =$ undefined, $\cot\theta = 0$

5.



7. $\frac{\sqrt{2}}{2}$ **9.** -2

11a.



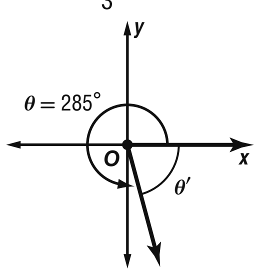
11b. 55°; $\cos 55° = \frac{d}{5\frac{1}{2}}$ **11c.** 3.2 in.

13. $\sin\theta = \frac{4}{5}$, $\cos\theta = -\frac{3}{5}$, $\tan\theta = -\frac{4}{3}$, $\csc\theta = \frac{5}{4}$, $\sec\theta = -\frac{5}{3}$, $\cot\theta = -\frac{3}{4}$

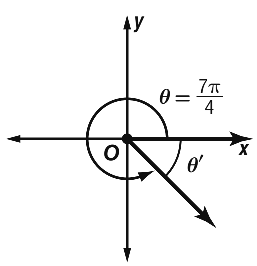
15. $\sin\theta = -1$, $\cos\theta = 0$, $\tan\theta =$ undefined, $\csc\theta = -1$, $\sec\theta =$ undefined, $\cot\theta = 0$

17. $\sin\theta = -\frac{\sqrt{10}}{10}$, $\cos\theta = -\frac{3\sqrt{10}}{10}$, $\tan\theta = \frac{1}{3}$, $\csc\theta = -\sqrt{10}$, $\sec\theta = -\frac{\sqrt{10}}{3}$, $\cot\theta = 3$

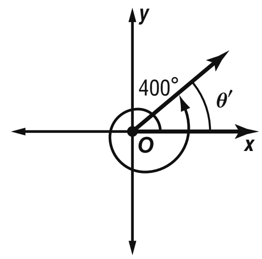
19.



21.



23.



25. -1 **27.** $-\sqrt{2}$ **29.** $\frac{1}{2}$ **31.** $\frac{2\sqrt{3}}{3}$

33. about 8.2 ft **35.** about 10.1 m

37. $\cos\theta = -\frac{3}{5}$, $\tan\theta = -\frac{4}{3}$, $\csc\theta = \frac{5}{4}$, $\sec\theta = -\frac{5}{3}$, $\cot\theta = -\frac{3}{4}$

39. $\sin\theta = -\frac{15}{17}$, $\tan\theta = \frac{15}{8}$, $\csc\theta = -\frac{17}{15}$, $\sec\theta = -\frac{17}{8}$, $\cot\theta = \frac{8}{15}$

41. 0 **43.** $-\frac{1}{2}$ **45.** $\frac{\sqrt{3}}{2}$

47. No; for $\sin\theta = \frac{\sqrt{2}}{2}$ and $\tan\theta = -1$, the reference angle is 45°. However, for $\sin\theta$ to be positive and $\tan\theta$ to be negative, the reference angle must be in the second quadrant. So, the value of θ must be 135° or an angle coterminal with 135°.

49. Sample answer: We know that $\cot\theta = \frac{x}{y}$, $\sin\theta = \frac{y}{r}$, and $\cos\theta = \frac{x}{r}$. Since $\sin 180° = 0$, it must be true that $y = 0$. Thus $\cot 180° = \frac{x}{0}$, which is undefined.

51. Sample answer: First, sketch the angle and determine in which quadrant it is located. Then use the appropriate rule for finding its reference angle θ'. A reference angle is the acute angle formed by the terminal side of θ and the x-axis. Next, find the value of the trigonometric function for θ'. Finally, use the quadrant location to determine the sign of the trigonometric function value of θ.

53. C **55.** E **57.** 330° **59.** 40.1° **61.** 66.0°

63. $10,737,418.23 **65.** $(x + 4)^2 + (y + 2)^2 = 73$

67. $\frac{x^2 + 7x - 35}{(x + 2)(x + 4)(x - 7)}$ **69.** $\frac{2(3x^2 + 2x - 12)}{3x(x + 4)(x - 6)}$

71. 2.5841 **73.** $\frac{1}{2}$ **75.** $\frac{1}{3125}$ **77.** 9

Lesson 11-4

1. 27.9 mm^2 **3.** 21.2 cm^2 **5.** $E = 107°$, $d \approx 7.9$, $f \approx 7.0$

7. $F = 60°$, $f \approx 12.3$, $h \approx 9.1$ **9.** no solution

11. one; $B = 90°$, $C = 60°$, $c \approx 5.2$ **13.** 10.6 km^2

15. 36.8 m^2 **17.** 5.9 ft^2 **19.** 65.2 m^2

21. $C = 30°$, $b \approx 11.1$, $c \approx 5.8$ **23.** $L = 74°$, $m \approx 4.9$, $n \approx 3.1$

25. $K = 107°$, $j \approx 13.3$, $k \approx 37.1$

27. $B = 63°$, $b \approx 2.9$, $c \approx 3.0$

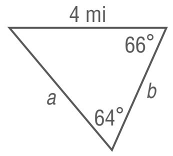
29. one; $B \approx 25°$, $C \approx 55°$, $c \approx 5.8$

31. one; $B \approx 32°$, $C \approx 110°$, $c \approx 32.1$

33. two; $B \approx 53°$, $C \approx 85°$, $c \approx 7.4$; $B \approx 127°$, $C \approx 11°$, $c \approx 1.4$

35. no solution **37.** about 28° **39.** about 15.8 mi

41a. Sample answer:



41b. Sample answer:
$\frac{\sin 66°}{a} = \frac{\sin 64°}{4}$; $\frac{\sin 50°}{b} = \frac{\sin 64°}{4}$

43. Cameron; R is acute and $r > t$, so there is one solution.

45. Sample answer:

$\sin A = \frac{\text{opposite}}{\text{hypotenuse}}$	Definition of sine
$\sin A = \frac{h}{c}$	h = opposite side, c = hypotenuse
$c \sin A = h$	Multiply both sides by c.
Area $= \frac{1}{2} \cdot$ base $\cdot$ height	Area of a triangle
Area $= \frac{1}{2}bh$	b = base, h = height
Area $= \frac{1}{2}bc \sin A$	Substitution

47. Sample answer: In the triangle, $B = 115°$. Using the Law of Sines, $\frac{\sin 50°}{a} = \frac{\sin 115°}{b}$. This equation cannot be solved because there are two unknowns. To solve a triangle using the Law of Sines, two sides and an angle must be given or two angles and a side opposite one of the angles must be given.

49. 2 **51.** G **53.** $-\frac{1}{2}$ **55.** $\frac{\sqrt{3}}{3}$ **57.** 328°, −392°

59. $I(m) = 400 + 0.1m$; \$6000 **61.** 5

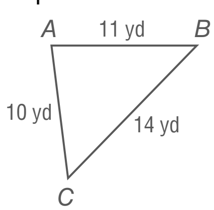
63. $\frac{x^2}{8.714 \times 10^{15}} + \frac{y^2}{8.712 \times 10^{15}} = 1$

65. $(y + 2)^2$ **67.** 56.25 **69.** 26

Lesson 11-5

1. $A \approx 36°$, $C \approx 52°$, $b \approx 5.1$ **3.** $A \approx 18°$, $B \approx 29°$, $C \approx 133°$ **5.** Sines; $B \approx 40°$, $C \approx 33°$, $c \approx 6.87$. Cosines; $S \approx 114°$, $T \approx 31°$, $r \approx 10.1$ **9.** $A \approx 70°$, $B \approx 40°$, $c \approx 3.0$ **11.** $A \approx 31°$, $B \approx 108°$, $C \approx 41°$ **13.** $a \approx 6.9$, $B \approx 41°$, $C \approx 23°$ **15.** $F \approx 65°$, $G \approx 94°$, $H \approx 21°$ **17.** Sines; $C \approx 45°$, $A \approx 85°$, $a \approx 18.2$ **19.** Cosines; $A \approx 27°$, $B \approx 115°$, $C \approx 38°$ **21.** Sines; $A \approx 17°$, $B \approx 79°$, $b \approx 6.9$ **23.** 514.2 m **25.** 81°, 36°, 63° **27.** about 13,148 yd^2

29a. Sample answer:



29b. Sample answer: Use the Law of Cosines to find the measure of $\angle A$. Then use the formula Area $= \frac{1}{2}bc \sin A$. **29c.** 54.6 yd^2

31. $B \approx 39°$, $C \approx 37°$, $c \approx 7.7$ **33.** $F \approx 42°$, $G \approx 72°$, $H \approx 66°$ **35.** The longest side is 14.5 centimeters. Use the Law of Cosines to find the measure of the angle opposite the longest side; 102°. **37.** Sample answer: To solve a right triangle, you can use the Pythagorean Theorem to find side lengths and trigonometric ratios to find angle measures and side lengths. To solve a nonright triangle, you can use the Law of Sines or the Law of Cosines, depending on what information is given. When two angles and a side are given or when two sides and an angle opposite one of the sides are given, you can use the Law of Sines. When two sides and an included angle or three sides are given, you can use the Law of Cosines.

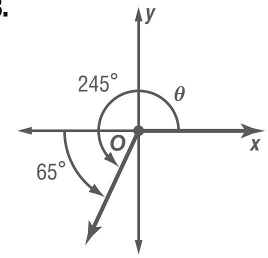
39. G **41.** $4, \frac{23}{15}$ **43.** 7.5 yd^2

45. $\sin \theta = \frac{5\sqrt{89}}{89}$, $\cos \theta = \frac{8\sqrt{89}}{89}$, $\tan \theta = \frac{5}{8}$, $\csc \theta = \frac{\sqrt{89}}{5}$, $\sec \theta = \frac{\sqrt{89}}{8}$, $\cot \theta = \frac{8}{5}$

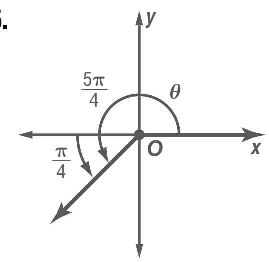
47. $\sin \theta = -\frac{3\sqrt{13}}{13}$, $\cos \theta = \frac{2\sqrt{13}}{13}$, $\tan \theta = -1.5$, $\csc \theta = \frac{-\sqrt{13}}{3}$, $\sec \theta = \frac{\sqrt{13}}{2}$, $\cot \theta = -\frac{2}{3}$

49. \$60, \$50 **51.** hyperbola

53.



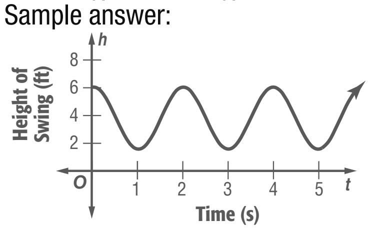
55.



Lesson 11-6

1. $\cos \theta = \frac{15}{17}$, $\sin \theta = \frac{8}{17}$ **3.** 2 **5a.** 4 seconds

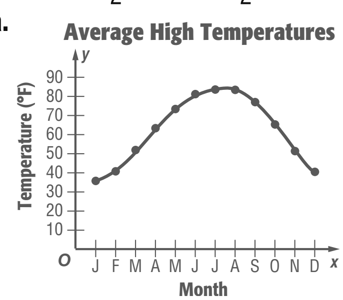
5b. Sample answer:



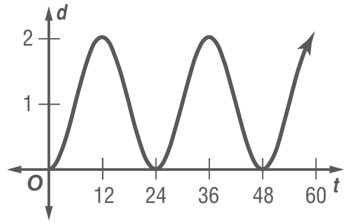
7. $-\frac{\sqrt{3}}{2}$ **9.** $\cos \theta = \frac{3}{5}$, $\sin \theta = -\frac{4}{5}$

11. $\cos \theta = \frac{\sqrt{3}}{2}$, $\sin \theta = \frac{1}{2}$ **13.** 3 **15.** 12 **17.** 180°

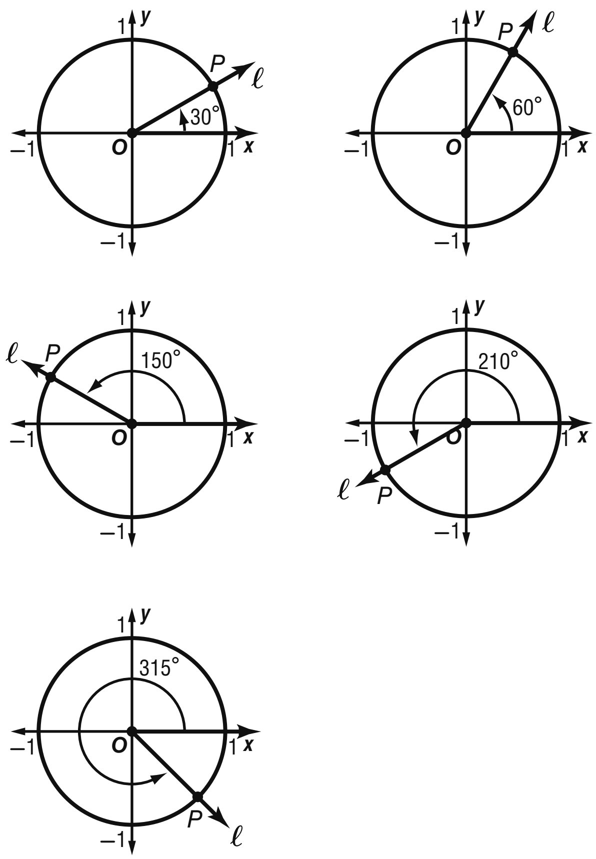
19a.



19b. 12 mo or 1 yr **21.** $\frac{1}{2}$ **23.** $\frac{\sqrt{2}}{2}$ **25.** $-\frac{\sqrt{3}}{2}$
27a. 24 seconds
27b. Sample answer:



29a.



29b.

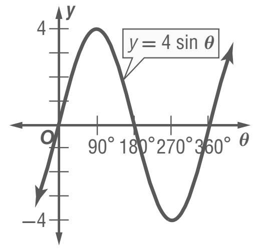
Angle	Slope
30	0.6
60	1.7
120	−1.7
150	−0.6
210	0.6
315	−1

29c. Sample answer: The slope corresponds to the tangent of the angle. For $\theta = 120°$, the x—coordinate of P is $-\frac{1}{2}$ and the y—coordinate is $= \frac{\sqrt{3}}{2}$; slope $= \frac{\text{change in } y}{\text{change in } x}$. Since change in $x = -\frac{1}{2}$ and change in $y = \frac{\sqrt{3}}{2}$, slope $= \frac{\sqrt{3}}{2} \div \left(-\frac{1}{2}\right) = -\sqrt{3}$ or about -1.7. **31.** $\frac{\sqrt{2}-\sqrt{3}}{2}$ **33.** $-\frac{5\sqrt{3}}{2}$ **35.** 1
37. Benita; Francis incorrectly wrote $\cos\frac{-\pi}{3} = -\cos\frac{\pi}{3}$.
39. Sometimes; the period of a sine curve could be $\frac{\pi}{2}$, which is not a multiple of π.

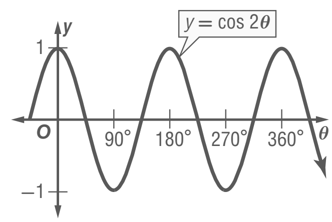
41. The period of a periodic function is the horizontal distance of the part of the graph that is nonrepeating. Each nonrepeating part of the graph is one cycle. **43.** C **45.** A **47.** $A \approx 34°$, $C \approx 64°$, $c \approx 12.7$ **49.** $B \approx 33°$, $C \approx 29°$, $c \approx 9.9$ **51.** one solution; $B \approx 35°$, $C \approx 99°$, $c \approx 13.7$ **53.** 0.267 **55.** 7
57. $46,794.34 **59.** (5, 0), (−4, ±6) **61.** 108

Lesson 11-7

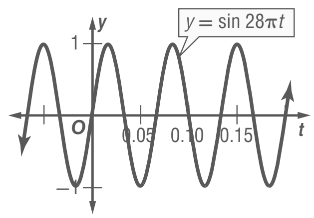
1. amplitude: 4; period: 360°



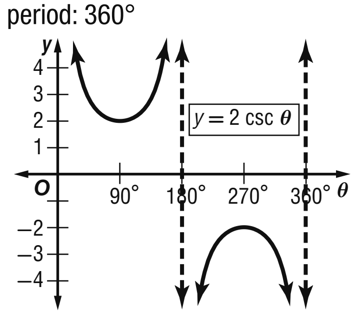
3. amplitude: 1; period: 180°



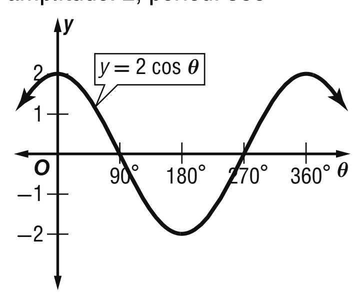
5a. $\frac{1}{14}$ or about 0.07 second
5b. $y = \sin 28\pi t$



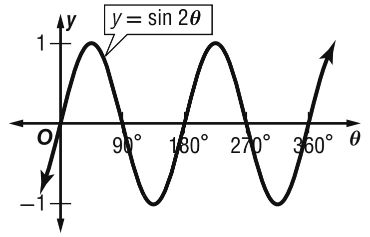
7. period: 360°



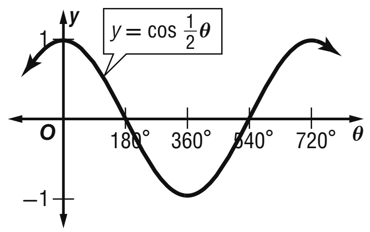
9. amplitude: 2; period: 360°



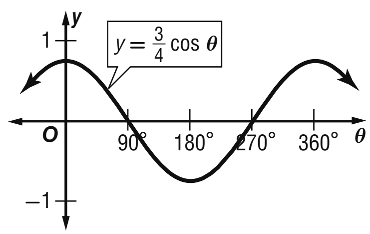
11. amplitude: 1; period: 180°



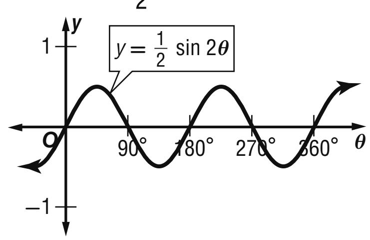
13. amplitude: 1; period: 720°



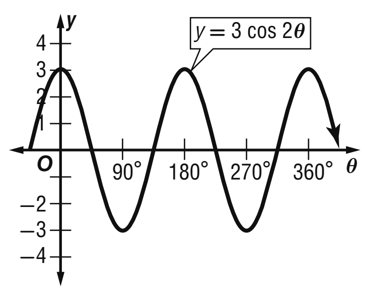
15. amplitude: $\frac{3}{4}$; period: 360°



17. amplitude: $\frac{1}{2}$; period: 180°

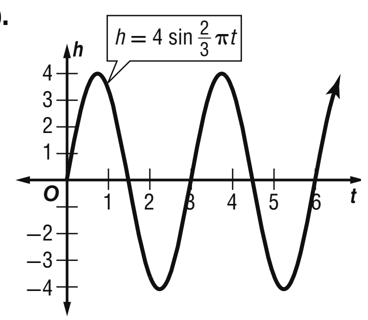


19. amplitude: 3; period: 180°

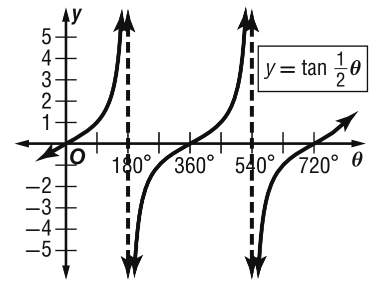


21a. $h = 4 \sin \frac{2}{3}\pi t$

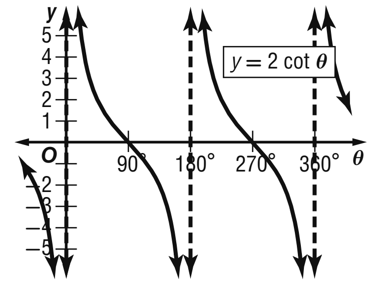
21b.



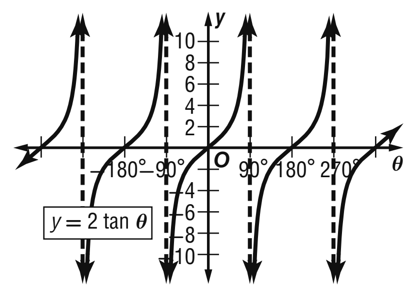
23. period: 360°



25. period: 180°

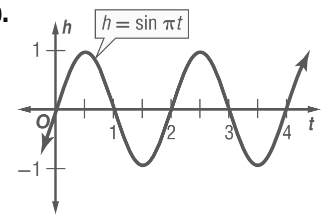


27. period: 180°

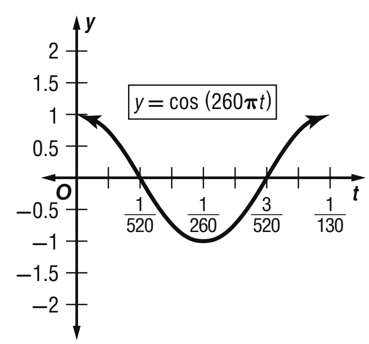


29a. $h = \sin \pi t$

29b.

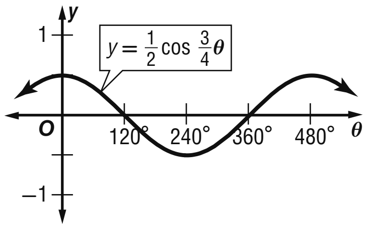


31a. $y = \cos 260\pi t$;

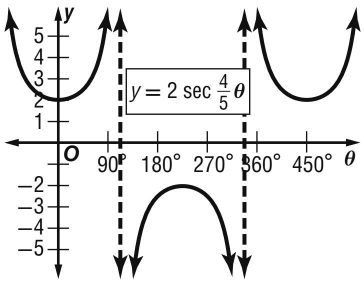


31b. The amplitude remains the same. The period decreases because it is the reciprocal of the frequency.

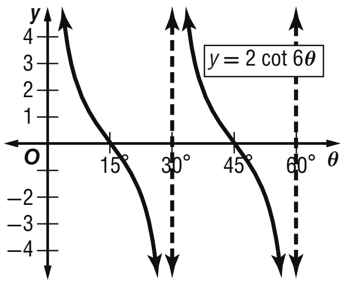
33. amplitude: $\frac{1}{2}$; period: 480°



35. amplitude: does not exist; period: 450°

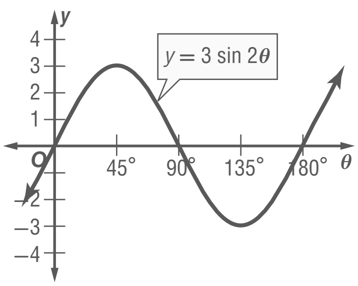


37. amplitude: does not exist; period: 30°



39. 180°; $y = 5 \sin 2\theta$ **41.** The domain of $y = a \cos \theta$ is the set of all real numbers. The domain of $y = a \sec \theta$ is the set of all real numbers except the values for which $\cos \theta = 0$. The range of $y = a \cos \theta$ is $-a \leq y \leq a$. The range of $y = a \sec \theta$ is $y \leq -a$ and $y \geq a$.

43. Sample answer: $y = 3 \sin 2\theta$

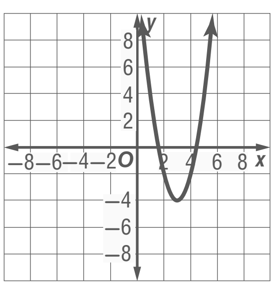


45. 700,013 **47.** G **49.** −1 **51.** $-3\sqrt{3}$

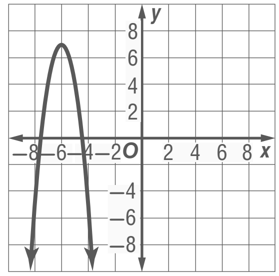
53. $R \approx 103°$, $S \approx 45°$, $q \approx 11.2$ **55.** 10.1% **57.** 5

59. $\frac{(x-6)^2}{20} + \frac{(y-3)^2}{4} = 1$

61.

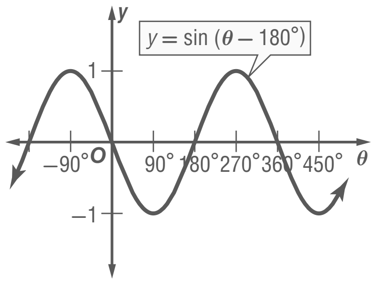


63.

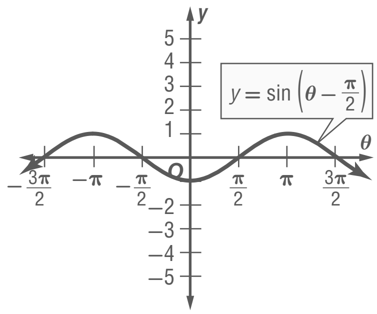


Lesson 11-8

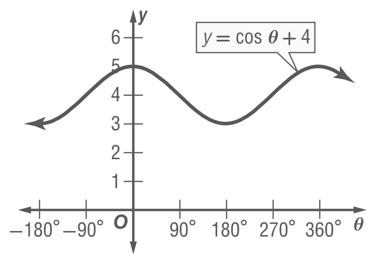
1. 1; 360°; $h = 180°$



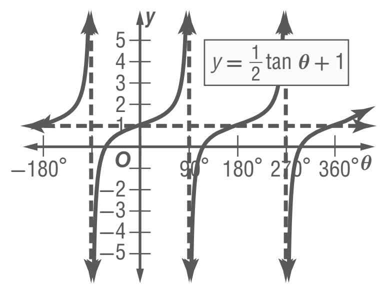
3. 1; 2π; $h = \frac{\pi}{2}$



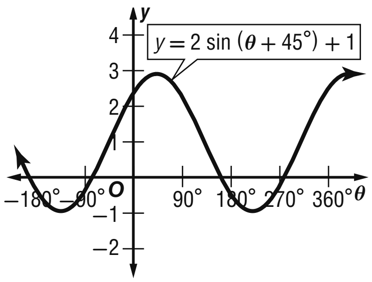
5. 1; 360°; $k = 4$; $y = 4$



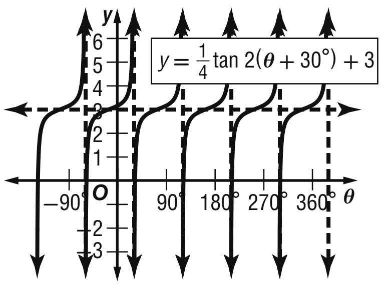
7. no amplitude; 180°; $k = 1$; $y = 1$



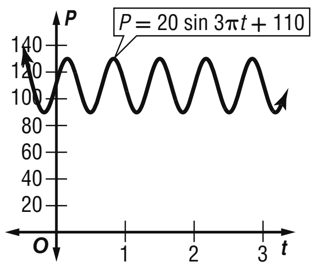
9. 2; 360°; $h = -45°$; $k = 1$



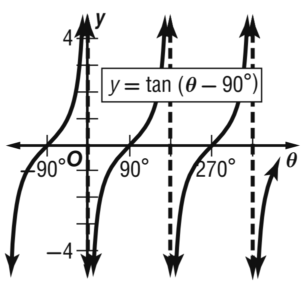
11. no amplitude; 90°; $h = -30°$; $k = 3$



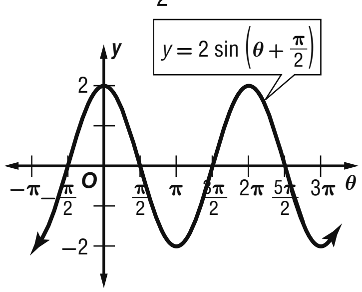
13. $P = 20 \sin 3\pi t + 110$



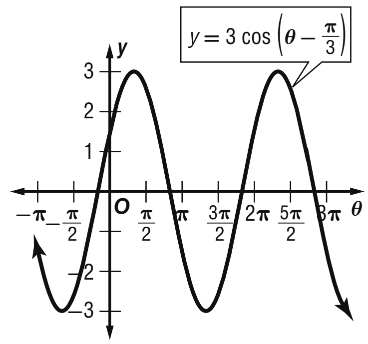
15. no amplitude; 180°; $h = 90°$



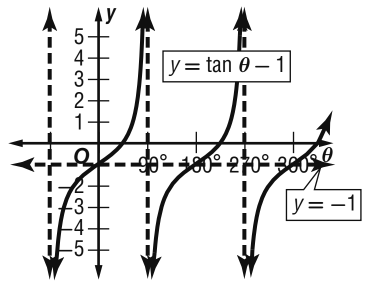
17. 2; 2π; $h = -\frac{\pi}{2}$



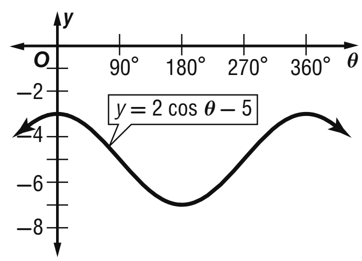
19. 3; 2π; $h = \frac{\pi}{3}$



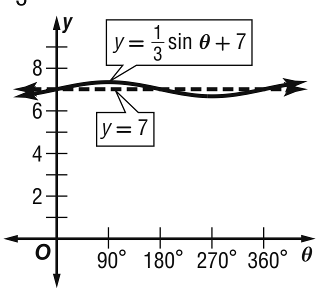
21. no amplitude; 180°; $k = -1$; $y = -1$



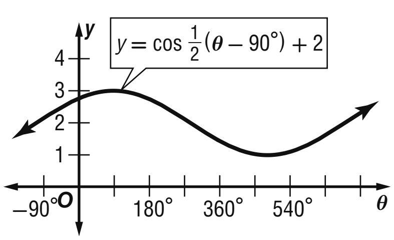
23. 2; 360°; $k = -5$; $y = -5$



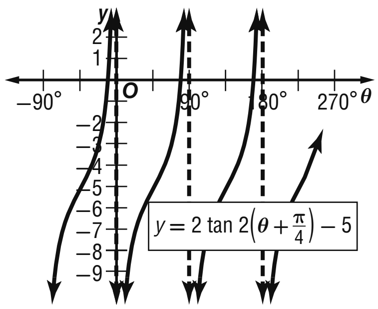
25. $\frac{1}{3}$; 360°; $k = 7$; $y = 7$



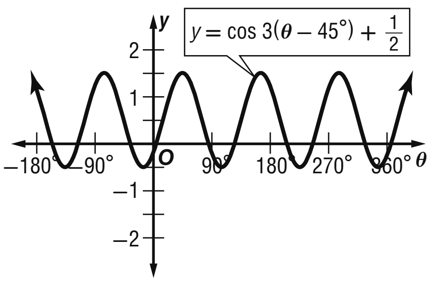
27. 1; 720°; $h = 90°$; $k = 2$



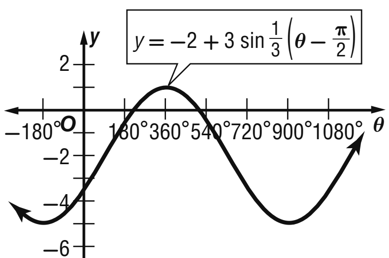
29. no amplitude; $\frac{\pi}{2}$; $h = -\frac{\pi}{4}$; $k = -5$



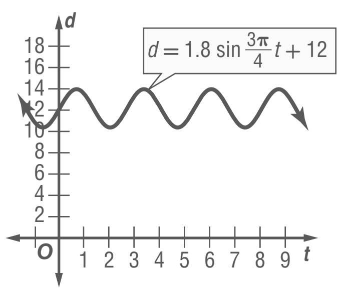
31. 1; 120°; $h = 45°$; $k = \frac{1}{2}$



33. 3; 6π; $h = \frac{\pi}{2}$; $k = -2$



35.

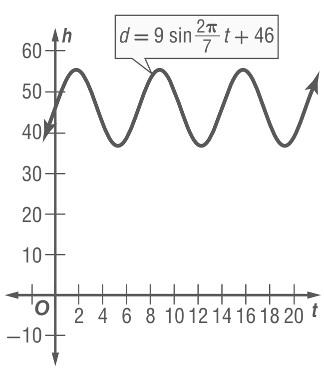


min**:** 10.2 ft; max: 13.8 ft

37. $y = \sin(x - 4) + 3$ **39.** $y = \tan(x - \pi) + 2.5$

41a. $h = 9\sin\frac{2\pi}{7}t + 46$

41b.



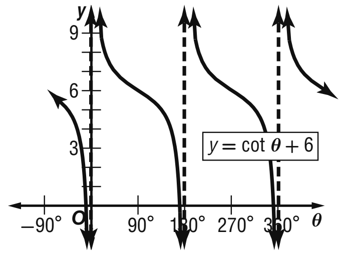
41c. Sample answer: 8 s; 53.0 in. **43.** $\left(\frac{3\pi}{2}, 2\right)$

45. no maximum values **47.** The graphs are reflections of each other over the x–axis. **49.** The graphs are identical.

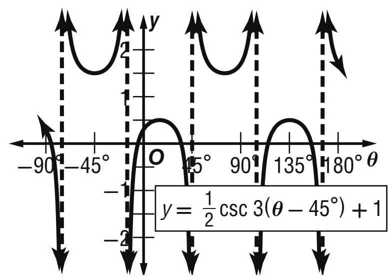
51. 360°; Sample answer: $y = 2\cos(\theta + 90°)$

53. 180°; Sample answer: $y = \sin 2(\theta - 45°) + 3$

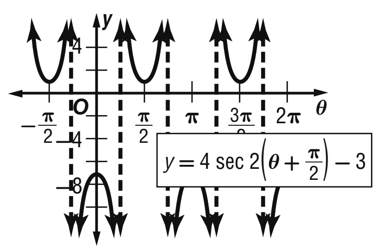
55. 180°; no phase shift; $k = 6$



57. 120°; $h = 45°$; $k = 1$

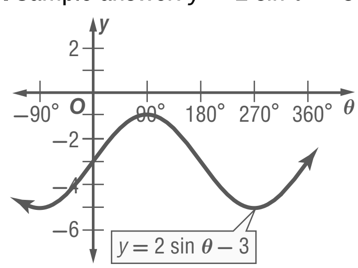


59. π; $h = -\frac{\pi}{2}$; $k = -3$



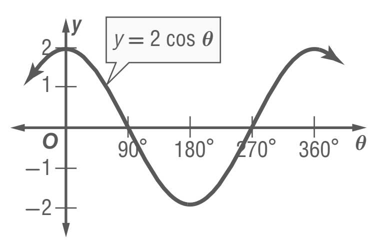
61. The graph of $y = 3\sin 2\theta + 1$ has an amplitude of 3 rather than an amplitude of 1. It is shifted up 1 unit from the parent graph and is compressed so that it has a period of 180°.

63. Sample answer: $y = 2\sin\theta - 3$

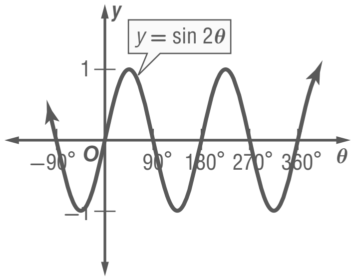


65. 1.25 **67.** F

69. amplitude: 2; period: 360°



71. amplitude: 1; period: 180°



73. $-\frac{1}{2}$

75. experiment; sample: people that exercise for an hour a day; population: all adults **77.** observational study; sample: 100 students selected; population: all students that have parttime jobs

79. 8 days **81.** 42° **83.** 37° **85.** 16°

Lesson 11-9

1. 30°; $\frac{\pi}{6}$ **3.** 180°; π **5.** 0 **7.** A **9.** −27.4°

11. Arctan $\frac{6.2}{18}$; 19° **13.** 30°; $\frac{\pi}{6}$ **15.** 60°; $\frac{\pi}{3}$

17. −30°; $-\frac{\pi}{6}$ **19.** −0.58 **21.** 0.87 **23.** 0.71 **25.** 64.2°

27. 104.5° **29.** −11.3° **31.** Arcsin $\frac{2.5}{24}$; 6° **33.** 40.8°

35. π **37.** no solution **39.** $\frac{\pi}{3}, \frac{5\pi}{3}$ **41.** false; $x = 2\pi$

43. The domain of $y = \text{Sin}^{-1} x$ is $-1 \leq x \leq 1$. This is the same as the range of $y = \text{Sin } x$.

45. Sample answer: $y = \tan^{-1} x$ is a relation that has a domain of all real numbers and a range of all real numbers except odd multiples of $\frac{\pi}{2}$. The relation is not a function. $y = \text{Tan}^{-1} x$ is a function that has a domain of all real numbers and a range of $-\frac{\pi}{2} \leq y \leq \frac{\pi}{2}$.

47. A **49.** G **51a.** 164; 164; 360°, 90°

51b. $y = 100\,[\sin(x - 90°)] + 100$

53. 2 **55.** 4 **57.** −1 **59.** $-\frac{\sqrt{3}}{2}$

Chapter 11 Study Guide and Review

1. false, Law of Sines **3.** true **5.** false, Arcsine function

7. $a = 10.9$; $A = 65°$; $B = 25°$ **9.** $A = 15°$; $a = 4.0$; $c = 15.5$

11. $B = 55°$; $a = 12.6$; $b = 18.0$ **13.** about 8.8 ft

15. 450° **17.** $-\frac{7\pi}{4}$ **19.** 295°, −425° **21.** $\frac{4\pi}{15}$ **23.** $-\frac{\sqrt{3}}{3}$

25. 0

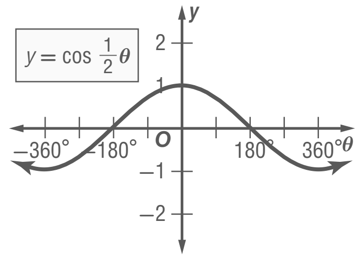
27. $\sin\theta = \frac{12}{13}$, $\cos\theta = \frac{5}{13}$, $\tan\theta = \frac{12}{5}$, $\csc\theta = \frac{13}{12}$, $\sec\theta = \frac{13}{5}$, $\cot\theta = \frac{5}{12}$,

29. about 17.1 meters **31.** two solutions; first solution: $C = 30°$, $B = 125°$, $b = 29.1$; second solution: $C = 150°$, $B = 5°$, $b = 3.1$ **33.** 98.9 ft **35.** Sines; $B \approx 52°$, $C \approx 48°$, $c \approx 11.3$

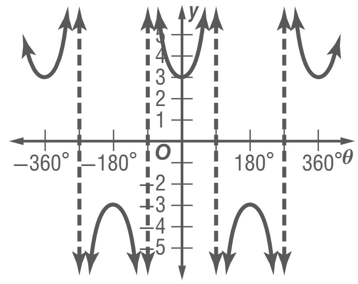
37. Sines; $B \approx 75°$, $C \approx 63°$, $c \approx 12.0$ or $B \approx 105°$, $C \approx 33°$, $c \approx 7.3$ **39.** about 750.5 ft

41. $-\frac{\sqrt{6}}{4}$ **43.** 0 **45.** 15 seconds

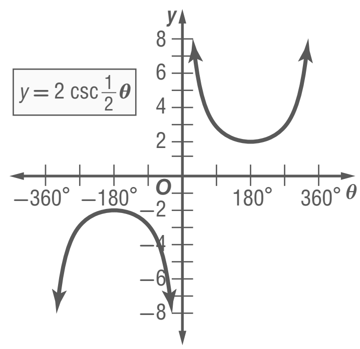
47. amplitude: 1, period: 720°



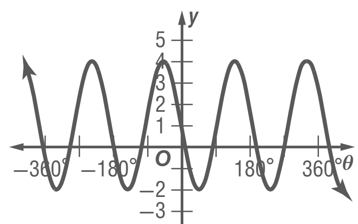
49. amplitude: not defined, period: 360°



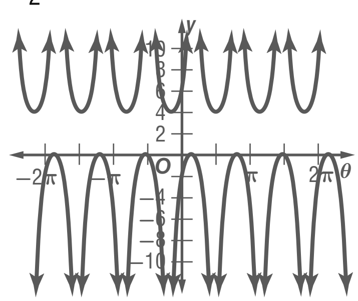
51. amplitude: not defined, period: 720°



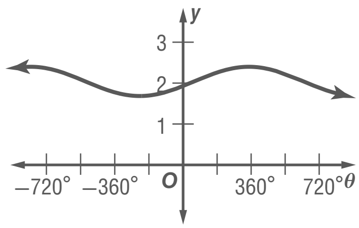
53. vertical shift: up 1, amplitude: 3, period: 180°, phase shift: 90° right



55. vertical shift: up 2, amplitude: not defined, period: $\frac{2\pi}{3}$, phase shift: $\frac{\pi}{2}$ right



57. vertical shift: up 2, amplitude: $\frac{1}{3}$, period: 1080°, phase shift: 90° right



59. $90°, \frac{\pi}{2}$ **61.** $60°, \frac{\pi}{3}$ **63.** $45°, \frac{\pi}{4}$

65. $\text{Sin}^{-1}\frac{5}{10} = \theta$; 30° **67.** −0.71 **69.** −55.0° **71.** 65.8°

CHAPTER 12

Trigonometric Identities and Equations

Chapter 12 Get Ready

1. $-4a(4a-1)$ **3.** prime **5.** $(x+2)$ in. **7.** $\{-7, 5\}$ **9.** $\{3, 4\}$ **11.** $\frac{\sqrt{2}}{2}$ **13.** $-\frac{\sqrt{3}}{3}$ **15.** 45 ft

Lesson 12-1

1. $\frac{1}{2}$ **3.** $\frac{\sqrt{5}}{3}$ **5.** $\sin\theta\cos\theta$ **7.** $\cot^2\theta$ **9.** $\frac{5}{4}$ **11.** $\frac{4}{5}$ **13.** $-\frac{5}{4}$ **15.** $\frac{-\sqrt{17}}{4}$ **17.** $-\frac{12}{13}$ **19.** $\frac{3}{5}$ **21.** $\sec^3\theta$ **23.** $\csc\theta$ **25.** 1 **27.** $F = I\ell B\sin\theta$ **29.** $\sec\theta$ **31.** 2 **33.** $2\cos^2\theta$ **35a.** $\frac{\sqrt{65}}{9}$ **35b.** $\frac{4\sqrt{65}}{65}$ **35c.** $\frac{4}{9}, -\frac{\sqrt{65}}{9}, -\frac{4\sqrt{65}}{65}$ **37.** $\mu_k = \tan\theta$ **39.** −1 **41.** $-\cot^2\theta$

43. Sample answer: $x = 45°$ **45.** Sample answer: The functions $\cos\theta$ and $\sin\theta$ can be thought of as the lengths of the legs of a right triangle, and the number 1 can be thought of as the measure of the corresponding hypotenuse.

47. Sample answer: $\frac{\sin\theta}{\cos\theta}\cdot\sin\theta$ and $\frac{\sin^2\theta}{\cos\theta}$ **49.** $-\frac{4}{3}$ **51.** A **53.** D **55.** 2.09 **57.** 0.52 **59.** 0.5 **61.** $d = 4 - \cos\frac{\pi}{2}t$ or $d = 4 - \cos 90°t$ **63.** $\frac{1093}{9}$ **65.** −3, 2 **67.** 2^2

Lesson 12-2

1.
$$\cot\theta + \tan\theta \stackrel{?}{=} \frac{\sec^2\theta}{\tan\theta}$$
$$\cot\theta + \tan\theta \stackrel{?}{=} \frac{\tan^2\theta + 1}{\tan\theta}$$
$$\cot\theta + \tan\theta \stackrel{?}{=} \frac{\tan^2\theta}{\tan\theta} + \frac{1}{\tan\theta}$$
$$\cot\theta + \tan\theta = \tan\theta + \cot\theta \checkmark$$

3.
$$\sin\theta \stackrel{?}{=} \frac{\sec\theta}{\tan\theta + \cot\theta}$$
$$\sin\theta \stackrel{?}{=} \frac{\frac{1}{\cos\theta}}{\frac{\sin\theta}{\cos\theta} + \frac{\cos\theta}{\sin\theta}}$$
$$\sin\theta \stackrel{?}{=} \frac{\frac{1}{\cos\theta}}{\frac{\sin^2\theta + \cos^2\theta}{\cos\theta\sin\theta}}$$
$$\sin\theta \stackrel{?}{=} \frac{\frac{1}{\cos\theta}}{\frac{1}{\cos\theta\sin\theta}}$$
$$\sin\theta \stackrel{?}{=} \frac{1}{\cos\theta}\cdot\frac{\cos\theta\sin\theta}{1}$$
$$\sin\theta = \sin\theta \checkmark$$

5.
$$\tan^2\theta\csc^2\theta \stackrel{?}{=} 1 + \tan^2\theta$$
$$\frac{\sin^2\theta}{\cos^2\theta}\cdot\frac{1}{\sin^2\theta} \stackrel{?}{=} \sec^2\theta$$
$$\frac{1}{\cos^2\theta} \stackrel{?}{=} \sec^2\theta$$
$$\sec^2\theta = \sec^2\theta \checkmark$$

7. D

9.
$$\cot\theta(\cot\theta + \tan\theta) \stackrel{?}{=} \csc^2\theta$$
$$\cot^2\theta + \cot\theta\tan\theta \stackrel{?}{=} \csc^2\theta$$
$$\cot^2\theta + \frac{\sin\theta}{\cos\theta}\cdot\frac{\cos\theta}{\sin\theta} \stackrel{?}{=} \csc^2\theta$$
$$\cot^2\theta + 1 \stackrel{?}{=} \csc^2\theta$$
$$\csc^2\theta = \csc^2\theta \checkmark$$

11.
$$\sin\theta\sec\theta\cot\theta \stackrel{?}{=} 1$$
$$\sin\theta\cdot\frac{1}{\cos\theta}\cdot\frac{\cos\theta}{\sin\theta} \stackrel{?}{=} 1$$
$$1 = 1 \checkmark$$

13.
$$\frac{1 - 2\cos^2\theta}{\sin\theta\cos\theta} \stackrel{?}{=} \tan\theta - \cot\theta$$
$$\frac{(1 - \cos^2\theta) - \cos^2\theta}{\sin\theta\cos\theta} \stackrel{?}{=} \tan\theta - \cot\theta$$
$$\frac{\sin^2\theta - \cos^2\theta}{\sin\theta\cos\theta} \stackrel{?}{=} \tan\theta - \cot\theta$$
$$\frac{\sin^2\theta}{\sin\theta\cos\theta} - \frac{\cos^2\theta}{\sin\theta\cos\theta} \stackrel{?}{=} \tan\theta - \cot\theta$$
$$\frac{\sin\theta}{\cos\theta} - \frac{\cos\theta}{\sin\theta} \stackrel{?}{=} \tan\theta - \cot\theta$$
$$\tan\theta - \cot\theta = \tan\theta - \cot\theta \checkmark$$

15.
$$\cos\theta \stackrel{?}{=} \sin\theta\cot\theta$$
$$\cos\theta \stackrel{?}{=} \sin\theta\left(\frac{\cos\theta}{\sin\theta}\right)$$
$$\cos\theta = \cos\theta \checkmark$$

17.
$$\cos\theta\cos(-\theta) - \sin\theta\sin(-\theta) \stackrel{?}{=} 1$$
$$\cos\theta\cos\theta - \sin\theta(-\sin\theta) \stackrel{?}{=} 1$$
$$\cos^2\theta + \sin^2\theta \stackrel{?}{=} 1$$
$$1 = 1 \checkmark$$

19.
$$\sec\theta - \tan\theta \stackrel{?}{=} \frac{1 - \sin\theta}{\cos\theta}$$
$$\frac{1}{\cos\theta} - \frac{\sin\theta}{\cos\theta} \stackrel{?}{=} \frac{1 - \sin\theta}{\cos\theta}$$
$$\frac{1 - \sin\theta}{\cos\theta} = \frac{1 - \sin\theta}{\cos\theta} \checkmark$$

21. $\sec\theta\csc\theta \stackrel{?}{=} \tan\theta + \cot\theta$

$$\frac{1}{\cos\theta}\cdot\frac{1}{\sin\theta} \stackrel{?}{=} \frac{\sin\theta}{\cos\theta} + \frac{\cos\theta}{\sin\theta}$$
$$\frac{1}{\cos\theta\sin\theta} \stackrel{?}{=} \frac{\sin^2\theta}{\sin\theta\cos\theta} + \frac{\cos^2\theta}{\sin\theta\cos\theta}$$
$$\frac{1}{\cos\theta\sin\theta} \stackrel{?}{=} \frac{\sin^2\theta + \cos^2\theta}{\sin\theta\cos\theta}$$
$$\frac{1}{\cos\theta\sin\theta} = \frac{1}{\cos\theta\sin\theta}\ \checkmark$$

23. $(\sin\theta + \cos\theta)^2 \stackrel{?}{=} \dfrac{2 + \sec\theta\csc\theta}{\sec\theta\csc\theta}$

$$(\sin\theta + \cos\theta)^2 \stackrel{?}{=} \frac{2 + \frac{1}{\cos\theta}\cdot\frac{1}{\sin\theta}}{\frac{1}{\cos\theta}\cdot\frac{1}{\sin\theta}}$$
$$(\sin\theta + \cos\theta)^2 \stackrel{?}{=} \left(2 + \frac{1}{\cos\theta\sin\theta}\right)\cdot\frac{\cos\theta\sin\theta}{1}$$
$$(\sin\theta + \cos\theta)^2 \stackrel{?}{=} 2\cos\theta\sin\theta + 1$$
$$(\sin\theta + \cos\theta)^2 \stackrel{?}{=} 2\cos\theta\sin\theta + \cos^2\theta + \sin^2\theta$$
$$(\sin\theta + \cos\theta)^2 = (\sin\theta + \cos\theta)^2\ \checkmark$$

25. $\csc\theta - 1 \stackrel{?}{=} \dfrac{\cot^2\theta}{\csc\theta + 1}$

$$\csc\theta - 1 \stackrel{?}{=} \frac{\csc^2\theta - 1}{\csc\theta + 1}$$
$$\csc\theta - 1 \stackrel{?}{=} \frac{(\csc\theta - 1)(\csc\theta + 1)}{\csc\theta + 1}$$
$$\csc\theta - 1 = \csc\theta - 1\ \checkmark$$

27. $\sin\theta\cos\theta\tan\theta + \cos^2\theta \stackrel{?}{=} 1$

$$\sin\theta\cos\theta\cdot\frac{\sin\theta}{\cos\theta} + \cos^2\theta \stackrel{?}{=} 1$$
$$\sin^2\theta + \cos^2\theta \stackrel{?}{=} 1$$
$$1 = 1\ \checkmark$$

29. $\csc^2\theta \stackrel{?}{=} \cot^2\theta + \sin\theta\csc\theta$

$$\csc^2\theta \stackrel{?}{=} \cot^2\theta + \sin\theta\cdot\frac{1}{\sin\theta}$$
$$\csc^2\theta \stackrel{?}{=} \cot^2\theta + 1$$
$$\csc^2\theta = \csc^2\theta\ \checkmark$$

31. $\sin^2\theta + \cos^2\theta \stackrel{?}{=} \sec^2\theta - \tan^2\theta$

$$1 \stackrel{?}{=} \tan^2\theta + 1 - \tan^2\theta$$
$$1 = 1\ \checkmark$$

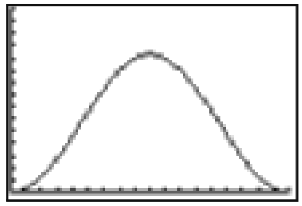
33. yes **35.** 1 **37.** 1 **39.** 1 **41.** $\cos\theta$ **43.** 2 **45.** $\sin\theta$

47. 1 **49.** $y = -\dfrac{gx^2}{2v_0^2}(1 + \tan^2\theta) + x\tan\theta$

51a.

Angle measure	Height
30°	28.2 m
45°	56.4 m
60°	84.5 m
90°	112.7 m

51b.



[0, 180] scl: 10 by [0, 150] scl: 10

51c. $\dfrac{v_0^2\tan^2\theta}{2g\sec^2\theta} \stackrel{?}{=} \dfrac{v_0^2\sin^2\theta}{2g}$

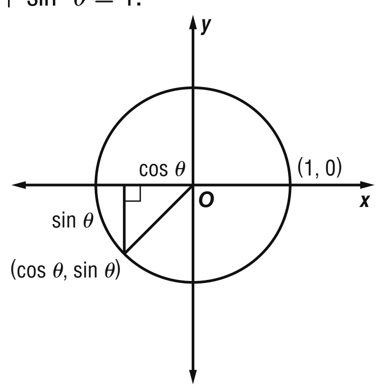
$$\frac{v_0^2\left(\frac{\sin^2\theta}{\cos^2\theta}\right)}{2g\left(\frac{1}{\cos^2\theta}\right)} \stackrel{?}{=} \frac{v_0^2\sin^2\theta}{2g}$$
$$\frac{v_0^2\sin^2\theta}{2g} = \frac{v_0^2\sin^2\theta}{2g}\ \checkmark$$

53. $\tan^2\theta = \dfrac{\sin^2\theta}{\cos^2\theta} \longrightarrow \tan^2\theta = \tan^2\theta \longrightarrow \tan^2\theta = \sec^2\theta - 1$

55. Sample answer: counterexample 45°, 30°

57. Sample answer: Sine and cosine are the trigonometric functions with which most people are familiar, and all trigonometric expressions can be written in terms of sine and cosine. Also, by rewriting complex trigonometric expressions in terms of sine and cosine it may be easier to perform operations and to apply trigonometric properties.

59. Using the unit circle and the Pythagorean Theorem, we can justify $\cos^2\theta + \sin^2\theta = 1$.



If we divide each term of the identity $\cos^2\theta + \sin^2\theta = 1$ by $\cos^2\theta$, we can justify $1 + \tan^2\theta = \sec^2\theta$.

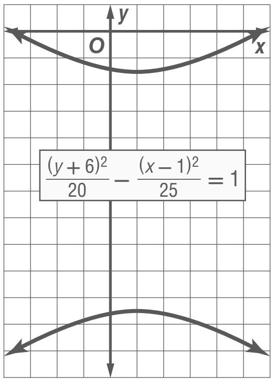
$$\frac{\cos^2\theta}{\cos^2\theta} + \frac{\sin^2\theta}{\cos^2\theta} = \frac{1}{\cos^2\theta}$$
$$1 + \tan^2\theta = \sec^2\theta$$

If we divide each term of the identity $\cos^2\theta + \sin^2\theta = 1$ by $\sin^2\theta$, we can justify $\cot^2\theta + 1 = \csc^2\theta$.

$$\frac{\cos^2\theta}{\sin^2\theta} + \frac{\sin^2\theta}{\sin^2\theta} = \frac{1}{\sin^2\theta}$$
$$\cot^2\theta + 1 = \csc^2\theta$$

61. H **63.** G **65.** $\dfrac{\sqrt{5}}{3}$ **67.** $\dfrac{3}{5}$ **69.** $4

71. $(1, -6 \pm 2\sqrt{5})$; $(1, -6 \pm 3\sqrt{5})$;
$y + 6 = \pm\frac{2\sqrt{5}}{5}(x - 1)$



73. $\frac{12 + 7\sqrt{2}}{23}$ **75.** $\sqrt{x} + 1$

Lesson 12-3

1. $-\frac{\sqrt{2} + \sqrt{6}}{4}$ **3.** $\frac{\sqrt{6} - \sqrt{2}}{4}$ **5.** $\frac{\sqrt{2}}{2}$ **7a.** 0

7b. The interference is destructive. The signals cancel each other completely.

9.
$$\cos\left(\frac{3\pi}{2} - \theta\right) \stackrel{?}{=} -\sin\theta$$
$$\cos\frac{3\pi}{2}\cos\theta + \sin\frac{3\pi}{2}\sin\theta \stackrel{?}{=} -\sin\theta$$
$$0 \cdot \cos\theta - 1 \cdot \sin\theta \stackrel{?}{=} -\sin\theta$$
$$-\sin\theta = -\sin\theta \checkmark$$

11.
$$\sin(\theta + \pi) \stackrel{?}{=} -\sin\theta$$
$$\sin\theta\cos\pi + \cos\theta\sin\pi \stackrel{?}{=} -\sin\theta$$
$$(\sin\theta)(-1) + (\cos\theta)(0) \stackrel{?}{=} -\sin\theta$$
$$-\sin\theta = -\sin\theta \checkmark$$

13. $-\frac{\sqrt{2}}{2}$ **15.** $\frac{\sqrt{6} - \sqrt{2}}{4}$ **17.** $\frac{\sqrt{2} + \sqrt{6}}{4}$

19.
$$\cos\left(\frac{\pi}{2} + \theta\right) \stackrel{?}{=} -\sin\theta$$
$$\cos\frac{\pi}{2}\cos\theta - \sin\frac{\pi}{2}\sin\theta \stackrel{?}{=} -\sin\theta$$
$$(0)(\cos\theta) - (1)(\sin\theta) \stackrel{?}{=} -\sin\theta$$
$$-\sin\theta = -\sin\theta \checkmark$$

21.
$$\cos(180^\circ + \theta) \stackrel{?}{=} -\cos\theta$$
$$\cos 180^\circ\cos\theta - \sin 180^\circ\sin\theta \stackrel{?}{=} -\cos\theta$$
$$-1 \cdot \cos\theta - 0 \cdot \sin\theta \stackrel{?}{=} -\cos\theta$$
$$-\cos\theta = -\cos\theta \checkmark$$

23a. $y = 30.9\sin\left(\frac{\pi}{6}x - 2.09\right) + 42.65$

23b. The new function represents the average of the high and low temperatures for each month.

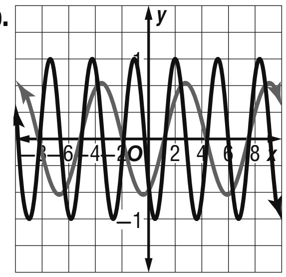
25. $\sqrt{2} - \sqrt{6}$ **27.** $-2 + \sqrt{3}$ **29.** $2 - \sqrt{3}$

31a. $\frac{3 + 4\sqrt{3}}{10}$ **31b.** $\frac{4 - 3\sqrt{3}}{10}$ **31c.** 96.9° **31d.** no

33a.

A	*B*	sin *A*	sin *B*	sin (*A* + *B*)	sin *A* + sin *B*
30°	90°	$\frac{1}{2}$	1	$\frac{\sqrt{3}}{2}$	$\frac{3}{2}$
45°	60°	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{2}+\sqrt{6}}{4}$	$\frac{\sqrt{2}+\sqrt{3}}{2}$
60°	45°	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{2}+\sqrt{6}}{4}$	$\frac{\sqrt{2}+\sqrt{3}}{2}$
90°	30°	1	$\frac{1}{2}$	$\frac{\sqrt{3}}{2}$	$\frac{3}{2}$

33b.



33c. No; a counterexample is: cos (30° + 45°) = cos 30° + cos 45°, which equals $\frac{\sqrt{3}}{2} + \frac{\sqrt{2}}{2}$ or about 1.5731. Since a cosine value cannot be greater than 1, this statement must be false.

35.
$$\cos(A + B) \stackrel{?}{=} \frac{1 - \tan A\tan B}{\sec A\sec B}$$
$$\cos(A + B) \stackrel{?}{=} \frac{1 - \frac{\sin A}{\cos A}\cdot\frac{\sin B}{\cos B}}{\frac{1}{\cos A}\cdot\frac{1}{\cos B}}$$
$$\cos(A + B) \stackrel{?}{=} \frac{1 - \frac{\sin A}{\cos A}\cdot\frac{\sin B}{\cos B}}{\frac{1}{\cos A}\cdot\frac{1}{\cos B}} \cdot \frac{\cos A\cos B}{\cos A\cos B}$$
$$\cos(A + B) \stackrel{?}{=} \frac{\cos A\cos B - \sin A\sin B}{1}$$
$$\cos(A + B) = \cos(A + B) \checkmark$$

37.
$$\sin(A + B)\sin(A - B) \stackrel{?}{=} \sin^2 A - \sin^2 B$$
$$(\sin A\cos B + \cos A\sin B)$$
$$(\sin A\cos B - \cos A\sin B) \stackrel{?}{=} \sin^2 A - \sin^2 B$$
$$(\sin A\cos B)^2 - (\cos A\sin B)^2 \stackrel{?}{=} \sin^2 A - \sin^2 B$$
$$\sin^2 B\cos^2 B - \cos^2 A\sin^2 B \stackrel{?}{=} \sin^2 A - \sin^2 B$$
$$\sin^2 A\cos^2 B + \sin^2 A\sin^2 B -$$
$$\sin^2 A\sin^2 B - \cos^2 A\sin^2 B \stackrel{?}{=} \sin^2 A - \sin^2 B$$
$$\sin^2 A(\cos^2 B + \sin^2 B) -$$
$$\sin^2 B(\sin^2 A + \cos^2 A) \stackrel{?}{=} \sin^2 A - \sin^2 B$$
$$(\sin^2 A)(1) - (\sin^2 B)(1) \stackrel{?}{=} \sin^2 A - \sin^2 B$$
$$\sin^2 A - \sin^2 B = \sin^2 A - \sin^2 B \checkmark$$

39. Sample answer: To determine wireless Internet interference, you need to determine the sine or cosine of the sum or difference of two angles. Interference occurs when waves pass through the same space at the same time. When the combined waves have a greater amplitude, constructive interference results. When the combined waves have a smaller amplitude, destructive interference results.

41. $d = \sqrt{(\cos\alpha - \cos\beta)^2 + (\sin\alpha - \sin\beta)^2}$

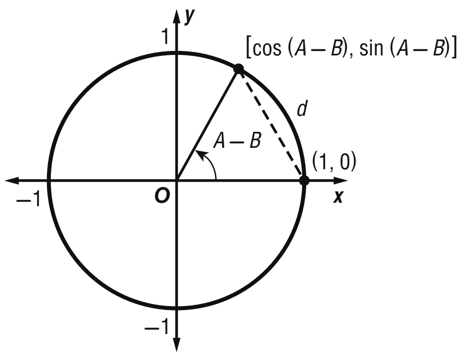
$d^2 = (\cos\alpha - \cos\beta)^2 + (\sin\alpha - \sin\beta)^2$

$d^2 = (\cos^2\alpha - 2\cos\alpha\cos\beta + \cos^2\beta) + (\sin^2\alpha - 2\sin\alpha \sin\beta + \sin^2\beta)$

$d^2 = \cos^2\alpha + \sin^2\alpha + \cos^2\beta + \sin^2\beta - 2\cos\alpha\cos\beta - 2\sin\alpha\sin\beta$

$d^2 = 1 + 1 - 2\cos\alpha\cos\beta - 2\sin\alpha\sin\beta$

$d^2 = 2 - 2\cos\alpha\cos\beta - 2\sin\alpha\sin\beta$



Now find the value of d^2 when the angle having measure $\alpha - \beta$ is in standard position on the unit circle, as shown in the figure above.

43. 9 **45.** H

47.

$$\frac{\sin\theta}{\tan\theta} + \frac{\cos\theta}{\cot\theta} \stackrel{?}{=} \cos\theta + \sin\theta$$

$$\frac{\sin\theta}{\frac{\sin\theta}{\cos\theta}} + \frac{\cos\theta}{\frac{\cos\theta}{\sin\theta}} \stackrel{?}{=} \cos\theta + \sin\theta$$

$$\sin\theta \cdot \frac{\cos\theta}{\sin\theta} + \cos\theta \cdot \frac{\sin\theta}{\cos\theta} \stackrel{?}{=} \cos\theta + \sin\theta$$

$$\cos\theta + \sin\theta = \cos\theta + \sin\theta \checkmark$$

49. $\sin^2\theta$ **51.** $\sec\theta$

53. Step 1: $4^1 - 1 = 3$, which is divisible by 3. The statement is true for $n = 1$.

Step 2: Assume that $4^k - 1$ is divisible by 3 for some positive integer k. This means that $4^k - 1 = 3r$ for some whole number r.

Step 3: $4^k - 1 = 3r$

$4^k = 3r + 1$

$4^{k+1} = 12r + 4$

$4^{k+1} - 1 = 12r + 3$

$4^{k+1} - 1 = 3(4r + 1)$

Since r is a whole number, $4r + 1$ is a whole number. Thus, $4^{k+1} - 1$ is divisible by 3, so the statement is true for $n = k + 1$. Therefore, $4^n - 1$ is divisible by 3 for all positive integers n.

55. -1 **57.** no solution

Lesson 12-4

1. $\frac{\sqrt{15}}{8}, \frac{7}{8}, \frac{\sqrt{8 - 2\sqrt{15}}}{4}, \frac{\sqrt{8 + 2\sqrt{15}}}{4}$

3. $-\frac{120}{169}, -\frac{119}{169}, \frac{3\sqrt{13}}{13}, \frac{2\sqrt{13}}{13}$ **5.** $-\frac{240}{289}, \frac{161}{289}, \frac{4\sqrt{17}}{17}, \frac{\sqrt{17}}{17}$

7. $\frac{\sqrt{2} - \sqrt{2}}{2}$ **9a.** $d = \frac{v^2 \sin 2\theta}{g}$ **9b.** ≈ 81 ft

11.

$$(\sin\theta + \cos\theta)^2 \stackrel{?}{=} 1 + 2\sin\theta\cos\theta$$

$$(\sin\theta + \cos\theta)(\sin\theta + \cos\theta) \stackrel{?}{=} 1 + 2\sin\theta\cos\theta$$

$$\sin^2\theta + 2\sin\theta\cos\theta + \cos^2\theta \stackrel{?}{=} 1 + 2\sin\theta\cos\theta$$

$$1 + 2\sin\theta\cos\theta = 1 + 2\sin\theta\cos\theta \checkmark$$

13. $\frac{240}{289}, -\frac{161}{189}, \frac{5\sqrt{34}}{34}, -\frac{3\sqrt{34}}{34}$

15. $-\frac{4\sqrt{6}}{25}, -\frac{23}{25}, \frac{\sqrt{10}}{5}, -\frac{\sqrt{15}}{5}$

17. $-\frac{4}{5}, -\frac{3}{5}, \sqrt{\frac{\sqrt{5} + 1}{2\sqrt{5}}}, \sqrt{\frac{\sqrt{5} - 1}{2\sqrt{5}}}$

19. $\frac{\sqrt{2 + \sqrt{2}}}{2}$ **21.** $\sqrt{3} - 2$ **23.** $\sqrt{1 - 2\sqrt{2}}$

25. $P = \frac{1}{2} I_0^2 R - \frac{1}{2} I_0^2 R \cos 2t\theta$

27.

$$1 + \frac{1}{2}\sin 2\theta \stackrel{?}{=} \frac{\sec\theta + \sin\theta}{\sec\theta}$$

$$\stackrel{?}{=} \frac{\frac{1}{\cos\theta} + \sin\theta}{\frac{1}{\cos\theta}}$$

$$\stackrel{?}{=} \frac{\frac{1}{\cos\theta} + \sin\theta}{\frac{1}{\cos\theta}} \cdot \frac{\cos\theta}{\cos\theta}$$

$$\stackrel{?}{=} 1 + \frac{1}{2} \cdot 2\sin\theta\cos\theta$$

$$= 1 + \frac{1}{2}\sin 2\theta \checkmark$$

29.

$$\tan\frac{\theta}{2} \stackrel{?}{=} \frac{\sin\theta}{1 + \cos\theta}$$

$$\tan\frac{\theta}{2} \stackrel{?}{=} \frac{\sin 2\left(\frac{\theta}{2}\right)}{1 + \cos 2\left(\frac{\theta}{2}\right)}$$

$$\tan\frac{\theta}{2} \stackrel{?}{=} \frac{2\sin\frac{\theta}{2}\cos\frac{\theta}{2}}{1 + 2\cos^2\frac{\theta}{2} - 1}$$

$$\tan\frac{\theta}{2} \stackrel{?}{=} \frac{2\sin\frac{\theta}{2}\cos\frac{\theta}{2}}{2\cos^2\frac{\theta}{2}}$$

$$\tan\frac{\theta}{2} \stackrel{?}{=} \frac{\sin\frac{\theta}{2}}{\cos\frac{\theta}{2}}$$

$$\tan\frac{\theta}{2} = \tan\frac{\theta}{2} \checkmark$$

31. $\frac{24}{25}, \frac{7}{25}, \frac{24}{7}$ **33.** $-\frac{3}{5}, -\frac{4}{5}, \frac{3}{4}$ **35.** $-\frac{4\sqrt{21}}{25}, \frac{17}{25}, -\frac{4\sqrt{21}}{17}$

37. No; Teresa incorrectly added the square roots, and Nathan used the half-angle identity incorrectly. He used sin 30° in the formula instead of first finding the cosine. **39.** If you are only given the value of $\cos\theta$, then $\cos 2\theta = 2\cos^2\theta - 1$ is the best identity to use. If you are only given the value of $\sin\theta$, then $\cos 2\theta = 1 - 2\sin^2\theta$ is the best identity to use. If you are given the values of both $\cos\theta$ and $\sin\theta$, then $\cos 2\theta = \cos^2\theta - \sin^2\theta$ works just as well as the other two.

41. $1 - 2\sin^2\theta = \cos 2\theta$ — Double-angle identity

$1 - 2\sin^2\frac{A}{2} = \cos A$ — Substitute $\frac{A}{2}$ for θ and A for 2θ.

$\sin^2\frac{A}{2} = \frac{1-\cos A}{2}$ — Solve for $\sin^2\frac{A}{2}$.

$\sin\frac{A}{2} = \pm\sqrt{\frac{1-\cos A}{2}}$ — Take the square root of each side.

Find $\cos\frac{A}{2}$.

$2\cos^2\theta - 1 = \cos 2\theta$ — Double-angle identity

$2\cos^2\frac{A}{2} - 1 = \cos A$ — Substitute $\frac{A}{2}$ for θ and A for 2θ.

$\cos^2\frac{A}{2} = \frac{1+\cos A}{2}$ — Solve for $\cos^2\frac{A}{2}$.

$\cos\frac{A}{2} = \pm\sqrt{\frac{1+\cos A}{2}}$ — Take the square root of each side.

43. 22.5 **45.** G **47.** $\frac{\sqrt{2}}{2}$ **49.** $\frac{-\sqrt{6}-\sqrt{2}}{4}$ **51.** $\frac{\sqrt{3}}{2}$

53. $\cot\theta + \sec\theta \stackrel{?}{=} \frac{\cos^2\theta + \sin\theta}{\sin\theta\cos\theta}$

$\cot\theta + \sec\theta \stackrel{?}{=} \frac{\cos^2\theta}{\sin\theta\cos\theta} + \frac{\sin\theta}{\sin\theta\cos\theta}$

$\cot\theta + \sec\theta \stackrel{?}{=} \frac{\cos\theta}{\sin\theta} + \frac{1}{\cos\theta}$

$\cot\theta + \sec\theta = \cot\theta + \sec\theta$ ✓

55. sines; $B \approx 102°$, $C \approx 44°$, $b \approx 21.0$ or $B \approx 10°$, $C \approx 136°$, $b \approx 3.7$ **57.** sines; $A = 80°$, $a \approx 10.9$, $c \approx 5.4$ **59.** {−4, 7}

Lesson 12-5

1. 210°, 330° **3.** 60°, 180°, 300° **5.** 150°, 210° **7.** 30°, 150°

9. $\pm\frac{\pi}{6} + 2k\pi$ or $\pm\frac{5\pi}{6} + 2k\pi$ **11.** $\frac{3\pi}{2} + 2k\pi$ **13.** $\pi + 2k\pi$

15. $90° + k \cdot 180°$ **17.** $45° + k \cdot 90°$ **19.** $270° + k \cdot 360°$

21a. There will be $10\frac{1}{2}$ hours of daylight 213 and 335 days after March 21; that is, on October 20 and February 19.

21b. Every day from February 19 to October 20; sample explanation: Since the longest day of the year occurs around June 22, the days between February 19 and October 20 must increase in length until June 22 and then decrease in length until October 20.

23. $\frac{3\pi}{4} + \pi k$ **25.** $\frac{\pi}{2} + \pi k$, $\frac{\pi}{6} + 2\pi k$, $\frac{5\pi}{6} + 2\pi k$

27. $0° + k \cdot 45°$ or $0 + k \cdot \frac{\pi}{4}$ **29.** $\frac{\pi}{3} + 2k\pi$, $\frac{\pi}{2} + k\pi$, $\frac{5\pi}{3} + 2k\pi$ **31.** 135°, 225° **33.** $\frac{\pi}{6}$ **35.** 210°, 330°

37. $\pi + 2k\pi$, $\frac{\pi}{3} + 2k\pi$, $\frac{5\pi}{3} + 2k\pi$ **39.** $0 + 2k\pi$

41. $0° + k \cdot 180°$ **43.** $30° + k \cdot 360°$, $150° + k \cdot 360°$

45. $\frac{7\pi}{6} + 2k\pi$, $\frac{11\pi}{6} + 2k\pi$ or $210° + k \cdot 360°$, $330° + k \cdot 360°$

47. $0 + 2k\pi$, $\frac{\pi}{2} + k\pi$ or $0° + k \cdot 360°$, $90° + k \cdot 180°$

49a. 11 m **49b.** 7:00 a.m. and 7:00 p.m.

51. $\frac{\pi}{6} + 2\pi k$, $\frac{5\pi}{6} + 2\pi k$, $\frac{5\pi}{4} + 2\pi k$, $\frac{7\pi}{4} + 2\pi k$

53. $120° + 360°k$, $240° + 360°k$ **55.** $\frac{\pi}{6} + 2\pi k$, $\frac{5\pi}{6} + 2\pi k$

57. 0.0026 second **59.** $\frac{\pi}{3} < x < \pi$ or $\frac{5\pi}{3} < x < 2\pi$

61. Sample answer: All trigonometric functions are periodic. Therefore, once one or more solutions are found for a certain interval, there will be additional solutions that can be found by adding integral multiples of the period of the function to those solutions.

63. 0, b, or $2b$ **65.** A **67.** E **69.** $\frac{\sqrt{\sqrt{2}-\sqrt{2}}}{2}$ **71.** $\frac{\sqrt{\sqrt{2}-\sqrt{3}}}{2}$

73. $\cos(90° + \theta) \stackrel{?}{=} -\sin\theta$

$\cos 90°\cos\theta - \sin 90°\sin\theta \stackrel{?}{=} -\sin\theta$

$0 - 1\sin\theta \stackrel{?}{=} -\sin\theta$

$-\sin\theta = -\sin\theta$ ✓

75. $\sin(90° - \theta) \stackrel{?}{=} \cos\theta$

$\sin 90°\cos\theta - \cos 90°\sin\theta \stackrel{?}{=} \cos\theta$

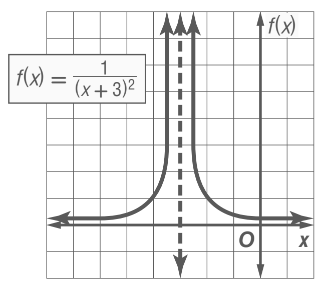
$1 \cdot \cos\theta - 0 \cdot \sin\theta \stackrel{?}{=} \cos\theta$

$\cos\theta - 0 \stackrel{?}{=} \cos\theta$

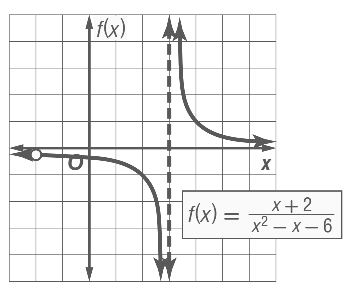
$\cos\theta = \cos\theta$ ✓

77. 17, 26, 35 **79.** −12, −9, −6

81.



83.



Chapter 12 Study Guide and Review

1. difference of angles identity **3.** trigonometric identity

5. trigonometric equation **7.** reciprocal identities

9. Pythagorean identity **11.** $-\sqrt{3}$ **13.** $-\frac{4}{5}$ **15.** $\frac{15\sqrt{709}}{709}$

17. sec θ **19.** sec θ

21.
$$\frac{\cos\theta}{\cot\theta} + \frac{\sin\theta}{\tan\theta} \stackrel{?}{=} \sin\theta + \cos\theta$$
$$\cos\theta \div \frac{\cos\theta}{\sin\theta} + \sin\theta \div \frac{\sin\theta}{\cos\theta} \stackrel{?}{=} \sin\theta + \cos\theta$$
$$\cos\theta \cdot \frac{\sin\theta}{\cos\theta} + \sin\theta \cdot \frac{\cos\theta}{\sin\theta} \stackrel{?}{=} \sin\theta + \cos\theta$$
$$\sin\theta + \cos\theta = \sin\theta + \cos\theta \checkmark$$

23.
$$\tan^2\theta + 1 = \left(\frac{\sqrt{7}}{3}\right)^2 + 1 = \frac{7}{9} + 1$$
$$= \frac{7}{9} + \frac{9}{9} = \frac{16}{9};$$
$$\sec^2\theta = \left(\frac{4}{3}\right)^2 = \frac{16}{9}$$

25. $\frac{\sqrt{6}+\sqrt{2}}{4}$ **27.** $\frac{\sqrt{6}+\sqrt{2}}{4}$ **29.** $\frac{\sqrt{-\sqrt{6}+\sqrt{2}}}{4}$

31.
$$\sin\left(\frac{3\pi}{2} - \theta\right) \stackrel{?}{=} -\cos\theta$$
$$\sin\frac{3\pi}{2}\cos\theta - \cos\frac{3\pi}{2}\sin\theta \stackrel{?}{=} -\cos\theta$$
$$(-1)\cos\theta - (0)\sin\theta \stackrel{?}{=} -\cos\theta$$
$$-\cos\theta = -\cos\theta \checkmark$$

33. $\sin 2\theta = \frac{24}{25}$, $\cos 2\theta = \frac{7}{25}$, $\sin\frac{\theta}{2} = \frac{\sqrt{10}}{10}$, and $\cos\frac{\theta}{2} = \frac{3\sqrt{10}}{10}$

35. $\sin 2\theta = -\frac{4\sqrt{5}}{9}$, $\cos 2\theta = -\frac{1}{9}$, $\sin\frac{\theta}{2} = \frac{\sqrt{30}}{6}$, and $\cos\frac{\theta}{2} = \frac{\sqrt{6}}{6}$

37. 60°, 300° **39.** 90°, 210°, 270°, 330°

41. $\frac{\pi}{3}, \frac{5\pi}{3}$

CHAPTER 13
Proportions and Similarity

Chapter 13 Get Ready

1. 4 or −4 **3.** −37 **5.** 64 **7.** 64.5

Lesson 13-1

1. 23:50 **3.** 30, 75, 60 **5.** 16 **7.** 8 **9.** $\frac{30}{l} = \frac{20}{40}$

11. $\frac{11}{44}$ 5 $\frac{x}{1200}$; x 5 300 students **13.** $\frac{1}{6}$

15. 16 min 22 sec **17.** 190 **19.** 1:1 **21.** $7\frac{4}{5}$ **23.** 48.6

25. D **27.** $-\frac{11}{3}$ **29.** C **31.** C **33.** 307.20 **35.** 4 **37.** 8.5

39. $\frac{1}{3}$ **41.** booth 1, 190 lb; booth 2, 150 lb; booth 3, 100 lb

43. $x^2 - 1$; $x^2 - 6x + 11$ **45.** $-15x - 5$; $-15x + 25$

47. $|x + 4|$; $|x| + 4$

Lesson 13-2

1. 10 **3.** Yes; $\frac{AD}{DC} = \frac{BE}{EC} = \frac{2}{3}$, so $\overline{DE} \parallel \overline{AB}$. **5.** 11

7. 2360.3 ft **9.** $x = 20$; $y = 2$ **11.** $x = 75$ yd, $y = 90$ yd

13. C **15.** B **17.** G.G.42 and G.G.46 **19.** B **21.** C

23. m$\angle 1 = 28^\circ$ **25.** 10 **27.** 120°, 60°, 60°, 120°

29. $\angle MHY$ and $\angle MJD$ **31.** C **33.** 80° **35.** D **37.** A

39. 18 **41.** 5 **43.** −1 **45.** $6x + 1$; $6x + 7$

47. $-2x^2 - 1$; $4x^2 - 4x + 2$ **49.** $x^3 - 2$; $x^3 - 6x^2 + 12x - 8$

Lesson 13-3

1. enlargement; 2 **3.** reduction; $\frac{1}{2}$

5. $\frac{RJ}{KJ} = \frac{SJ}{LJ} = \frac{RS}{KL} = \frac{1}{2}$, so $\triangle RSJ \sim \triangle KLJ$ by SSS Similarity. **7.** D

9. 9 **11.** A **13.** 20 **15.** 31 **17.** $7\frac{1}{2}$ **19.** $m\angle ECD = m\angle EAB$

21. (−8,0) **23.** 4 **25.** B **27.** H **29.** yes; $\frac{AC}{BD} = \frac{DE}{CE} = \frac{4}{3}$

31. no; $\frac{AB}{CD} \neq \frac{AE}{CE}$ **33.** (−4, −6, 1) **35.** (3, −4) **37.** (−2, 3, −1)

Lesson 13-4

1. about 117 mi **3a.** 6 in.: 50 ft **3b.** $\frac{1}{100}$

5. The volume of the scale model is 1783 cu in. **7.** 5 mm

9. D **11.** $336 **13.** 50 to 55 min

15. Part A It is 196 miles from Spokane to Yakima, 142 miles from Yakima to Seattle, and 280 miles from Seattle to Spokane, for a total of 618 miles. At 50 miles per hour the traveling time would be $\frac{618}{50}$ or 12.36 hours.

15. Part B Yes; she wants 2 hours with her grandmother and 3 hours with her friend, or 5 hours of visiting. Adding that to 12.36 hours of traveling gives a total of 17.36 hours. If she leaves at 6 A.M. she would be home just after 11:20 P.M. that same day

17. 3.125 in. **19.** 8 **21.** 225 **23.** 600 **25.** 800

27. 800 miles **29.** D **31.** C **33.** parabola **35.** ellipse

37. ≈$1.14 **39.** no solution

Chapter 13 Study Guide and Review

1. j **3.** g **5.** d **7.** m **9.** −15 **11.** 4.5

13a. 7.2 ft and 4.8 ft **15.** 22.5 **17.** reduction; $\frac{1}{3}$

19. 15 in. by 22.5 in. **21.** 18 in

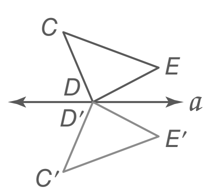
CHAPTER 14
Transformations and Symmetry

Chapter 14 Get Ready

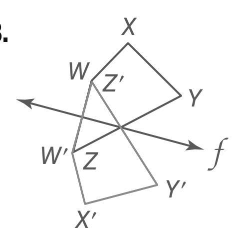
1. rotation **3.** translation **5.** ⟨−16, −28⟩ **7.** reduction; $\frac{1}{2}$

Lesson 14-1

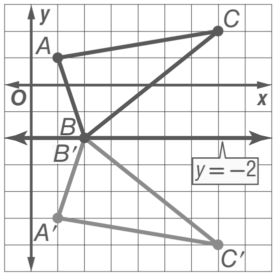
1.

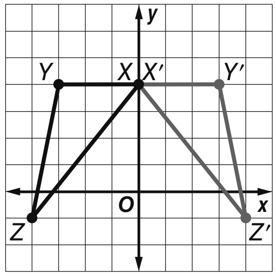


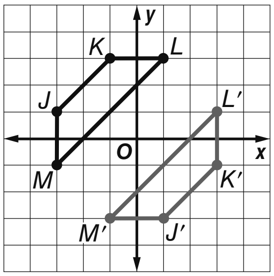
3.



Selected Answers and Solutions

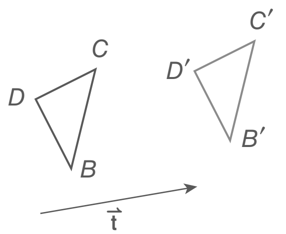
5. 

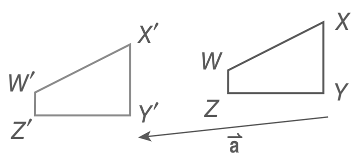
7. 

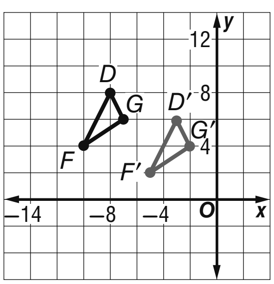
9. 

11. C **13.** (Geometry) **15.** $\overleftrightarrow{AD}$ **17.** (2, −3)
19. (5, 1) **21.** (−2, 4) **23.** (−2, −6) **25.** $y = x$ **27.** (2, 4)
29. $A(1, -3)$, $B(5, 1)$, and $C(0, 7)$ **31.** $P'(10, -3)$
33. Figure C **35.** reflection **37.** B **39.** B **41.** B
43. E **45.** $\frac{1}{2}$ **47.** $\frac{\sqrt{5}}{2}$ **49.** $Y = 94°$, $x \approx 7.3$, $y \approx 10.4$
51. −35.5° **53.** 69.7° **55.** $2\sqrt{5} \approx 4.5$, 243.4°
57. $2\sqrt{122} \approx 22.1$, 275.2°

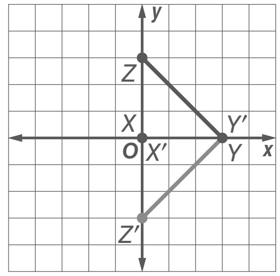
Lesson 14-2

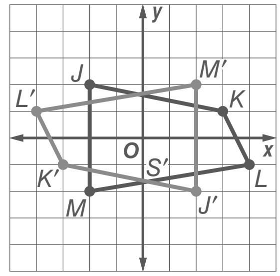
1. 

3. 

5. 

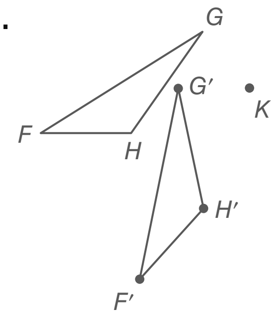
7. $(x, y) \rightarrow (x + 3, y - 5)$ **9.** A
11. (5, 1) **13.** $(x, y) \rightarrow (x - 1, y + 2)$ **15.** (−3, 5)
17. translation **19.** $(x, y) \rightarrow (x + 3, y)$ **21.** translation
23. (3, 5) **25.** $J'(-5, 4)$, $K'(0, 0)$, $L'(-3, -1)$ **27.** D
29. $A(3, -5)$, $B(3, -1)$, $C(8, -1)$, $D(8, -5)$
31. $T_{5, -3}$ **33.** $H'(0, 10)$ **35.** translation right 4 units and up 7 units **37.** $\langle -5, -3 \rangle$ **39.** B

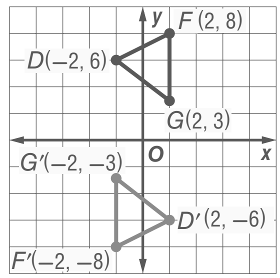
41 

43. 

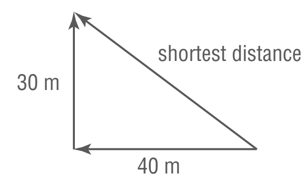
45. 120°, 240° **47.** y ≈ 9.5, X ≈ 39°, Z ≈ 47° **49.** −35.5°
51. 69.7° **53.** acute; 20 **55.** right; 90

Lesson 14-3

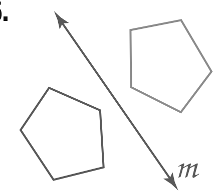
1. 

3. 

5. A **7.** (3, 22) **9.** 120°; 360° ÷ 6 petals = 60° per petal. Two petal turns is 2 · 60° or 120° **11.** (0,1) **13.** 90° **15.** (−2, −3)
17. $P'(-7, 0)$ **19.** I **21.** 90°−counterclockwise rotation
23. Quadrant II **25.** $P(-3.5, (-4.7)$ **27.** $P'(-12, -5)$
29. D **31.** (7, −1)
33. 50 mi;

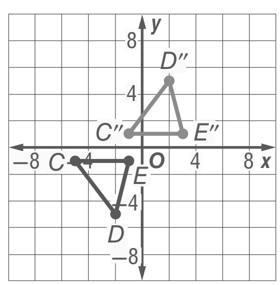


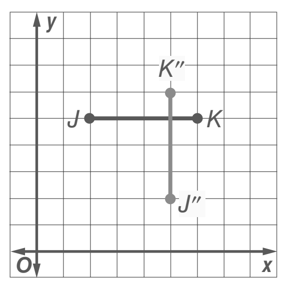
35.



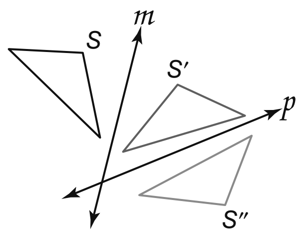
37. reflection **39.** rotation or reflection

Lesson 14-4

1. 

3. 

5.



rotation clockwise 100° about point where lines m and p intersect

7. two reflections **9.** Figure 4 **11.** A **13.** J′(1, 3) **15.** (0, 2) **17.** P′(5, 3), Q′(3, 2), R′(7, 3) **19.** (2, 1) **21.** Translate 4 units to the left and then reflect over the x−axis. **23.** glide reflection **25.** $P'(-x, y + a)$ **27.** (−15, 9), (−6, 15), (−12, 3)

29. Proof: We are given that ℓ and m intersect at point P and that A is not on ℓ or m. Reflect A over m to A' and reflect A' over ℓ to A''. By the definition of reflection, m is the perpendicular bisector of $\overline{AA'}$ at R, and ℓ is the perpendicular bisector of $\overline{A'A''}$ at S. $\overline{AR} \cong \overline{A'R}$ and $\overline{A'S} \cong \overline{A''S}$ by the definition of a perpendicular bisector. Through any two points there is exactly one line, so we can draw auxiliary segments $\overline{AP}$, $\overline{A'P}$, and $\overline{A''P}$. $\angle ARP$, $\angle A'RP$, $\angle A'SP$ and $\angle A''SP$ are right angles by the definition of perpendicular bisectors. $\overline{RP} \cong \overline{RP}$ and $\overline{SP} \cong \overline{SP}$ by the Reflexive Property. $\triangle ARP \cong \triangle A'RP$ and $\triangle A'SP \cong \triangle A''SP$ by the SAS Congruence Postulate. Using CPCTC, $\overline{AP} \cong \overline{A'P}$ and $\overline{A'P} \cong \overline{A''P}$, and $\overline{AP} \cong \overline{A''P}$ by the Transitive Property. By the definition of a rotation, A'' is the image of A after a rotation about point P. Also using CPCTC, $\angle APR \cong \angle A'PR$ and $\angle A'PS \cong \angle A''PS$. By the definition of congruence, $m\angle APR = m\angle A'PR$ and $m\angle A'PS = m\angle A''PS$. $m\angle APR + m\angle A'PR + m\angle A'PS + m\angle A''PS = m\angle APA''$ and $m\angle A'PS + m\angle A'PR = m\angle SPR$ by the Angle Addition Postulate. $m\angle A'PR + m\angle A'PR + m\angle A'PS + m\angle A'PS = m\angle APA''$ by Substitution, which simplifies to $2(m\angle A'PR + m\angle A'PS) = m\angle APA''$. By Substitution, $2(m\angle SPR) = m\angle APA''$.

31. rotation 180° about the origin and reflection in the x-axis

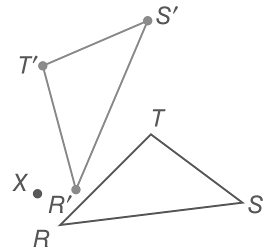
33. Sample answer: No; there are no invariant points in a glide reflection because all of the points are translated along a vector. Perhaps for compositions of transformations, there may be invariant points when a figure is rotated and reflected, rotated twice, or reflected twice.

35. Yes; sample answer: If a segment with endpoints (a, b) and (c, d) is to be reflected about the x-axis, the coordinates of the endpoints of the reflected image are $(a, -b)$ and $(c, -d)$. If the segment is then reflected about the line $y = x$, the coordinates of the endpoints of the final image are $(-b, a)$ and $(-d, c)$. If the original image is first reflected about $y = x$, the coordinates of the endpoints of the reflected image are (b, a) and (d, c). If the segment is then reflected about the x−axis, the coordinates of the endpoints of the final image are $(b, -a)$ and $(d, -c)$.

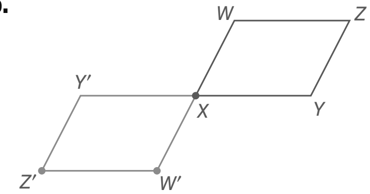
37. Sometimes; sample answer: When two rotations are performed on a single image, the order of the rotations does not affect the final image when the two rotations are centered at the same point.

39. A **41.** H

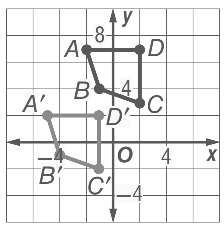
43.



45.

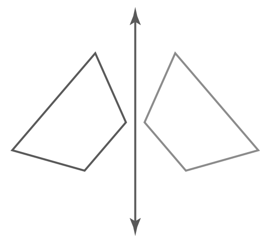


47.



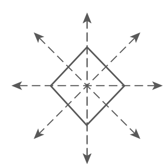
49. 37°

51.

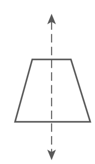


Lesson 14-5

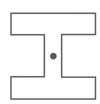
1. yes; 4



3. yes; 1

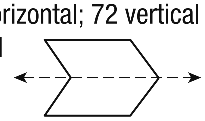


5. yes; 2; 180°



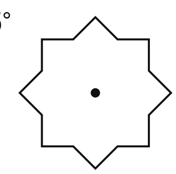
7a. no horizontal; 72 vertical **7b.** yes; 36; 10° **9.** no

11. yes; 1



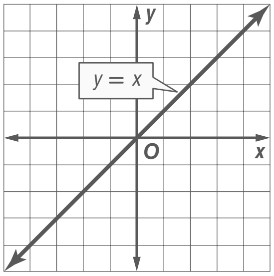
13. r **15.** no

17. yes; 8; 45°

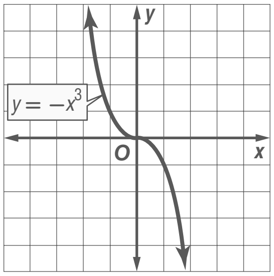


19. both **21.** neither **23.** B **25.** D **27.** line and rotational

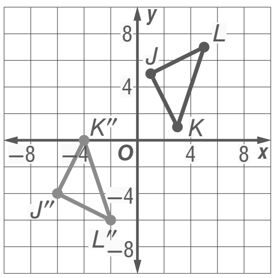
29. rotational; 2; 180°; line symmetry; $y = -x$



31. rotational; 2; 180°



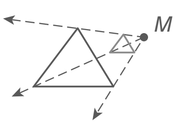
33. plane and axis; 90 **35.** plane and axis; 180
37. Sample answer: (−1, 0), (2, 3), (4, 1), and (1, −2);
39. B **41.** H
43.



45. (7, −7) **47.** reduction; $\frac{1}{2}$ **49.** enlargement; 3

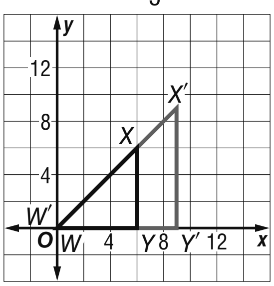
Lesson 14-6

1.

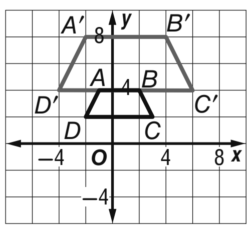


3. enlargement; $\frac{4}{3}$; 2

5.



7.



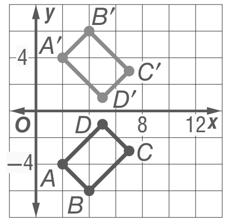
9. slope of $\overline{DE}$ = slope of $\overline{BC}$. **11.** $\frac{1}{3}$ **13.** (12,10)
15. (2, 6), (6, 8), (4, −6) **17.** 54 cm2 **19.** 2 units **21.** $\frac{2}{3}$
23. *A*(1,−3) **25.** point *A* **27a.** Dilation; the size was increased by a scale factor of 2 **27b.** The rotated figure looks the same as quadrilateral *ABCD*.

29. A **31.** D **33.** yes; 1 **35.** translation along ⟨−1, 8⟩ and reflection in the *y*—axis **37a.** 93.3% **37b.** about 14 yr
39. 34.6 **41.** 107.1

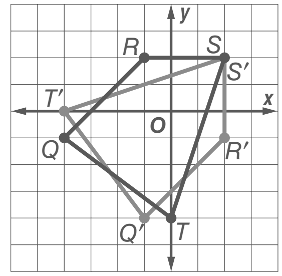
Chapter 14 Study Guide and Review

1. composition of transformations **3.** dilation **5.** line of reflection **7.** translation **9.** reflection

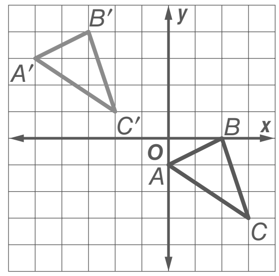
11.



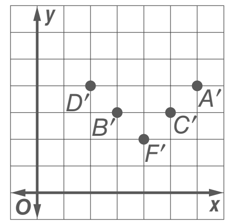
13.



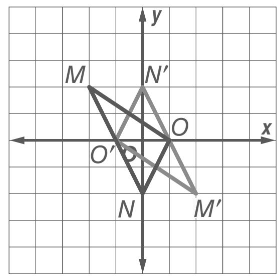
15.



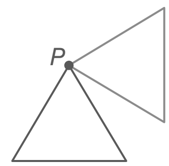
17.



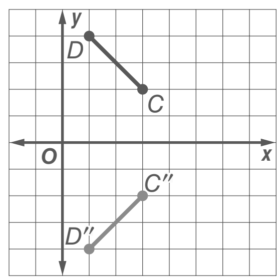
19.



21.

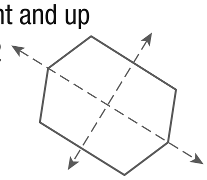


23.

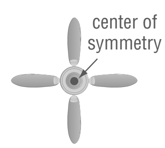


25. Sample answer: translation right and down, translation of result right and up

27. yes; 2



29. yes; 4; 90°



31. 4 **33.** reduction;8.25, 0.45

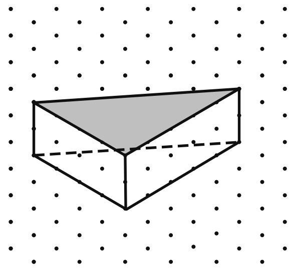
Extending Surface Area and Volume

Chapter 15 Get Ready

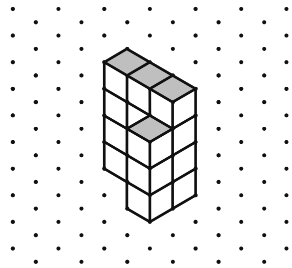
1. true **3.** true **5.** true **7.** 168 in^2 **9.** 176 in^2 **11.** ± 15

Lesson 15-1

1. Sample answer:



3.

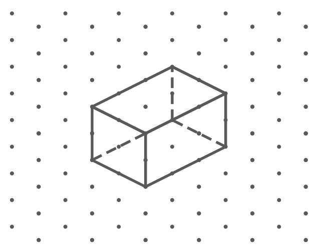


5a. slice vertically **5b.** slice horizontally **5c.** slice at an angle **7.** triangle **9.** 12 inches **11.** A **13.** C **15.** B **17.** D **19.** 5 L **21.** D **23.** 1 hexagon and 6 triangles **25.** triangular-based pyramid **27.** D **29.** D **31a.** inner side of deck = circumference of pool = 81.64 $\div \pi \approx 26$ ft; outer side of deck = 26 + 3 + 3 = 32 ft; outer perimeter of deck = $4 \times 32 = 128$ ft **31b.** area of deck = $(2 \times 3 \times 32) + (2 \times 3 \times 26) = 348$ square feet **33.** E **35a.** $(s + 0.25)^3$ **35b.** $s^3 + 0.75s^2 + 0.1875s + 0.015625$ **37.** 28.9 in.; 66.5 in^2

Lesson 15-2

1. 112.5 in^2 **3.** $L = 288$ ft^2; $S = 336$ ft^2 **5.** $L \approx 653.5$ yd^2; $S \approx 1715.3$ yd^2 **7.** 10.0 cm **9.** 125.7 **11.** 306.4 **13.** 8 inches **15.** 163.90 m^2 **17.** 12 cm^2 **19.** 336 cm^2 **21.** 45.8 **23.** 96.5 **25.** 230 square centimeters **27.** 112π cm^2 **29.** 32π sq in. **31.** 96.5 ft^2 **33.** A **35.** No, because the path was an obtuse triangle. **37.** A **39.** H

41.



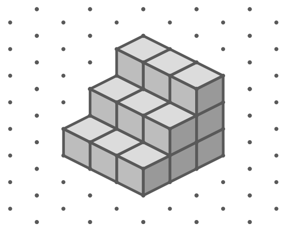
43. $\approx$\$1.14 **45.** 8.1 **47.** 42.3

Lesson 15-3

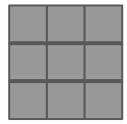
1. $L = 384$ cm^2; $S = 640$ cm^2 **3.** $L \approx 207.8$ m^2; $S \approx 332.6$ m^2 **5.** $L \approx 188.5$ m^2; $S \approx 267.0$ m^2

7. 3 ft^2 **9.** 90π **11.** 21 cm^2 **13.** $3\pi\sqrt{130}$ cm^2 **15.** 1825 cm^2 **17.** 240 **19.** $\frac{h}{l} = \frac{3}{r}$ **21.** 8 in. **23.** 0 **25.** 6000 cubic feet **27.** 270 in^3 **29.** 7 in. **31a.** Sample answer: The volume of the solid is the number of unit cubes that would fill up the solid. **31b.** Sample answer: The bottom layer of the solid has dimensions 24 by 42, so the number of unit cubes in the bottom layer would be 24×42 or 1,008. There are 10 layers, for a total of 10,080 unit cubes. The unit for this solid is inches, so the volume is 10,080 cubic inches. **33.** 13,085 in^3 **35.** D **37.** 3299 mm^2 **39.** D

41.

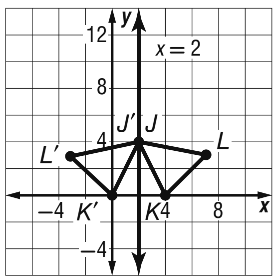


corner view

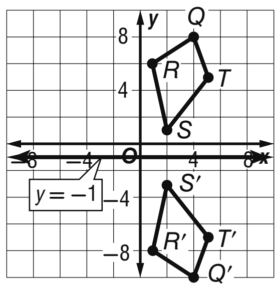


back view

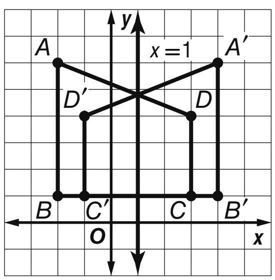
43.



45.



47.



49. 57 m, 120 m^2 **51.** 166.2 in., 1443 in^2

Lesson 15-4

1. 108 cm^3 **3.** 26.95 m^3 **5.** 206.4 ft^3 **7.** 1025.4 cm^3 **9.** D **11.** 4752 **13.** 314.2

15. 18 in. $\times$ 18 in. $\times$ 27 in. = 8,748 in^3

$$8{,}748 \text{ in}^3 \times \frac{1 \text{ ft}^3}{1728 \text{ in}^3} = 5 \text{ ft}^3$$

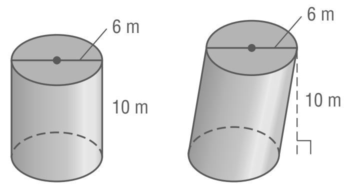
17. x(x + 1)(2x + 1)

5 x(2x^2 + 3x + 1)

5 (2x^3 + 3x^2 + x) cubic units

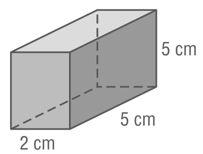
19. 1.125 in^3 **21.** 28 **23.** 135 lb **25.** 49 cm^3 **27.** 299.1 in.^{3} **29.** 929.1 ft^3 **31.** 12,833.3 cm^3 **33.** 3,190,680.0 cm^3 **35.** $11\frac{1}{4}$ in. **37.** 1100 cm^3; Each triangular prism has a base area of $\frac{1}{2}(8)(5.5)$ or 22 cm^2 and a height of 10 cm.

39a.



39b. Greater than; a square with a side length of 6 m has an area of 36 m^2. A circle with a diameter of 6 m has an area of 9π or 28.3 m^2. Since the heights are the same, the volume of the square prism is greater. **39c.** Multiplying the radius by x; since the volume is represented by $\pi r^2 h$, multiplying the height by x makes the volume x times greater. Multiplying the radius by x makes the volume x^2 times greater. **41a.** base 3 in. by 5 in., height 4π in. **41b.** base 5 in. per side, height $\frac{12}{5}\pi$ in. **41c.** base with legs measuring 3 in. and 4 in., height 10π in.

43. Sample answer:



45. Both formulas involve multiplying the area of the base by the height. The base of a prism is a polygon, so the expression representing the area varies, depending on the type of polygon it is. The base of a cylinder is a circle, so its area is πr^2.

47. F **49.** C **51.** 126 cm^2; 175 cm^2 **53.** 205 in^2

55. $\frac{x+3}{x+5}$ **57.** $\frac{(x+3)(x-5)}{(x-2)(x-4)}$ **59.** 378 m^2

Lesson 15-5

1. 75 in^3 **3.** 62.4 m^3 **5.** 51.3 in^3 **7.** 28.1 mm^3

9. 513,333.3 ft^3 **11.** 452.4 **13.** 100π m^2 **15.** 80 min

17. $3z^2$ **19.** 12π cu in. **21.** 36 cm^2 **23.** 650 in^3

25. 33.5 m^3 **27.** 7A, 7C ; Level 7 **29.** 381.5 in^3

31. 288π **33.** $360{,}000\pi$ **35.** Sometimes; the statement is true if the base area of the cone is 3 times as great as the base area of the prism. For example, if the base of the prism has an area of 10 square units, then its volume is 10 h cubic units. So, the cone must have a base area of 30 square units so that its volume is $\frac{1}{3}$ **(30)**h or $10h$ cubic units. **37.** 1704 cm^3; The volume of a cylinder is three times as much as the volume of a cone with the same radius and height. **39.** To find the volume of each solid, you must know the area of the base and the height. The volume of a pyramid is one third the volume of a prism that has the same height and base area. The volume of a cone is one third the volume of a cylinder that has the same height and base area.

41. 5.5 ft **43.** E **45.** 1140.0 ft^3 **47.** $\pi(216 + 9\sqrt{106} + 81\sqrt{2}) \approx 1330$ ft^2 **49.** 54.4 in^2 **51.** 168.2 mm^2

Chapter 15 Study Guide and Review

1. false, right cone **3.** true **5.** true **7.** true

9. circle **11.** 78 cm^2; 122 cm^2 **13.** 125.7 in^2; 226.2 in^2

15. 36 m^2; 45 m^2 **17.** 7 cm **19.** 1440 ft^3

21. 18 cm^3 **23.** 461.8 in^2 **25.** 3619.1 m^3 **27.** 56.5 cm^3