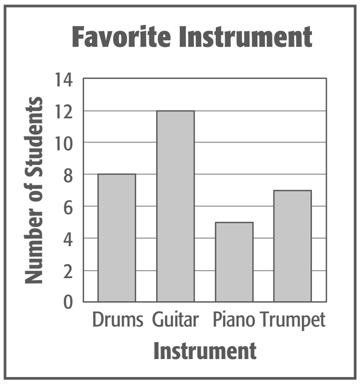
Selected Answers and Solutions

CHAPTER 0
Preparing for Integrated Math II

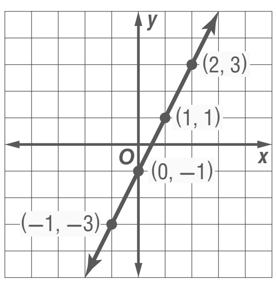
Pretest

1. cm **3.** 48 **5.** 0.18 **7.** 1.13 **9.** 32 **11.** 170
13. 87 **15.** $\frac{5}{19}$ or about 26% **17.** $\frac{12}{19}$ or about 63%
19. −12 **21.** −1 **23.** 12 **25.** 16 **27.** −13 **29.** −2
31. $-\frac{10}{3}$ **33.** 8 **35.** 38 **37.** $\{t \mid t \geq 11\}$ **39.** $\{a \mid a \leq 5\}$
41. $\{w \mid w > -12$ **43.** $\{b \mid b \geq 30\}$ **45.** (4, −2) **47.** (−3, 5)

49 & 51.



53.



55. (0, −4) **57.** no solution **59.** infinitely many solutions
61. $\frac{5}{7}$ **63.** $\frac{12 + 3\sqrt{5}}{11}$

Lesson 0-1

1. cm **3.** kg **5.** mL **7.** 10 **9.** 10,000 **11.** 0.18
13. 2.5 **15.** 24 **17.** 0.370 **19.** 4 **21.** 5 **23.** 16
25. 208 **27.** 9050

Lesson 0-2

1. 20 **3.** 12.1 **5.** 16 **7.** 12 **9.** 5.4 **11.** 22.47
13. 1.125 **15.** 5.4 **17.** 15 **19.** 367.9 g **21.** 735.8 g

Lesson 0-3

1. $\frac{1}{3}$ or 33% **3.** $\frac{2}{3}$ or 67% **5.** $\frac{1}{3}$ or 33%
7. $\frac{13}{28}$ or about 46% **9.** $\frac{11}{14}$ or about 79%
11. $\frac{9}{70}$ or about 13% **13.** $\frac{9}{28}$ or about 32%
15. $\frac{1}{28}$ or about 3.6% **17.** $\frac{13}{28}$ or about 46%
19. $\frac{13}{14}$ or about 93% **21.** $\frac{1}{10}$ or 10%; $\frac{1}{8}$ or 12.5%
23. Sample answer: Assign each friend a different colored marble: red, blue, or green. Place all the marbles in a bag and without looking, select a marble from the bag. Whoever's marble is chosen gets to go first.

Lesson 0-4

1. 3 **3.** −2 **5.** −1 **7.** −26 **9.** 26 **11.** 15

Lesson 0-5

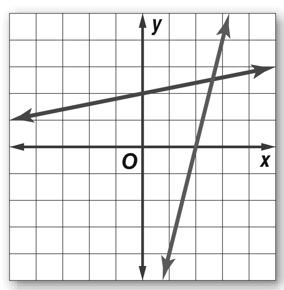
1. −8 **3.** 15 **5.** −72 **7.** $-\frac{15}{2}$ **9.** $\frac{7}{2}$
11. −15 **13.** −7 **15.** −7 **17.** −1
19. 60 **21.** −4 **23.** 4 **25.** 15 **27.** 21 **29.** −2
31. $-\frac{29}{2}$ **33.** −6 **35.** 1

Lesson 0-6

1. $\{x \mid x < 13\}$ **3.** $\{y \mid y < 5\}$ **5.** $\{t \mid t > -42\}$ **7.** $\{d \mid d \leq 4\}$
9. $\{k \mid k \geq -3\}$ **11.** $\{z \mid z < -2\}$ **13.** $\{m \mid m < 29\}$
15. $\{b \mid b \geq -16\}$ **17.** $\{z \mid z > -2\}$ **19.** $\{b \mid b \leq 10\}$
21. $\{q \mid q \geq 2\}$ **23.** $\left\{w \mid w \geq -\frac{7}{3}\right\}$

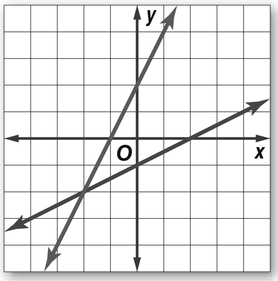
Lesson 0-7

1. {(–15, 4), (–18, –8), (–16.5, –2), (–15.25, 3)}
3.



5. $f^{-1}(x) = -\frac{1}{2}x + \frac{7}{2}$
7a. $C^{-1}(x) = \frac{1}{70}x - \frac{60}{7}$
7b. x is Dwayne's total cost, and $C^{-1}(x)$ is the number of games Dwayne attended. **7c.** 5
9. {(−49, −4), (35, 8), (−28, −1), (7, 4)}
11. {(7.4, −3), (4, −1), (0.6, 1), (−2.8, 3), (−6.2, 5)}

13.



15. $f^{-1}(x) = -3x + 51$ **17.** $f^{-1}(x) = -\frac{1}{6}x + 2$

19. $f^{-1}(x) = -\frac{3}{4}x - 12$

21a. $C^{-1}(x) = \frac{1}{35}x - \frac{2}{7}$

21b. x is the total amount collected from the Fosters, and $C^{-1}(x)$ is the number of times Chuck mowed the Fosters' lawn. **21c.** 22

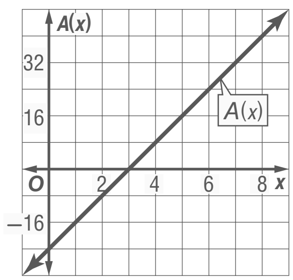
23. $f^{-1}(x) = 15 - 5x$ **25.** $f^{-1}(x) = \frac{3}{2}x + 12$

27. $f^{-1}(x) = 3x - 3$ **29.** B **31.** A

33. $f^{-1}(x) = \frac{3}{2}x - 12$ **35.** $f^{-1}(x) = \frac{1}{4}x + \frac{3}{4}$

37a. $A(x) = 8(x - 3)$ or $A(x) = 8x - 24$

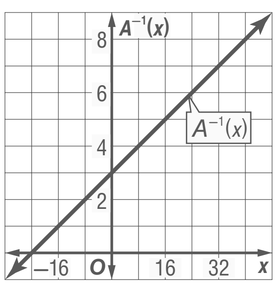
37b.



Sample answer: The domain represents possible values of x. The range represents the area of the rectangle and must be positive. This means that the domain of $A(x)$ is all real numbers greater than 3, and the range of $A(x)$ is all positive real numbers.

37c. $A^{-1}(x) = \frac{1}{8}x + 3$; x is the area of the rectangle and $A^{-1}(x)$ is the value of x in the expression for the length of the side of the rectangle $x - 3$.

37d.



Sample answer: The domain represents the area of the rectangle and must be positive. The range represents possible values for x in the expression $x - 3$. This means that the domain of $A^{-1}(x)$ is all positive real numbers, and the range of $A^{-1}(x)$ is all real numbers greater than 3.

37e. Sample answer: The domain of $A(x)$ is the range of $A^{-1}(x)$, and the range of $A(x)$ is the domain of $A^{-1}(x)$.

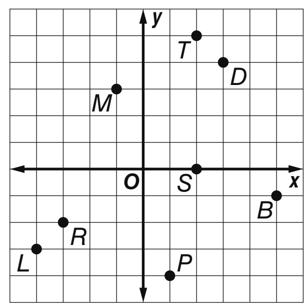
39. $a = 2$; $b = 14$

41. Sometimes; sample answer: $f(x)$ and $g(x)$ do not need to be inverse functions for $f(a) = b$ and $g(b) = a$. For example, if $f(x) = 2x + 10$, then $f(2) = 14$ and if $g(x) = x - 12$, then $g(14) = 2$, but $f(x)$ and $g(x)$ are not inverse functions. However, if $f(x)$ and $g(x)$ are inverse functions, then $f(a) = b$ and $g(b) = a$.

43. Sample answer: A situation may require substituting values for the dependent variable into a function. By finding the inverse of the function, the dependent variable becomes the independent variable. This makes the substitution an easier process.

Lesson 0-8

1. (−2, 3) **3.** (2, 2) **5.** (−3, 1) **7.** (4, 1) **9.** (−1, −1) **11.** (3, 0) **13.** (2, −4) **15.** (−4, 2) **17.** none **19.** IV **21.** I **23.** III



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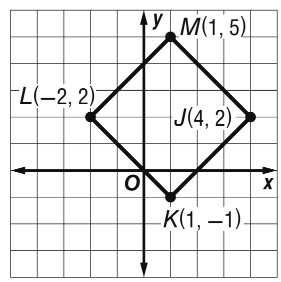

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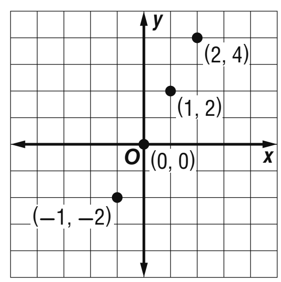

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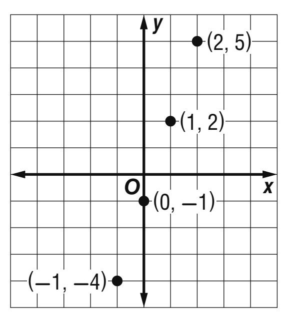


Lesson 0-9

1. (2, 0) **3.** no solution **5.** (2, −5) **7.** $\left(-\frac{4}{3}, 3\right)$ **9.** (4, 1)

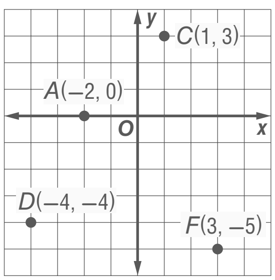
11. elimination, no solution **13.** elimination or substitution, (3, 0) **15.** elimination or substitution, (−6, 4)

Lesson 0-10

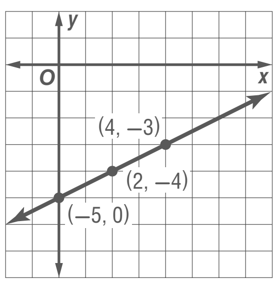
1. $4\sqrt{2}$ **3.** $10\sqrt{5}$ **5.** 6 **7.** $7x\left|y^3\right|\sqrt{2x}$ **9.** $\frac{9}{7}$ **11.** $\frac{3\sqrt{14}}{4}$
13. $\frac{p\sqrt{30p}}{9}$ **15.** $\frac{20 + 8\sqrt{3}}{13}$ **17.** $\frac{\sqrt{3}}{4}$
19. $\frac{6\sqrt{5} + 3\sqrt{10}}{2}$

Posttest

1. g **3.** $\frac{2}{3}$ or 0.67 **5.** 1.5 **7.** 4200 **9.** 750,000
11. $\frac{3}{25}$ or 12% **13.** $\frac{11}{15}$ or about 73% **15.** $\frac{7}{15}$ or about 47%
17. -10 **19.** -4 **21.** 21 **23.** 20 **25.** 45 **27.** 16
29. 59 **31.** $\left\{z \mid z \leq \frac{11}{2}\right\}$ **33.** $\{k \mid k \geq -75\}$
35. $\{m \mid m \geq 2\}$ **37.** $\{n \mid n < -15\}$ **39.** $(-2, -5)$ **41.** $(4, -1)$
43 & 45.



47.



49. $(1, 1)$ **51.** $(3, -2)$ **53.** $(3, -1)$
55. $\frac{8\sqrt{10}}{5}$ **57.** $\frac{x\sqrt{21x}}{3}$ **59.** $2x^2y\sqrt{3x}$

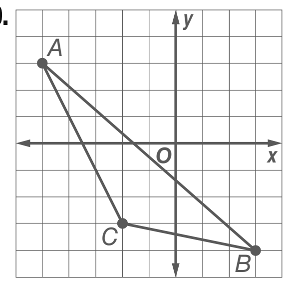
CHAPTER 1
Quadratic Expressions and Equations

Chapter 1 Get Ready

1. $a(a) + a(5)$; $a^2 + 5a$ **3.** $n(n) + n(-3n^2) + n(2)$; $n^2 - 3n^3 + 2n$ **5.** $5(9 + 3 + 6)$; \$90 **7.** $11a - 2$ **9.** $19w^2 + w$ **11.** simplified **13.** $a^2 - 8a + 16$ **15.** $9g^2 - 9g + 2$ **17.** $4n^5$ **19.** $-15z^9$ **21.** $-14a^5c^9$

Lesson 1-1

1. yes; 3; trinomial **3.** yes; 2; monomial **5.** yes; 5; binomial **7.** $2x^5 + 3x - 12$; 2 **9.** $-5z^4 - 2z^2 + 4z$; -5 **11.** $4x^3 + 5$ **13.** $-a^2 + 6a - 3$ **15.** $-8z^3 - 3z^2 - 2z + 13$ **17.** $4y^2 + 3y + 3$ **19a.** $D(n) = 6n + 14$ **19b.** 116,000 students **19c.** 301,000 students **21.** yes; 0; monomial **23.** No; the exponent is a variable. **25.** yes; 4; binomial **27.** $7y^3 + 8y$; 7 **29.** $-y^3 - 3y^2 + 3y + 2$; -1 **31.** $-r^3 + r + 2$; -1 **33.** $-b^6 - 9b^2 + 10b$; -1 **35.** $11x^2 + 2x - 7$ **37.** $2z^2 + z - 11$ **39.** $-2b^2 + 2a + 9$ **41.** $7x^2 - 2xy - 7y$ **43.** $3x^2 - rxt - 8r^2x - 6rx^2$ **45.** quadratic trinomial **47.** quartic binomial **49.** quintic polynomial **51a.** $S = 0.55t^2 - 0.05t + 3.7$ **51b.** 3030 **53a.** the area of the rectangle **53b.** the perimeter of the rectangle **55.** $10a^2 - 8a + 16$ **57.** $7n^3 - 7n^2 - n - 6$ **59a.** $15 + 0.15m$ **59b.** \$36.75 **59c.** \$123 **59d.** \$336 **61.** Neither; neither of them found the additive inverse correctly. All terms should have been multiplied by -1. **63.** $6n + 9$ **65.** Sample answer: To add polynomials in a horizontal format, you combine like terms. For the vertical format, you write the polynomials in standard form, align like terms in columns, and combine like terms. To subtract polynomials in a horizontal format you find the additive inverse of the polynomial you are subtracting, and then combine like terms. For the vertical format you write the polynomials in standard form, align like terms in columns, and subtract by adding the additive inverse.
67. $8x + 12$ units **69.** C **71.** $6\sqrt{7}$ **73.** $\frac{\sqrt{2}}{2}$ **75.** $\frac{\left|a^3\right|\sqrt{6}}{9}$
77. $4\sqrt{15} - 8\sqrt{3}$
79.



81. 424.5 g **83.** 1.25 kg **85.** $-2n^8$ **87.** $-40u^5z^9$
89. 64 **91.** $288x^8y^{10}z^6$

Lesson 1-2

1. $-15w^3 + 10w^2 - 20w$ **3.** $32k^2m^4 + 8k^3m^3 + 20k^2m^2$
5. $14a^5b^3 + 2a^6b^2 - 4a^2b$ **7.** $4t^3 + 15t^2 - 8t + 4$
9. $-5d^4c^2 + 8d^2c^2 - 4d^3c + dc^4$ **11.** 20 **13.** $-\frac{20}{9}$
15. 20 **17.** 1 **19.** $f^3 + 2f^2 + 25f$
21. $10j^5 - 30j^4 + 4j^3 + 4j^2$ **23.** $8t^5u^3 - 40t^4u^5 + 8t^3u$
25. $-8a^3 + 20a^2 + 4a - 12$
27. $-9g^3 + 21g^2 + 12$
29. $8n^4p^2 + 12n^2p^2 + 20n^2 - 8np^3 + 12p^2$
31. 2 **33.** $\frac{43}{6}$ **35.** $\frac{30}{43}$ **37.** $20np^4 + 6n^3p^3 - 8np^2$
39. $-q^3w^3 - 35q^2w^4 + 8q^2w^2 - 27qw$ **41a.** $53.50 - 0.25h$
41b. \$50.50 **43a.** $1.5x^2 + 24x$ **43b.** $x^2 - 9x$ **43c.** 264 ft
45. Ted; Pearl used the Distributive Property incorrectly.
47. $8x^2y^{-2} + 24x^{-10}y^8 - 16x^{-3}$ **49.** Sample answer: $3n$, $4n + 1$; $12n^2 + 3n$ **51.** B **53.** A **55.** $-3x^2 + 1$
57. $-9a^2 + 4a + 7$ **59.** $6ab + 2a + 4b$ **61a.** about 2.1 seconds **61b.** about 9.7 in. **63.** $\{p \mid p > 9\}$
65. $\{x \mid x \leq -13\}$ **67.** $6y^3$ **69.** $15z^7 - 6z^4$
71. $-8p^5 + 10p^{10}$

Lesson 1-3

1. $x^2 + 7x + 10$ **3.** $b^2 - 4b - 21$ **5.** $16h^2 - 26h + 3$
7. $4x^2 + 72x + 320$ **9.** $16y^4 + 28y^3 - 4y^2 - 21y - 6$
11. $10n^4 + 11n^3 - 52n^2 - 12n + 48$
13. $2g^2 + 15g - 50$ **15.** $24x^2 + 18x + 3$
17. $24d^2 - 62d + 35$ **19.** $49n^2 - 84n + 36$ **21.** $25r^2 - 49$
23. $33z^2 + 7yz - 10y^2$ **25.** $2y^3 - 17y^2 + 37y - 22$
27. $m^4 + 2m^3 - 34m^2 + 43m - 12$ **29.** $6b^5 - 3b^4 - 35b^3 - 10b^2 + 43b + 63$ **31.** $2m^3 + 5m^2 - 4$ **33.** $4\pi x^2 + 12\pi x + 9\pi - 3x^2 - 5x - 2$ **35a.** $18y^2 + 9y - 20$ **35b.** 1519 ft^2
37. $a^2 - 4ab + 4b^2$ **39.** $x^2 - 10xy + 25y^2$
41. $125g^3 + 150g^2h + 60gh^2 + 8h^3$
43a. $x > 4$; If $x = 4$ the width of the rectangular sandbox would be zero and if $x < 4$ the width of the rectangular sandbox would be negative. **43b.** square **43c.** 4 ft^2
45. Always; by grouping two adjacent terms a trinomial can be written as a binomial, a sum of two quantities, and apply the FOIL method. For example, $(2x + 3)(x^2 + 5x + 7) = (2x + 3)[x^2 + (5x + 7)] = 2x(x^2) + 2x(5x + 7) + 3(x^2) + 3(5x + 7)$. Then use the Distributive Property and simplify.
47. Sample answer: $x - 1$, $x^2 - x - 1$; $(x - 1)(x^2 - x - 1) = x^3 - 2x^2 + 1$
49. The Distributive Property can be used with a vertical or horizontal format by distributing, multiplying, and combining like terms. The FOIL method is used with a horizontal format. You multiply the first, outer, inner, and last terms of the binomials and then combine like terms. A rectangular method can also be used by writing the terms of the polynomials along the top and left side of a rectangle and then multiplying the terms and combining like terms. **51.** F
53. $\frac{3}{2}$ **55.** $4a+5$ **57.** $3n^3 - 6n^2 + 10$ **59.** $4b+c+2$
61. $-7m^3 - 3m^2 - m + 17$ **63.** $-56t^{12}$ **65.** $50y^6 - 27y^9$

Lesson 1-4

1. $x^2 + 10x + 25$ **3.** $4x^2 + 28xy + 49y^2$ **5.** $g^2 - 8gh + 16h^2$
7a. $0.5Dy + 0.5y^2$ **7b.** 50% **9.** $x^2 - 25$
11. $81t^2 - 36$ **13.** $b^2 - 12b + 36$ **15.** $x^2 + 12x + 36$
17. $81 - 36y + 4y^2$ **19.** $25t^2 - 20t + 4$ **21a.** $(T + t)^2 = T^2 + 2Tt + t^2$ **21b.** TT: 25%; Tt: 50%; tt: 25% **23.** $b^2 - 49$
25. $16 - x^2$ **27.** $9a^4 - 49b^2$ **29.** $64 - 160a + 100a^2$ **31.** $9t^2 - 144$ **33.** $9q^2 - 30qr + 25r^2$ **35.** $g^2 + 10gh + 25h^2$ **37.** $9a^8 - b^2$ **39.** $64a^4 - 81b^6$
41. $\frac{4}{25}y^2 - \frac{16}{5}y + 16$ **43.** $4m^3 + 16m^2 - 9m - 36$
45. $2x^2 + 2x + 5$ **47.** $6x + 3$ **49.** $c^3 + 3c^2d + 3cd^2 + d^3$
51. $f^3 + f^2g - fg^2 - g^3$ **53.** $n^3 - n^2p - np^2 + p^3$
55a. about $(3.14r^2 + 56.52r + 254.34)$ ft^2
55b. about $(1189.66 - 3.14r^2 - 56.52r)$ ft^2
57. Sample answer: $(2c + d) \cdot (2c - d)$; The product of these binomials is a difference of two squares and does not have a middle term. The other three do. **59.** 81
61. Sample answer: To find the square of a sum, apply the FOIL method or apply the pattern. The square of the sum of two quantities is the first quantity squared plus two times the product of the two quantities plus the second quantity squared. The square of the difference of two quantities is the first quantity squared minus two times the product of the two quantities plus the second quantity squared. The product of the sum and difference of two quantities is the square of the first quantity minus the square of the second quantity.
63. D **65.** C **67.** $2c^2 + 5c - 3$ **69.** $8h^2 - 34h + 21$
71. $40m^2 + 47m + 12$ **73.** $3c^2 - 2c$
75. $-13d^2 - 18d$ **77.** $19p^2 - 18p$ **79.** $9\sqrt{2}$
81. $3y^4\sqrt{5x}$ **83.** $(4, -3)$ **85.** $(1, 2)$ **87.** $(-1, -1)$ **89.** $2p^5 - 5p^4 + p^2 + 12$; 2

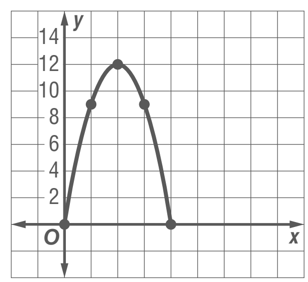
Lesson 1-5

1. $3(7b - 5a)$ **3.** $gh(10gh + 9h - g)$ **5.** $(n + 8)(p + 2)$
7. $(b + 5)(3c - 2)$ **9.** $0, -10$ **11.** $0, \frac{3}{4}$ **13a.** 0 seconds and 2.08125 seconds **13b.** 17.3 ft, 2.6 ft **15.** $8(2t - 5y)$
17. $2k(k + 2)$ **19.** $2ab(2ab + a - 5b)$ **21.** $(g + 4)(f - 5)$
23. $(h + 5)(j - 2)$ **25.** $(9q - 10)(5p - 3)$ **27.** $(3d - 5)(t - 7)$
31. $(r - 5)(5b + 2)$ **33.** $gf(5f + g + 15)$ **35.** $3cd(9d - 6cd + 1)$ **37.** $2(8u - 15)(3t + 2)$ **39.** 0, 3 **41.** $-\frac{1}{2}, -2$
43. $0, -3$ **45a.** ab **45b.** $(a + 6)(b + 6)$ **45c.** $6(a + b + 6)$

47a.

x	0	1	2	3	4
y	0	9	12	9	0

47b.



47c. 12 ft **49.** 4 s **51a.** 3 and -2

51b.

x^2	$+3x$
$-2x$	-6

51c.

	x	$+3$
x	x^2	$+3x$
-2	$-2x$	-6

51d. Sample answer: Place x^2 in the top left-hand corner and place -40 in the lower right-hand corner. Then determine which two factors have a product of -40 and a sum of -3. Then place these factors in the box. Then find the factor of each row and column. The factors will be listed on the very top and far left of the box.

53. If $a = 0$ and $b = 0$, then all real numbers are solutions. If $a \neq 0$, then the solutions are $-\frac{b}{a}$ and $\frac{b}{a}$. **55.** Sample answer: $a = 0$ or $a = b$ for any real values of a and b. **57.** D **59.** 350 **61.** $0.5Bb + 0.5b^2$; $\frac{1}{2}$ **63.** $2b^3 + 2b^2 - 10b$ **65.** $-4x^4 - 4x^3 - 8x^2 + 4x$ **67.** $-3x^3y - 3x^2y^2 - 6xy^3$ **69.** 0 **71.** 2 **73.** 3 **75.** $a^2 + 7a + 10$ **77.** $z^2 - 9z + 8$ **79.** $x^2 - 13x + 42$

Lesson 1-6

1. $(x + 2)(x + 12)$ **3.** $(n + 7)(n - 3)$ **5.** $-3, 7$ **7.** 6, 9 **9.** $-8, 9$ **11.** 8 in. by 12 in. **13.** $(y - 9)(y - 8)$ **15.** $(n - 7)(n + 5)$ **17.** $(x - 2)(x - 20)$ **19.** $(m + 6)(m - 7)$. **21.** $4, -5$ **23.** $-2, -9$ **25.** 2, 16 **27.** $-4, -14$ **29.** 4, 12 **31.** $(x - 6)$ ft **33.** $(q + 2r)(q + 9r)$ **35.** $(x - y)(x - 5y)$ **37a.** Sample answer: Let w = width; $(w + 20)w = 525$. **37b.** $-35, 15$ **37c.** The solution of 15 means that the width is 15 ft. The solution -35 does not make sense because length cannot be negative. **39.** $4x + 26$ **41.** Charles; Jerome's answer once multiplied is $x^2 - 6x - 16$. The middle term should be positive. **43.** $-15, -9, 9, 15$ **45.** 4, 6 **47.** Sample answer: $x^2 + 19x - 20$; $(x - 1)(x + 20)$ **49.** Sample answer: Find factors m and n such that $m + n = b$ and $mn = c$. If b and c are positive, then m and n are positive. If b is negative and c is positive, then m and n are negative. When c is negative, m and n have different signs and the factor with the greatest absolute value has the same sign as b. **51.** 204 **53.** A **55.** $11x(1 + 4xy)$ **57.** $(2x + b)(a + 3c)$ **59.** $(x - y)(x - y)$ **61.** about 3 mi **63.** 300 ft **65.** $(3x - 4)(a - 2b)$

Lesson 1-7

1. $(3x + 2)(x + 5)$ **3.** prime **5.** $-\frac{3}{2}, -3$ **7.** $\frac{4}{3}, 2$ **9a.** 5 ft **9b.** 2.5 seconds **11.** $(2x + 3)(x + 8)$ **13.** $2(2x + 5)(x + 7)$ **15.** $(4x - 5)(x - 2)$ **17.** prime **19.** prime **21.** prime **23.** $\frac{3}{2}, -6$ **25.** $\frac{2}{3}, 8$ **27.** $-\frac{1}{3}, 2$ **29a.** $10 = -16t^2 + 20t + 6$ **29b.** 1 second **29c.** Less; sample answer: It starts closer to the ground so the shot will not have as far to fall. **31.** -2 or $\frac{1}{6}$ **33.** $-(x + 2)(4x + 7)$ **35.** $-(2x - 7)(3x - 5)$ **37.** $-(3x - 4)(4x + 5)$ **39a.** a^2 and b^2 **39b.** $a^2 - b^2$ **39c.** width: $a - b$, length: $a + b$ **39d.** $(a - b)(a + b)$ **39e.** $(a - b)(a + b)$; the figure with area $a^2 - b^2$ and the rectangle with area $(a - b)(a + b)$ have the same area, so $a^2 - b^2 = (a - b)(a + b)$. **41.** $(12x + 20y)$ in.; The area of the square equals $(3x + 5y) \cdot (3x + 5y)$ in^2, so the length of one side is $(3x + 5y)$ in. The perimeter is $4(3x + 5y)$ or $(12x + 20y)$ in. **43.** Sample answer: A quadratic equation may have zero, one, or two solutions. If there are two solutions, you must consider the context of the situation to determine whether one or both solutions answer the given question. **45.** 6 **47.** J **49.** $(x - 2)(x - 7)$ **51.** $(x + 3)(x - 8)$ **53.** $(r + 8)(r - 5)$ **55.** 0, 9 **57.** 0, 2 **59.** 0, 4 **61.** elimination; $x = -3$, $y = -1$ **63.** substitution; $x = -4$, $y = -2.5$ **65.** 0.275 **67.** $4x + 38 \leq 75$; 9.25 lb or less **69.** 6 **71.** 9 **73.** 10

Lesson 1-8

1. $(x + 3)(x - 3)$ **3.** $9(m + 4)(m - 4)$ **5.** $(u + 3)(u - 3)(u^2 + 9)$ **7.** $5(2r^2 - 3n^2)(2r^2 + 3n^2)$ **9.** $(c + 1)(c - 1)(2c + 3)$ **11.** $(t + 4)(t - 4)(3t + 2)$ **13.** 36 mph **15.** $(q + 11)(q - 11)$ **17.** $6(n^2 + 1)(n + 1)(n - 1)$ **19.** $(r + 3t)(r - 3t)$ **21.** $h(h + 10)(h - 10)$ **23.** $(x + 9)(x - 9)(2x - 1)$ **25.** $7(h^2 + p^2)(h + p)(h - p)$ **27.** $6k^2(h^2 + 3k)(h^2 - 3k)$ **29.** $(f + 8)(f - 8)(f + 2)$ **31.** $10q(q + 11)(q - 11)$ **33.** $p^3r(r + 1)(r - 1)(r^2 + 1)$ **35.** $(r + 10)(r - 10)(r - 5)$ **37.** $(a + 7)(a - 7)$ **39.** $3(m^4 + 81)$ **41.** $2(a + 4)(a - 4)(6a + 1)$ **43.** $3(m + 5)(m - 5)(5m + 4)$ **45a.** $-0.5x(x - 9)$ **45b.** 9 ft **45c.** 10.125 ft **47a.** 5 **47b.** 2.5 **47c.** 156,250 **49.** $2, -2$ **51.** $\frac{3}{8}, -\frac{3}{8}$ **53.** $-45, 45$ **55.** $\frac{3}{16}, -\frac{3}{16}$ **57.** Lorenzo; sample answer: Checking Elizabeth's answer gives us $16x^2 - 25y^2$. The exponent on x in the final product should be 4. **59.** $(x^4 - 3)(x^4 + 3)(x^8 + 9)$ **61.** false; $a^2 + b^2$ **63.** When the difference of squares pattern is multiplied together using the FOIL method, the outer and inner terms are opposites of each other. When these terms are added together, the sum is zero. **65.** G **67a.** Car A, because it is traveling at 65 mph, and Car B is traveling at 60 mph. **67b.** $5t - 10$ **67c.** 2.5 mi **69.** prime **71.** {3, 6} **73.** {6, 16} **75.** $-1, 9$ **77.** -4 **79.** $\frac{3}{2}$ **81.** $-2d^2 - 7d - 10$ **83.** $6h^4 + 2h^3 + h^2 + 5$ **85.** $x^2 - 4x + 4$ **87.** $4x^2 - 20x + 25$ **89.** $16x^2 + 40x + 25$

Lesson 1-9

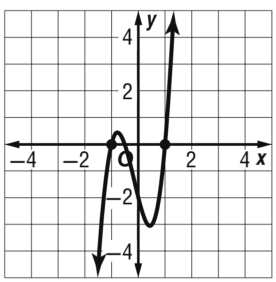
1. yes; $(5x + 6)^2$ **3.** $(x - 4)(2x + 7)$ **5.** $4(x^2 + 16)$ **7.** ± 3 **9.** $\frac{3}{8}$ **11.** 0.6 second **13.** yes; $(4x - 7)^2$ **15.** no **17.** prime **19.** $8(y - 5z)(y + 5z)$ **21.** $2m(2m - 7)(3m + 5)$ **23.** $3(2x - 7)^2$ **25.** $3p(2p + 1)(2p - 1)$ **27.** $2t(t + 6)(2t - 7)$ **29.** $2a(a - b)(b + 1)(b - 1)$ **31.** $3k(k - 4)(k - 4)$ **33.** prime **35.** $4 \pm \sqrt{7}$ **37.** $\frac{3}{4}$ **39.** 6 **41.** $\frac{1}{3}$ **43.** $8 \pm \sqrt{6}$ **45.** 20 ft **47.** $|4x + 5|$ **49a.** 500 ft^2 **49b.** 20 ft by 25 ft by 42 in. **49c.** Sample answer: 20 ft by 50 ft by 42 in. **49d.** 1:4 **51.** 6 feet wide by 2 feet long by 15 feet high **53.** Adriano; Debbie did not factor the expression completely. **55.** Sample answer: $x^2 - 3x + \frac{9}{4} = 0$; $\left\{\frac{3}{2}\right\}$ **57.** First look for a GCF in all the terms and factor the GCF out of

all the terms. Then, if the polynomial has two terms, check if the terms are the differences of squares and factor if so. If the polynomial has three terms, check if the polynomial if a perfect square polynomial and factor if so. If the polynomial has four or more terms, factor by grouping. If the polynomial does not have a GCF and cannot be factored, the polynomial is a prime polynomial.
59. Sample answer: $x^4 - 1$; 1, −1 **61.** B **63.** H
65. $(x - 4)(x + 4)$ **67.** $(1 - 10p)(1 + 10p)$
69. $(5n - 1)(5n + 1)$ **71.** {−2, 4} **73.** {−2, 1} **75.** {2, 3}
77. 144 ft **79.** $(a - 11)(a + 11)$ **81.** $(2y - 5)(2y + 5)$
83. $4(t - 1)(t + 1)(t^2 + 1)$ **85.** $-\frac{2}{3}$ **87.** $\frac{3}{8}$ **89.** undefined

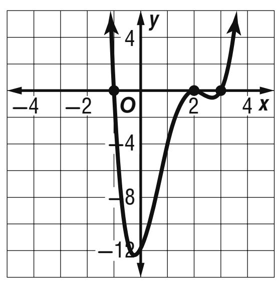
Lesson 1-10

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

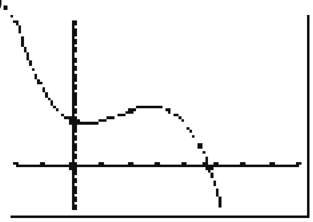
47.



49.



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



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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.
59a. Sample answer: $f(x) = x^4 + 4x^2 + 4$
59b. Sample answer: $f(x) = x^3 + 6x^2 + 9x$
61. C **63.** H **65.** $0.5Bb + 0.5b^2$; $\frac{1}{2}$ **67.** $(x + 6)(x + 5)$
69. $(x - 12)(x + 3)$ **71.** $(x - 7)(x + 6)$
73. $\pm1, \pm2, \pm3, \pm6, \pm\frac{1}{2}, \pm\frac{3}{2}, \pm\frac{1}{4}, \pm\frac{3}{4}$
75. $\pm1, \pm7, \pm\frac{1}{2}, \pm\frac{7}{2}, \pm\frac{1}{3}, \pm\frac{7}{3}, \pm\frac{1}{6}, \pm\frac{7}{6}$

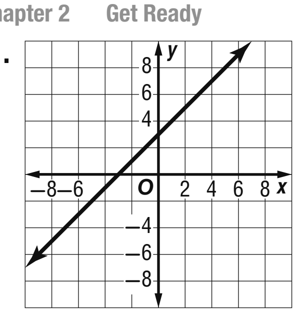
Chapter 1 Study Guide and Review

1. false; sample answer: $x^2 + 5x + 7$ **3.** true **5.** true **7.** true
9. false; difference of squares **11.** $3x^2 + x + 2$
13. $x^2 + 3x + 2$ **15.** $-2x^3 - 3$ **17.** $-x^2 - x + 6$ **19.** 0
21. 1 **23.** $x^2 + 4x - 21$ **25.** $6r^2 + rt - 35t^2$
27. $10x^2 + 7x - 12$ **29.** $9x^2 - 12x + 4$ **31.** $4x^2 - 9$
33. $9m^2 - 4$ **35.** $12(x + 2y)$ **37.** $2y(4x - 8x^3 + 5)$
39. $(2x - 3z)(x - y)$ **41.** 0, 2 **43.** 0, 3 **45.** $x^2 - 2x + 5$
47. $(x + 5)(x + 4)$ **49.** $(x + 6)(x - 3)$ **51.** 2, 4 **53.** −6, 8
55. 14 in. **57.** prime **59.** $(2a - 3)(a + 8)$ **61.** $4, -\frac{5}{2}$
63. $\frac{5}{3}, -\frac{1}{2}$ **65.** $(y + 9)(y - 9)$ **67.** prime **69.** 5, −5
71. −9, 9 **73.** 2 seconds **75.** prime **77.** $(2 - 7a)^2$
79. $x^2(x + 4)(x - 4)$ **81.** 1, −2 **83.** $-2, -\frac{1}{2}$
85. positive real zeros: 3 or 1
negative real zeros: 0
imaginary zeros: 2 or 0
87. positive real zeros: 3 or 1
negative real zeros: 1
imaginary zeros: 4 or 2
89. positive real zeros: 2 or 0
negative real zeros: 2 or 0
imaginary zeros: 6, 4, or 2

CHAPTER 2
Quadratic Functions and Equations

Chapter 2 Get Ready

1.



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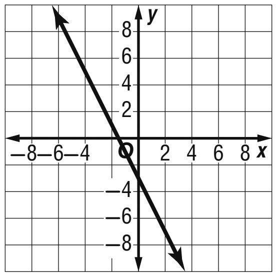

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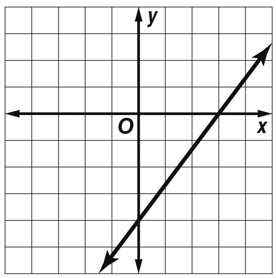
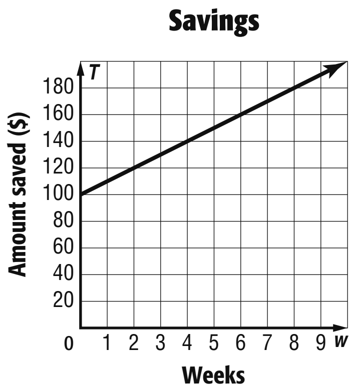


7.

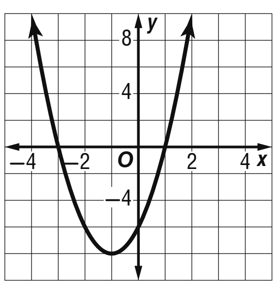


9. no **11.** yes; $(x + 10)^2$ **13.** yes; $(k - 8)^2$ **15.** no
17. 3 **19.** $2\frac{1}{2}$ **21.** 4 **23.** −2.5

Lesson 2-1

1.

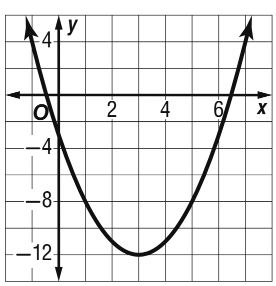
x	−3	−2	−1	0	1	2
y	0	−6	−8	−6	0	10



D = {all real numbers};
R = {y | y ≥ −8}

3.

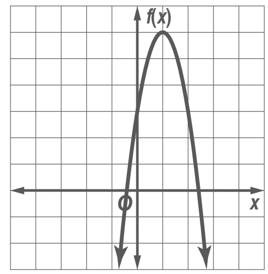
x	y
−1	4
0	−3
1	−8
2	−11
3	−12
4	−11
5	−8
6	−3
7	4



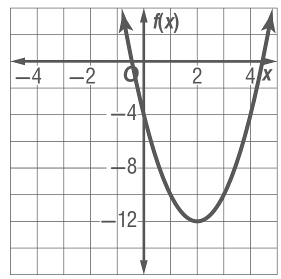
D = {all real numbers};
R = {y | y ≥ −12}

5. vertex (−1, 5), axis of symmetry $x = -1$, y—intercept 3
7. vertex (−2, −12), axis of symmetry $x = -2$, y—intercept −4
9. vertex (1, 2), axis of symmetry $x = 1$, y—intercept −1
11. vertex (2, 1), axis of symmetry $x = 1$, y—intercept 5
13a. maximum **13b.** 1
13c. D = {all real numbers}; R = {y | y ≤ 1}
15a. maximum **15b.** 6
15c. D = {all real numbers}; R = {y | y ≤ 6}

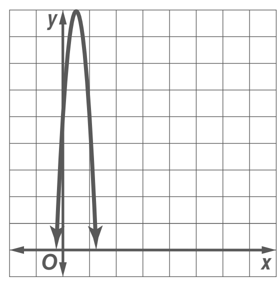
17.



19.



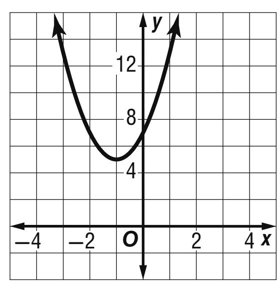
21a.



21b. 5 ft **21c.** 9ft

23.

x	−3	−2	−1	0	1
y	13	7	5	7	13

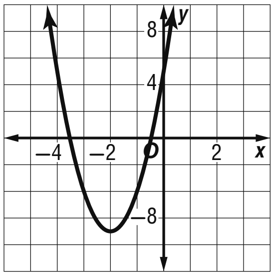


D = {all real numbers};
R = {y | y ≥ 5}

25.

x	0	−1	−2	−3	−4
y	5	−4	−7	−4	5

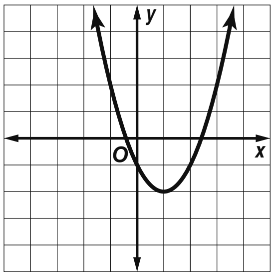
Selected Answers and Solutions



D = {all real numbers};
R = {y | $y \geq -7$}

27.

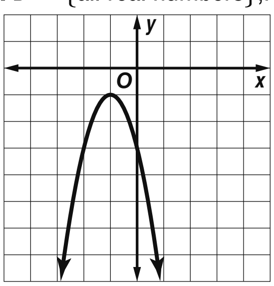
x	3	2	1	0	−1
y	2	−1	−2	−1	2



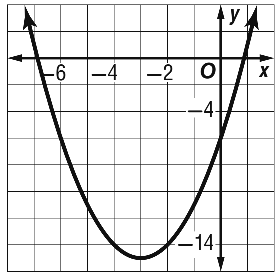
D = {all real numbers};
R = {y | $y \geq -2$}

29. vertex (0, 1), axis of symmetry $x = 0$, y-intercept 1
31. vertex (1, 1), axis of symmetry $x = 1$, y-intercept 4
33. vertex (0, 0), axis of symmetry x = 0, y-intercept 0
35. vertex (−3, −8), axis of symmetry $x = -3$, y-intercept 10
37. vertex (−3, 4), axis of symmetry $x = -3$, y-intercept −5
39. vertex (2, −14), axis of symmetry $x = 2$, y-intercept 14
41. vertex (1, −15), axis of symmetry $x = 1$, y-intercept −18
43a. maximum **43b.** 9
43c. D = {all real numbers}, R = {y | $y \leq 9$}
45a. minimum **45b.** −48
45c. D = {all real numbers}, R = {y | $y \geq -48$}
47a. maximum **47b.** 33
47c. D = {all real numbers}, R = {y | $y \leq 33$}
49a. maximum **49b.** 4
49c. D = {all real numbers}, R = {y | $y \leq 4$}
51a. maximum **51b.** 3
51c. D = {all real numbers},R = {y | $y \leq 3$}

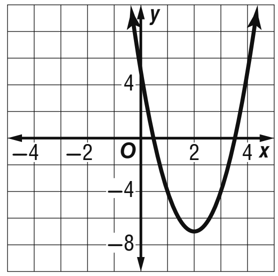
53.



55.

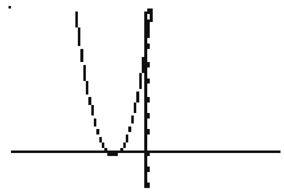


57.



59. (−1.25, −0.25)

59.



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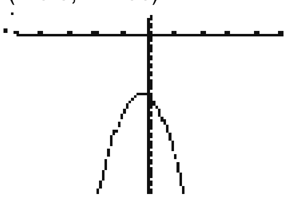
61. (−0.3, −7.55)

61.



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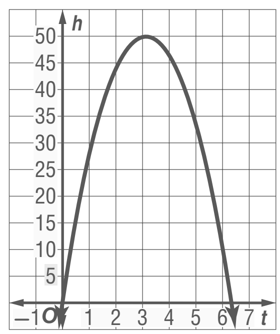
63a. (−0.3, −7.55)

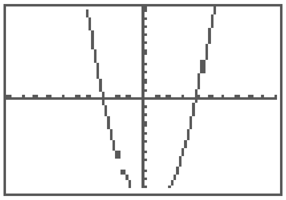


Where $h > 0$, the ball is above the ground. The height of the ball decreases as more time passes.
63b. 0 m **63c.** about 50.0 m **63d.** about 6.4 s
63e. D = {t | $0 \leq t \leq 6.4$}; R = {h | $0 \leq h \leq 50.0$}
65a. 74 ft **65b.** 2.625 seconds and 3 seconds
65c. $t = 0$, $t = 5.625$; before the ball is kicked, and when the ball hits the ground after the kick

67a.

Equation	Related Function	Zeros	*y*-Values
$x^2 - x = 12$	$y = x^2 - x - 12$	−3, 4	−3; 8, −6; 4; −6, 8
$x^2 + 8x = 9$	$y = x^2 + 8x - 9$	−9, 1	−9; 11, −9; 1; −9, 11
$x^2 = 14x - 24$	$y = x^2 - 14x + 24$	2, 12	2; 11, −9; 12; −9. 11
$x^2 + 16x = -28$	$y = x^2 + 16x + 28$	−14, −2	−14; 13, −11; −2; −11, 13

67b.



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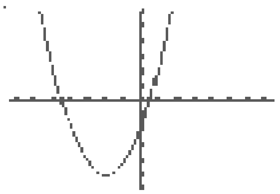
$y = x^2 - x - 12$



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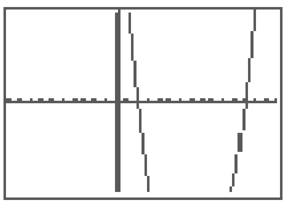
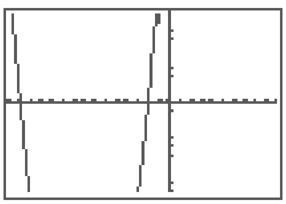
$y = x^2 + 8x - 9$



[−10, 15] scl: 1 by [−10, 10] scl: 1

$y = x^2 - 14x + 24$



[−15, 10] scl: 1 by [−10, 10] scl: 1

$y = x^2 + 16x + 28$

67c. See table.

67d. The function values have opposite signs just before and just after a zero.

69. Chase; the lines of symmetry are $x = 2$ and $x = 1.5$.

71. (−1, 9); Sample answer: I graphed the points given, and sketched the parabola that goes through them. I counted the spaces over and up from the vertex and did the same on the opposite side of the line $x = 2$.

73. Sample answer: The function $y = -x^2 - 4$ has a vertex at (0, −4), but it is a maximum.

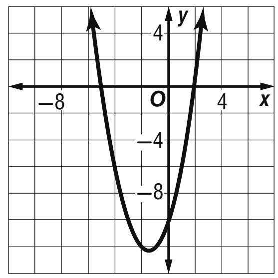
75. C **77.** D **79.** yes; $(2x + 1)^2$

81. no **83.** prime **85.** $b^2 - 4b - 21$

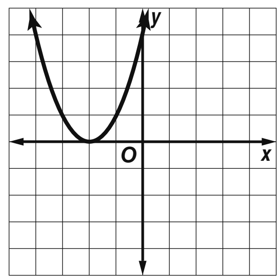
87. $2x^2 + 17x - 9$ **89.** 20 in. **91.** 6

Lesson 2-2

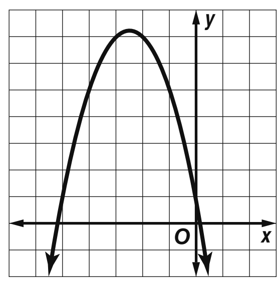
1. 2, −5



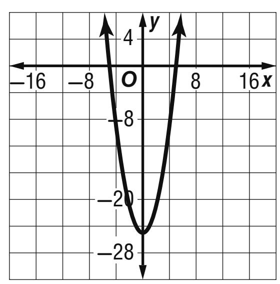
3. −2



5. −5.2, 0.2

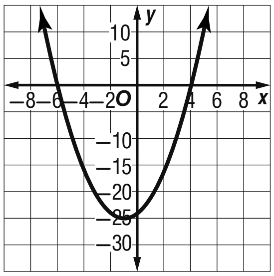


7. 5, −5

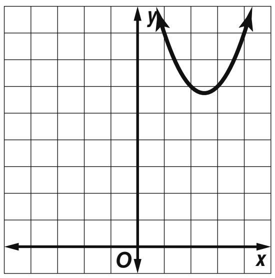


9. about 8.4 seconds

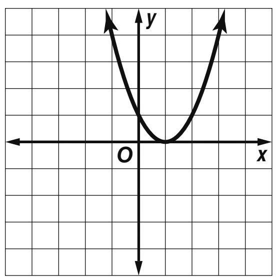
11. 4, −6



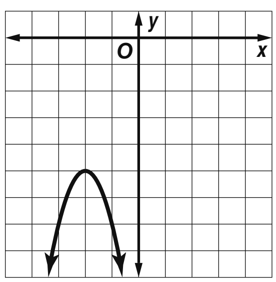
13. ∅



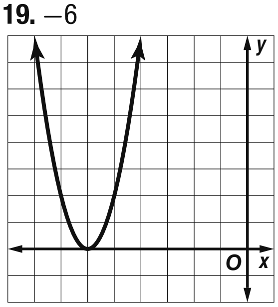
15. 1



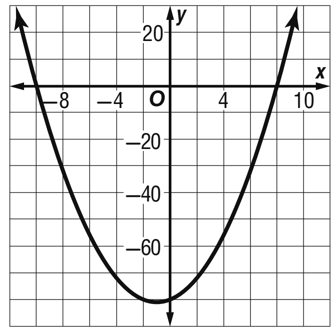
17. ∅



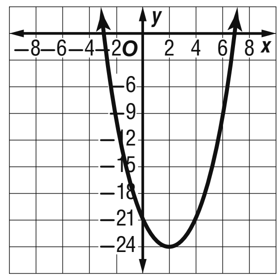
19. −6



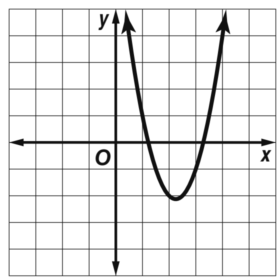
21. 8, −10



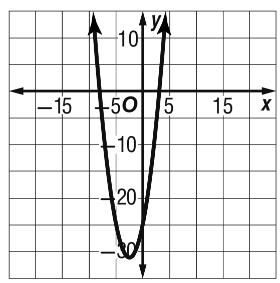
23. 6.9, −2.9



25. 3.3, 1.2



27. 3.1, −8.1



29. about 7.6 seconds **31.** 1; −2 **33.** 2; −4, −8 **35.** −3, 4

37a. about 2.2 seconds

37b. about 1.7 seconds and 0.2 seconds

37c. Yes; Stefanie's maximum height is about 24 ft.

39. −2, 1, 4

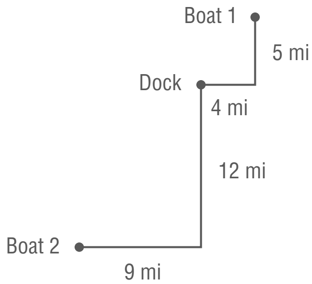
41. Iku; sample answer: The zeros of a quadratic function are the *x*-intercepts of the graph. Since the graph does not intersect the x-axis, there are no *x*-intercepts and no real zeros.

43. Sometimes; for (1, 3), the *y*-value is greater than 2, but for (1, −1), it is less than 2.

45. 1.5 and −1.5; Sample answer: Make a table of values for *x* from −2.0 to 2.0. Use increments of 0.1.

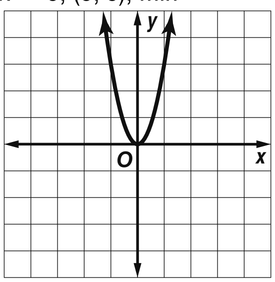
47. A

49.

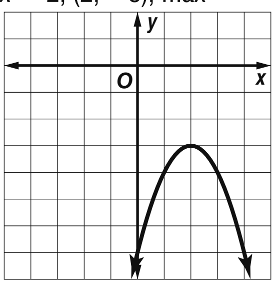


about 21.4 mi

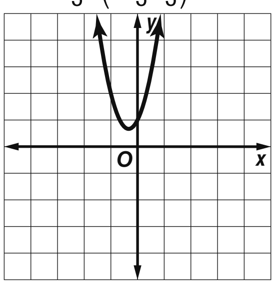
51. $x = 0$; $(0, 0)$; min



53. $x = 2$; $(2, -3)$; max



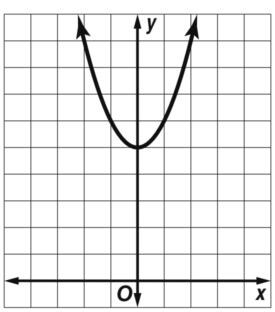
55. $x = -\frac{1}{3}$; $\left(-\frac{1}{3}, \frac{2}{3}\right)$; min



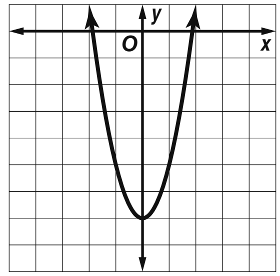
57. $-4, 4$ **59.** $-\frac{3}{2}, \frac{5}{2}$ **61.** $-3 \pm \sqrt{5}$ **63.** $7n^2 + 1$

65. $-3b^4 + 2b^3 - 9b^2 + 13$

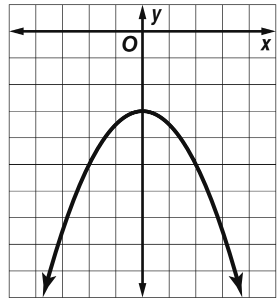
67.



69.



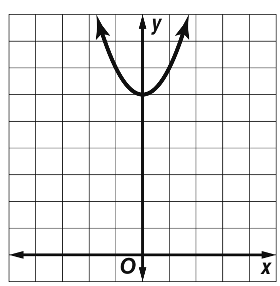
71.



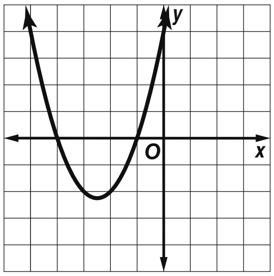
Lesson 2-3

1. translated down 11 units
3. reflected across the x—axis, translated up 8 units
5. reflected across the x—axis, translated left 3 units and stretched vertically **7.** C
9. reflected across the x—axis, translated down 7 units
11. compressed vertically, translated up 6 units
13. stretched vertically, translated up 3 units
15. translated left 1 unit and up 2.6 units and stretched vertically
17. stretched vertically, translated down 6.5 units **19.** A
21. F **23.** E **25.** $g(x)$, $h(x)$ **27.** $h(x)$, $g(x)$, $f(x)$
29a. $h = -16t^2 + 300$ and $h = -16t^2 + 700$
29b. about 2.3 seconds
31a. The graph of $g(x)$ is the graph of $f(x)$ translated 200 yards right, compressed vertically, reflected in the x—axis, and translated up 20 yards.
31b. $h(x) = 0.0005(x - 230)^2 + 20$
33. Translate the graph of $f(x)$ up 11 units and to the right 2 units. **35a.** 20 h **35b.** $h(t) = 40t$ **35c.** $T(t) = -t^2 + 50t + 200$; the fuel in the tank after t hours with refueling **35d.** Yes; after about 53 hours 43 minutes.
37. $y = x^2 - 1$ **39.** Sample answer: $f(x) = -\frac{1}{2}x^2$
41. $C = 55 + 30h$ **43.** J

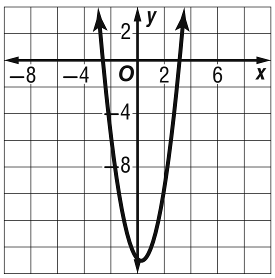
45. $\varnothing$



47. 4, −1



49. $-\frac{5}{2}$, 3



51. (0, 4); $x = 0$; 4 **53.** (−2, 6); $x = -2$; 2 **55.** $(4x - 3)^2$
57. $(5x - 6)^2$ **59.** $(6x - 7)^2$

Lesson 2-4

1. 81 **3.** $\frac{81}{4}$ **5.** −5.2, 1.2 **7.** −2.4, 0.1
9. 8 ft by 18 ft **11.** 144 **13.** $\frac{289}{4}$ **15.** $\frac{169}{4}$
17. $\frac{225}{4}$ **19.** −8, 2 **21.** −1, 9 **23.** −0.2, 11.2 **25.** ∅
27. −2.6, 1.1 **29.** −1.1, 6.1
31. on the 30th and 40th day after purchase
33. 5.3 **35.** −21 and −23 **37.** −1, 2 **39.** 0.2, 0.9
41. −8.2, 0.2 **43a.** Earth **43b.** Earth: 4.9 seconds, Mars: 8.0 seconds **43c.** Sample answer: Yes; the acceleration due to gravity is much greater on Earth than on Mars, so the time to reach the ground should be much less.
45. −30 and 30
47a & b.

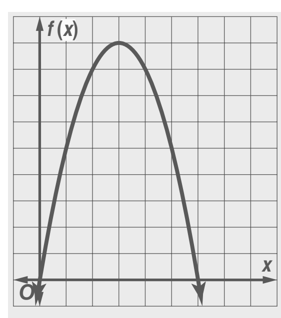
Trinomial	$b^2 - 4ac$	Number of Roots
$x^2 - 8x + 16$	0	1
$2x^2 - 11x + 3$	97	2
$3x^2 + 6x + 9$	−72	0
$x^2 - 2x + 7$	−24	0
$x^2 + 10x + 25$	0	1
$x^2 + 3x - 12$	57	2

47c. If $b^2 - 4ac$ is negative, the equation has no real solutions. If $b^2 - 4ac$ is zero, the equation has one solution. If $b^2 - 4ac$ is positive, the equation has 2 solutions.
47d. 0 because $b^2 - 4ac$ is negative. The equation has no real solutions because taking the square root of a negative number does not produce a real number.

49. None; sample answer: If you add $\left(\frac{b}{2}\right)^2$ to each side of the equation and each side of the inequality, you get $x^2 + bx + \left(\frac{b}{2}\right)^2 = c + \left(\frac{b}{2}\right)^2$ and $c + \left(\frac{b}{2}\right)^2 < 0$. Since the left side of the last equation is a perfect square, it cannot equal the negative number $c + \left(\frac{b}{2}\right)^2$. So, there are no real solutions.
51. Sample answer: $x^2 - 8x + 16 = 0$ **53.** B **55.** 32
57. translated down 12 units
59. stretched vertically, translated up 5 units
61. stretched vertically, translated up 6 units
63. $40 = -16t^2 + 250$; about 3.6 s **65.** compressed vertically
67. translated left 10 **69.** reflected across the x−axis, translated down $\frac{4}{3}$ **71.** ±10 **73.** ±7.8 **75.** not a real number

Lesson 2-5

1. −3, 5 **3.** 6.4, 1.6 **5.** 0.6, 2.5 **7.** −6, $\frac{1}{2}$ **9.** $\pm\frac{5}{3}$
11. −3; no real solutions **13.** 0; one real solution
15. The discriminant is −14.91, so the equation has no real solutions. Thus, Eva will not reach a height of 10 feet.
17. ∅ **19.** 2.2, −0.6 **21.** −3, $-\frac{6}{5}$ **23.** 0.5, −2
25. (0.5, −1.2) **27.** 3 **29.** −1.2, 5.2 **31a.** −2, 5
33. −6.2, −0.8 **35.** −0.07; no real solution
37. 12.64; two real solutions **39.** 0; one real solution
41a. in 1993 and 2023
41b. Sample answer: No; the parabola has a maximum at about 66, meaning only 66% of the population would ever have high−speed Internet. **43.** 0 **45.** 1 **47.** −1.4, 2.1
49a. $(20 - 2x)(25 - 7x) = 375$ **49b.** about 12.9, 0.7
49c. about 0.7 in. on the sides, 2.8 in. on the top, and 2.1 in. on the bottom
51. $k < \frac{9}{40}$ **53.** none **55.** two
57. Sample answer: If the discriminant is positive, the Quadratic Formula will result in two real solutions because you are adding and subtracting the square root of a positive number in the numerator of the expression. If the discriminant is zero, there will be one real solution because you are adding and subtracting the square root of zero. If the discriminant is negative, there will be no real solutions because you are adding and subtracting the square root of a negative number in the numerator of the expression.
59. D **61.** G **63.** $\frac{4}{3}, \frac{3}{2}$ **65.** $\frac{5}{2}$ **67.** Translate down 6 units.
69. −10, −2 **71.** −0.8, 1 **73.** −0.4, 3.9
75a.

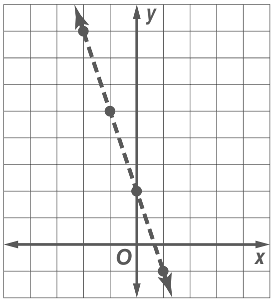


6 ft

75b. 9 ft
77. Arithmetic; the common difference is −50.
79. Geometric; the common ratio is 3.
81. Geometric; the common ratio is $-\frac{1}{2}$.

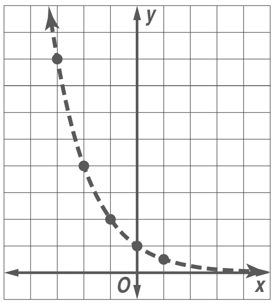
Lesson 2-6

1.



linear

3.

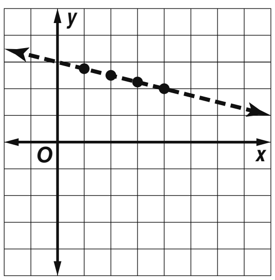


exponential

5. quadratic **7.** exponential **9.** exponential; $y = 3 \cdot 3^x$

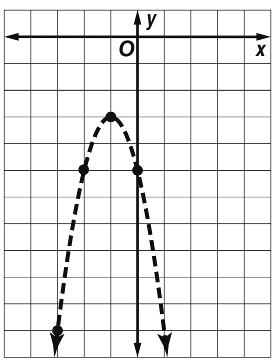
11. linear; $y = \frac{1}{2}x + \frac{5}{2}$ **13.** linear; $y = 0.5x + 3$

15.



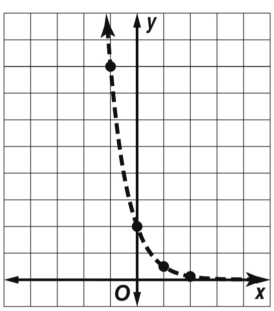
linear

17.



quadratic

19.

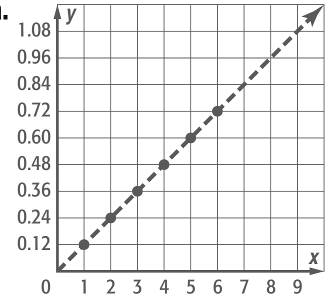


exponential

21. quadratic; $y = 2.5x^2$ **23.** exponential; $y = 0.2 \cdot 5^x$

25. linear; $y = -5x - 0.25$

27a.



27b. $y = 0.12x$ **27c.** $1.20

29a.

Time (hour)	0	1	2	3	4
Amount of Bacteria	12	36	108	324	972

29b. exponential **29c.** $b = 12 \cdot 3^t$ **29d.** 78,732

31a. Sample answer: $y = 2x^2 - 5$ **33.** $y = 4x + 1$

35. Sample answer: The data can be graphed to determine which function best models the data. You can also find the differences in ratios of the y—values. If the first differences are constant, the data can be modeled by a linear function. If the second differences are constant but the first differences are not, the data can be modeled by a quadratic function. If the ratios are constant, then the data can be modeled by an exponential function.

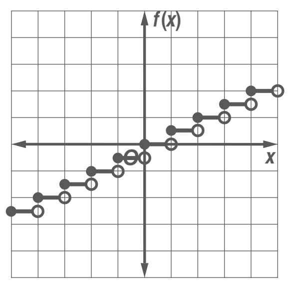
37. A **39.** B

41. −5, 0.5 **43.** ±5 **45.** 3.1, 10.9 **47.** exponential

49. linear **51.** 7 **53.** 0 **55.** 4

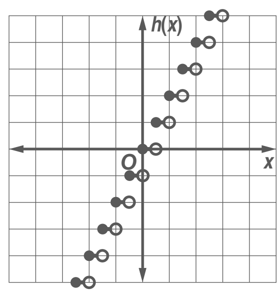
Lesson 2-7

1.



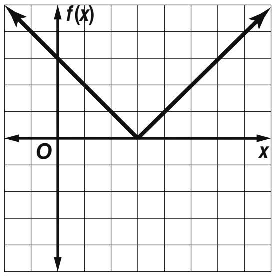
D = all real numbers; R = all integer multiples of 0.5

3.



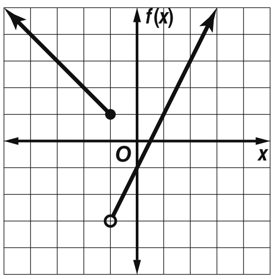
D = all real numbers; R = all integers

5.



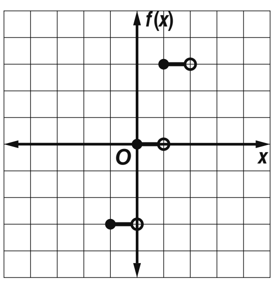
D = all real numbers,
R = $f(x) \geq 0$

7.



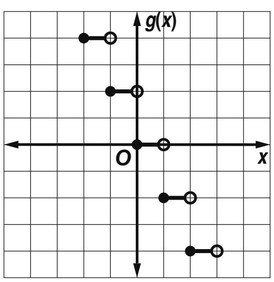
D = all real numbers,
R = $f(x) > -3$

9.



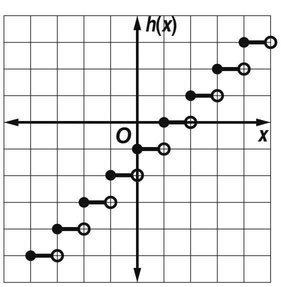
D = all real numbers,
R = all integer multiples of 3

11.



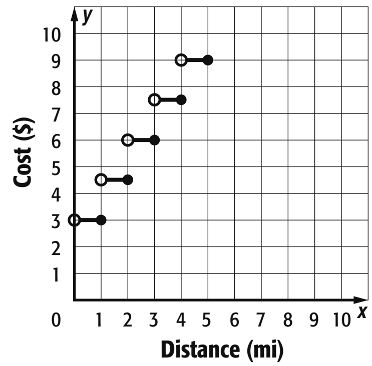
D = all real numbers,
R = all even integers

13.



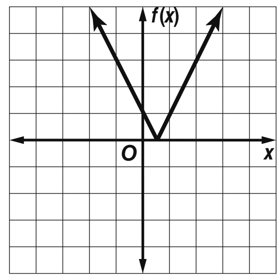
D = all real numbers,
R = all integers

15a.



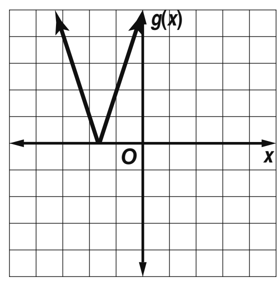
15b. $15

17.



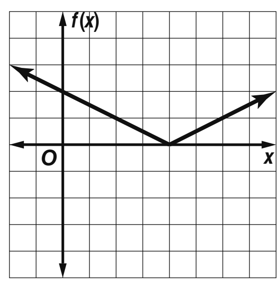
D = all real numbers,
R = $f(x) \geq 0$

19.



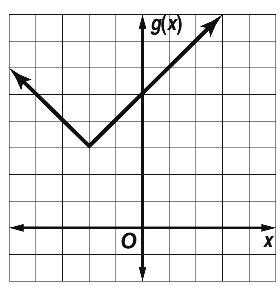
D = all real numbers,
R = $g(x) \geq 0$

21.



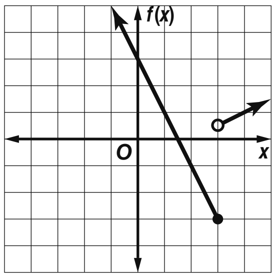
D = all real numbers,
R = $f(x) \geq 0$

23.



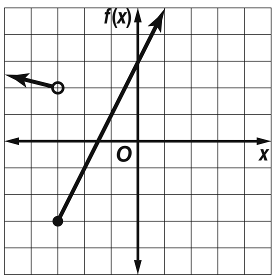
D = all real numbers,
R = $g(x) \geq 3$

25.



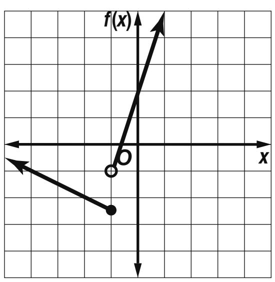
D = all real numbers,
R = $f(x) \geq -3$

27.



D = all real numbers,
R = all real numbers

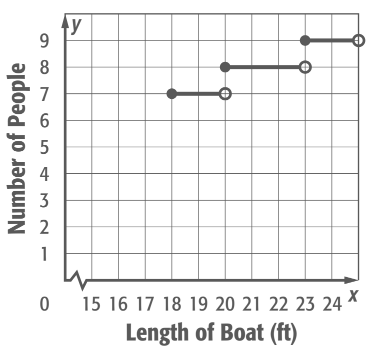
29.



D = all real numbers,
R = $f(x) \geq -2.5$

31. D = all real numbers; R = $y \geq 4$ **33.** D = all real numbers; R = all integers **35.** D = all real numbers; R = $y > -2$

37.



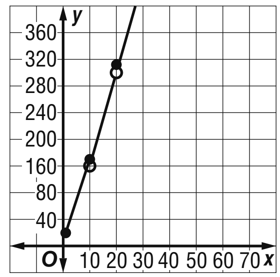
39. D **41.** B

43a.

Number of Orders	Total Price
$1 \leq x \leq 10$	$10 + (10 + 4 + 2)x = 10 + 16x$
$11 \leq x < 20$	$(10 + 16x)(0.95) = 9.5 + 15.20x$
$x \geq 20$	$(10 + 16x)(0.90) = 9 + 14.40x$

43b. $y = \begin{cases} 10 + 16x \text{ if } 1 \leq x \leq 10 \; 9.50 + 15.20x \text{ if } 10 < x \leq 20 \\ 9 + 14.40x \text{ if } x > 20 \end{cases}$

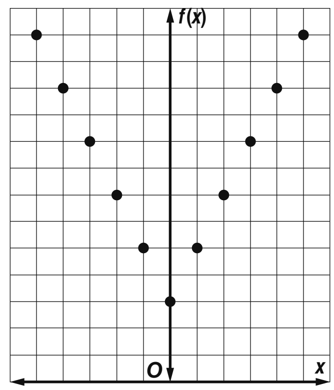
43c.



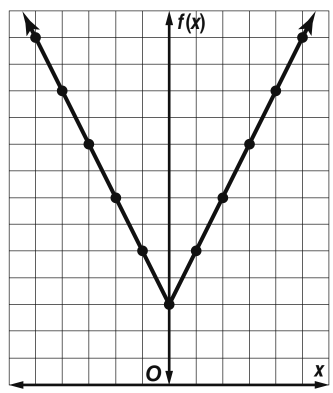
45a.

x	−5	−4	−3	−2	−1	0	1	2	3	4	5
$f(x)$	13	11	9	7	5	3	5	7	9	11	13

45b.

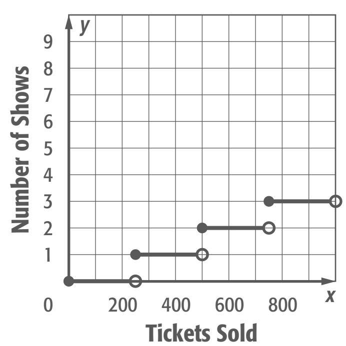


45c.

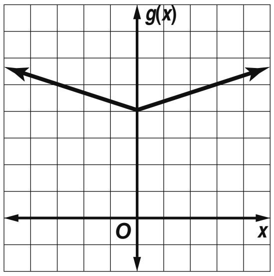


45d. The graph is shifted 1.5 units to the right and 3 units up.

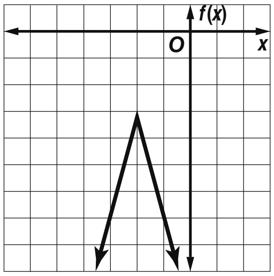
47.



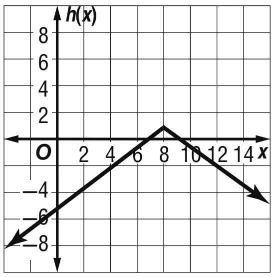
49.



51.



53.



55. No; the pieces of the graph overlap vertically, so the graph fails the vertical line test.

57. $f(x) = \begin{cases} \frac{1}{2}x - 3 \text{ if } x > 6 \\ -\frac{1}{2}x + 3 \text{ if } x \leq 6 \end{cases}$

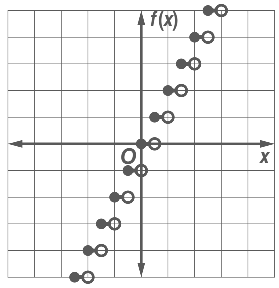
59. Sample answer: The domain of absolute value, step, quadratic, and exponential functions is all real numbers, while some piecewise functions may not be defined for all real numbers. The range of absolute value, step, quadratic, and exponential functions is limited to a portion of the real numbers, but the range of a piecewise–defined function can be all real numbers. The graphs of absolute value and quadratic functions have either one maximum and no minima or one minimum and no maxima, and both have symmetry with respect to a vertical line through the point where this maximum or minimum occurs. The graphs of absolute value, quadratic, and exponential functions have no breaks or jumps, while graphs of step functions always do and graphs of piecewise–defined functions sometimes do.

61. C **63.** B **65.** linear **67.** exponential

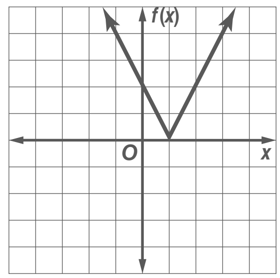
69. D = {all real numbers}; R = $\{y \mid y \geq 0\}$
71. D = {all real numbers}; R = $\{y \mid y \leq 1\}$
73. ∅ **75.** −2.9, 2.4 **77.** −0.5, 0.6 **79.** 3.46 **81.** 12
83. 0.24

Chapter 2 Study Guide and Review

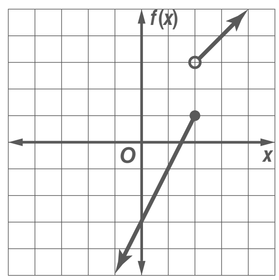
1. true **3.** false; parabola **5.** false; two **7.** true **9.** true
11a. minimum **11b.** 0
11c. D = {all real numbers}; R = $\{y \mid y \geq 0\}$
13a. minimum **13b.** −4
13c. D = {all real numbers}; R = $\{y \mid y \geq -4\}$
15a. maximum **15b.** 16
15c. D = $\{t \mid 0 \leq t \leq 2\}$; R = $\{h \mid 0 \leq h \leq 16\}$ **17.** 3
19. −4.6, 0.6 **21.** −0.8, 3 **23.** shifted up 8 units
25. vertical stretch **27.** vertical compression
29. $y = 2x^2 - 3$ **31.** 1, −7 **33.** 10, −2 **35.** −0.7, 7.7
37. −8, 6 **39.** −0.7, 0.5 **41.** −5, 1.5 **43.** −2.5, 1.5
45. quadratic; $y = 3x^2$ **47.** quadratic; $y = -x^2$
49. D = all real numbers; R = all integers



51. D = all real numbers; R = $f(x) \geq 0$



53. D = all real numbers; R = $f(x) \leq -1$ or $f(x) > 3$



CHAPTER 3
Quadratic Functions and Relations

Chapter 3 Get Ready

1. 6 **3.** 4 **5.** 3 **7.** $f(x) = 9x$ **9.** $(x + 8)(x + 5)$
11. $(2x - 1)(x + 4)$ **13.** prime **15.** $(x + 8)$ feet

Lesson 3-1

1. $x^2 + 3x - 40 = 0$ **3.** $6x^2 - 11x - 10 = 0$
5. $(6x - 1)(3x + 4)$ **7.** $(x - 7)(x + 3)$ **9.** $(4x - 3)(4x - 1)$
11. $0, \frac{3}{2}$ **13.** 0, 9 **15.** 6 **17.** $x^2 - 14x + 49 = 0$
19. $5x^2 - 31x + 6 = 0$ **21.** $17c(3c^2 - 2)$ **23.** $3(x + 2)(x - 2)$
25. $(12c - d) \cdot (4g + 3f)$ **27.** $(x - 11) \cdot (x + 2)$
29. $(5x - 1) \cdot (3x + 2)$ **31.** $3(2x - 1) \cdot (3x + 4)$
33. $(3x + 5)(3x - 5)$ **35.** $-\frac{2}{5}, 6$ **37.** 0, 9 **39.** 8, −3
41. 2, −2 **43.** $5, \frac{3}{4}$ **45** 24 and 26 or −24 and −26

47. $x = 20$; 24 in. by 18 in. **49.** $-\frac{1}{2}, \frac{5}{6}$ **51.** $-\frac{3}{2}$

53. 6, −6 **55.** 16 to 32 screens **57.** $25x^2 - 100x + 51 = 0$

59. $-3, \frac{1}{2}$ **61.** $1, -\frac{5}{4}$ **63.** $-\frac{3}{2}, \frac{5}{6}$

65. $x^2 - 62$; $(x + 6)(x - 6)$

67. 20 in. by 15 in. **69.** 13 cm **71.** $2(3 - 4y)(3a + 8b)$

73. $6b^2(a^2 - 2a - 3b)$ **75.** $2(2x - 3y)(8a + 3b)$

77. $(x + y)(x - y)(5a + 2b)$ **79.** Sample answer: Morgan; Gwen did not have like terms in the parentheses in the third line.

81. $5x^2(2x - 3y)(4x^2 + 6xy + 9y^2)$

83. Sample answer:

$(x - p)(x - q) = 0$ (Original equation)

$x^2 - px - qx + pq = 0$ (Multiply)

$x^2 - (p + q)x + pq = 0$ (Simplify)

$x = -\frac{b}{2a}$ (Formula for axis of symmetry)

$x = -\frac{-(p + q)}{2(1)}$

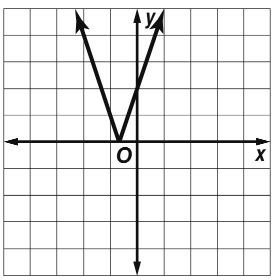
$a = 1$ and $b = -(p + q)$

$x = \frac{p + q}{2}$ (Simplify)

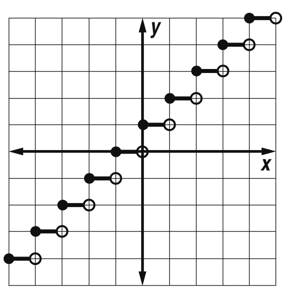
x is midway between p and q. (Definition of midpoint

85. Sample answer: Always; in order to factor using perfect square trinomials, the coefficient of the linear term, bx, must be a multiple of 2, or even. **87.** 192 square units **89.** H

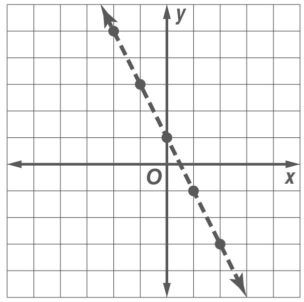
91.



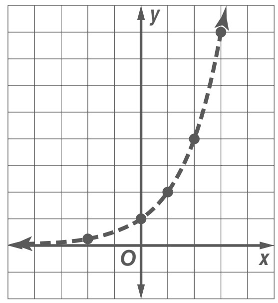
93.



95. Liner



97. exponential



99. about \$4514.89 **101.** $5\sqrt{3}$ **103.** 18

Lesson 3-2

1. $9i$ **3.** 12 **5.** 1 **7.** $\pm 2i\sqrt{2}$ **9.** 3, −2 **11.** $-3 + 2i$

13. $70 - 60i$ **15.** $\frac{1}{2} - \frac{1}{2}i$ **17.** $12 + 6j$ amps **19.** $13i$ **21.** $9i$

23. $-144i$ **25.** i **27.** −7 **29.** 9 **31.** $30 + 16i$ **33.** $1 + i$

35. $\frac{1}{3} - \frac{5}{3}i$ **37.** $\pm 4i$ **39.** $\pm i\sqrt{5}$ **41.** $\pm 4i$ **43.** 2, −3

45. $\frac{4}{3}$, 4 **47.** 25, −2 **49.** $4i$ **51.** 8

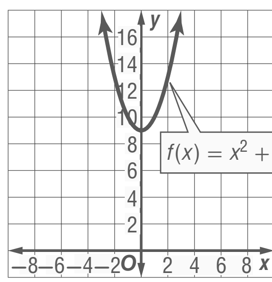
53. $-21 + 15i$ **55.** $\frac{15}{13} + \frac{16}{13}i$, 10 **57.** $11 + 23i$

59. $\frac{1}{7} - \frac{4\sqrt{3}}{7}i$ **61.** $21 + 27j$ volts

63. $(3 + i)x^2 + (-2 + i)x - 8i + 7)$

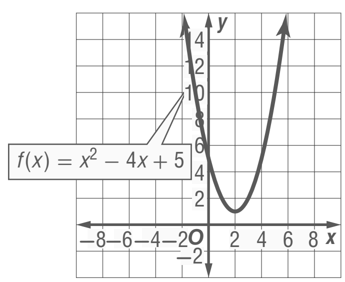
65a. Sample answer: $x^2 + 9 = 0$

65b.



65c. Sample answer: $x^2 - 4x + 5 = 0$

65d.



65e. Sample answer: A quadratic equation will have only complex solutions when the graph of the related function has no x-intercepts. **67.** $-11 - 2i$ **69.** Sample answer: $(4 + 2i)(4 - 2i)$ **71a.** $\triangle CBE \cong \triangle ADE$

71b. $\angle AED \cong \angle CEB$ (Vertical angles) $\overline{DE} \cong \overline{BE}$ (Both have length x.) $\angle ADE \cong \angle CBE$ (Given) Consecutive angles and the included side are all congruent, so the triangles are congruent by the ASA Property.

71c. $\overline{EC} \cong \overline{EA}$ by CPCTC (corresponding parts of congruent triangles are congruent). $EA = 7$, so $EC = 7$.

73. J 75. $-5, \frac{3}{2}$ 77. $-\frac{1}{2}, \frac{4}{3}$ **79.** $5 - 2j$ ohms

81. $24 - 34i$ **83.** $20x^2 - 31x + 12 = 0$

85. $28x^2 + 31x + 6 = 0$ **87.** yes **89.** no **91.** yes

Lesson 3-3

1. $-6 \pm 3\sqrt{5}$ **3.** $\frac{5 \pm \sqrt{57}}{8}$ **5.** $(1.5, -0.2)$ **7.** $\frac{2 \pm 2\sqrt{7}}{3}$

9. about 0.78 second **11a.** -36 **11b.** 2 complex roots

13a. -76 **13b.** 2 complex roots

15. $\frac{-3 \pm \sqrt{15}}{2}$ **17.** $\frac{-7 \pm \sqrt{129}}{8}$ **19.** $\frac{-3 \pm i\sqrt{71}}{8}$

21a. 33 **21b.** 2 irrational **21c.** $\frac{-3 \pm \sqrt{33}}{4}$ **23a.** 49

23b. 2 rational **23c.** $\frac{1}{6}, -1$ **25a.** -87 **25b.** 2 complex

25c. $\frac{3 \pm i\sqrt{87}}{6}$ **27a.** 36 **27b.** 2 rational **27c.** $1, -\frac{1}{5}$

29a. 1 **29b.** 2 rational **29c.** $-1, -\frac{4}{3}$ **31a.** -16

31b. 2 complex **31c.** $-1 \pm 2i$ **33a.** 0

33b. about 2.3 seconds **35a.** 64 **35b.** 2 rational

35c. $0, -\frac{8}{5}$ **37a.** 160 **37b.** 2 irrational **37c.** $\frac{-1 \pm \sqrt{10}}{6}$

39a. 13.48 **39b.** 2 irrational **39c.** $\frac{-0.7 \pm \sqrt{3.37}}{0.6}$

41a. 25.1, 7.3 **41b.** 11.7

41c. 2018; Sample answer: No; the death rate from cancer will never be 0 unless a cure is found. If and when a cure will be found cannot be predicted.

43. Jonathan; you must first write the equation in the form $ax^2 + bx + c = 0$ to determine the values of a, b, and c. Therefore, the value of c is -7, not 7.

45a. Sample answer: Always; when a and c are opposite signs, then ac will always be negative and $-4ac$ will always be positive. Since b^2 will also always be positive, then $b^2 - 4ac$ represents the addition of two positive values, which will never be negative. Hence, the discriminant can never be negative and the solutions can never be imaginary.

45b. Sample answer: Sometimes; the roots will only be irrational if $b^2 - 4ac$ is not a perfect square.

47. -0.75 **49.** B **51.** 112.5 in^2 **53.** -1 **55.** -120

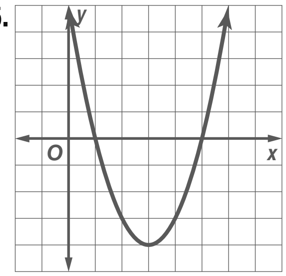
57a. -0.00288

57b. Sample answer: This means that the cables do not touch the floor of the bridge, since the graph does not intersect the x-axis and the roots are imaginary. **59.** $y = 0.25x^2$

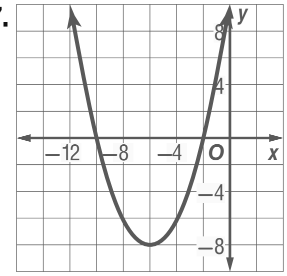
Lesson 3-4

1. $y = (x + 3)^2 - 7$ **3.** $y = 4(x + 3)^2 - 12$

5.



7.

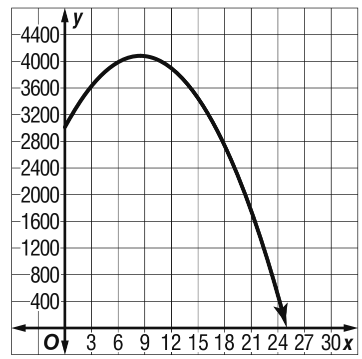


9. $y = (x - 3)^2 - 6$ **11.** $y = (x + 1)^2 + 6$

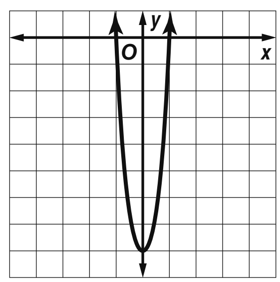
13. $y = (x + 4)^2$ **15.** $y = 3\left(x + \frac{5}{3}\right)^2 - \frac{25}{3}$

17. $y = -4(x + 3)^2 + 21$ **19.** $y = -(x + 2)^2 + 3$

21. $y = -15(x - 8.5)^2 + 4083.75$



23.



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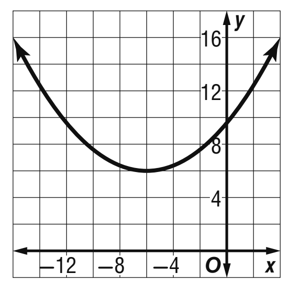
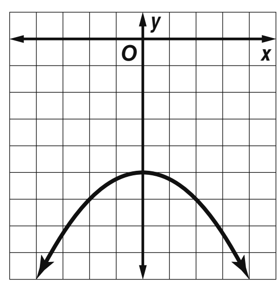


27.



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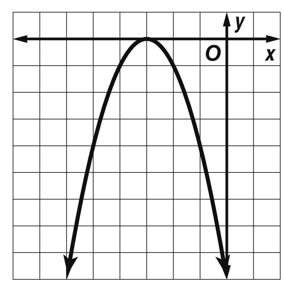
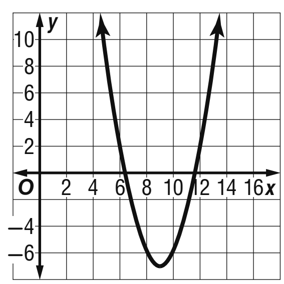
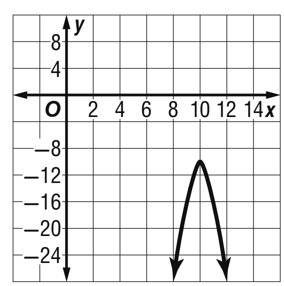


31.



33.



35. $y = 9(x - 6)^2 + 1$ **37.** $y = -\frac{2}{3}(x - 3)^2$

39. $y = \frac{1}{3}x^2 + 5$

41. $y = 3\left(x - \frac{2}{3}\right)^2 - \frac{10}{3}$; $\left(\frac{2}{3}, -\frac{10}{3}\right)$, $x = \frac{2}{3}$, opens up

43. $y = -(x + 2.35)^2 + 8.3225$; $(-2.35, 8.3225)$, $x = -2.35$, opens down

45. $y = \left(x - \frac{1}{3}\right)^2 - 3$; $\left(\frac{1}{3}, -3\right)$, $x = \frac{1}{3}$, opens up

47a. $S(t) = 0.001(t + 4.861)^2 - 0.024$ **47b.** 4.58 seconds

47c. Yes; if we substitute $\frac{1}{8}$ for $S(t)$ and solve for t we get 7.35 seconds. This is how long Valerie will be on the ramp. Since it will take her 4.58 seconds to accelerate to 68 mph, she will be on the ramp long enough to accelerate to match the average expressway speed.

49. The equation of a parabola can be written in the form $y = ax^2 + bx + c$ with $a \neq 0$. For each of the three points, substitute the value of the x-coordinate for x in the equation and substitute the value of the y-coordinate for y in the equation. This will produce three equations in three variables a, b, and c. Solve the system of equations to find the values of a, b, and c. These values determine the quadratic equation.

51. Sample answer: The variable a represents different values for these functions, so making $a = 0$ will have a different effect on each function. For $f(x)$, when $a = 0$, the graph will be a horizontal line, $f(x) = k$. For $g(x)$, when $a = 0$, the graph will be linear, but not necessarily horizontal, $g(x) = bx + c$.

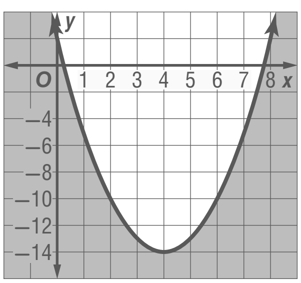
53. B **55.** D

57. $\frac{-15 \pm \sqrt{561}}{8}$ **59.** $\frac{3 \pm \sqrt{39}}{5}$ **61.** 7 **63.** $-\frac{2}{5} - \frac{11}{5}i$

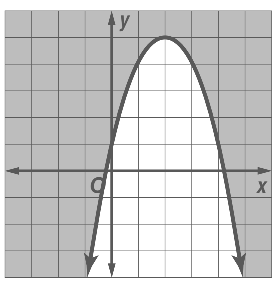
65. yes **67.** yes

Lesson 3-5

1.



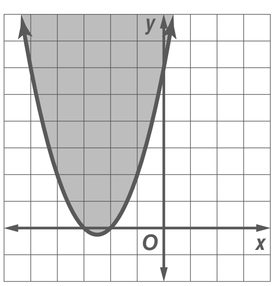
3.



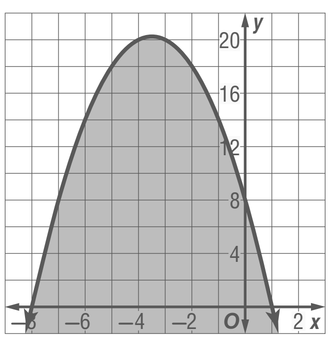
5. $\{x \mid -5 < x < -3\}$ **7.** $\{x \mid 0.29 \leq x \leq 1.71\}$

9. $\{x \mid -8 < x < 2\}$ **11.** $\{x \mid 3.17 \leq x \leq 8.83\}$

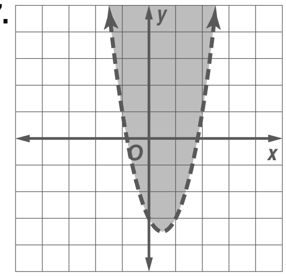
13.



15.



17.



19. $\{x \mid 1.1 < x < 7.9\}$ **21.** {all real numbers}

23. $\{x \mid x < -1.42 \text{ or } x > 8.42\}$ **25.** $\varnothing$ **27.** $\{x \mid x < -0.73 \text{ or } x > 2.73\}$ **29.** $\{x \mid -0.5 \leq x \leq 2.5\}$

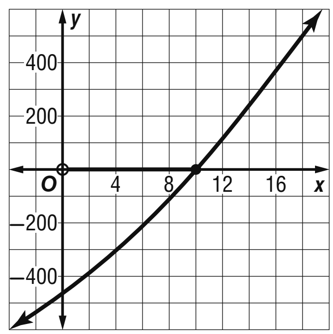
31. about 1.26 ft to 4.73 ft **33.** $\{x \mid 4 < x < 5\}$

35. $\{x \mid -1 < x < 2\}$ **37.** $\{x \mid x \leq -2.32 \text{ or } x \geq 4.32\}$

39. $\{x \mid x \leq -1.58 \text{ or } x \geq 1.58\}$ **41.** {all real numbers}

43. $\{x \mid -2.84 < x < 0.84\}$

45a.

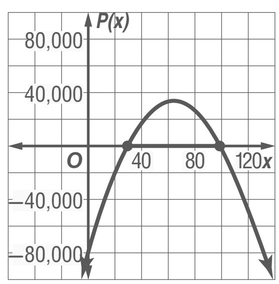


45b. greater than 0 ft but no more than 10.04 ft

47. $y \leq -x^2 + 2x + 6$ **49.** $\{x \mid x < -1.06 \text{ or } x > 7.06\}$

51. $\{x \mid x \leq -2.75 \text{ or } x \geq 1\}$ **53.** $\{x \mid x < 0.61 \text{ or } x > 2.72\}$

55a.

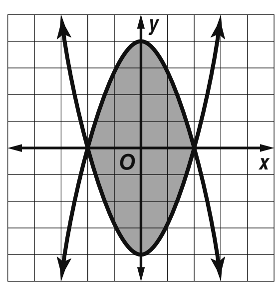


55b. from 30,000 to 98,000 digital audio players **55c.** The graph is shifted down 25,000 units. The manufacturer must sell from 47,000 to 81,000 digital audio players.

57a. Sample answer: $x^2 + 2x + 1 \geq 0$ **57b.** Sample answer: $x^2 - 4x + 6 < 0$

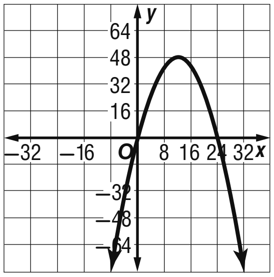
59. No; the graphs of the inequalities intersect the x-axis at the same points.

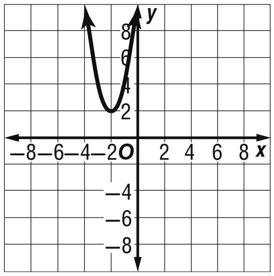
61.



63. 15 **65.** G **67.** $y = 2(x - 3)^2 - 4$ **69.** $y = 0.25(x + 4)^2 + 3$ **71.** -152; 2 complex roots **73.** $22.087 \le x \le 67.91$ mph

75. $y = -\frac{1}{3}(x - 12)^2 + 48$; (12, 48); $x = 12$; down **77.** $y = 2(x + 2)^2 + 2$; $(-2, 2)$; $x = -2$; up





79. $8w + 24x$ **81.** $d - c$ **83.** $18y + 12z - 4$

Chapter 3 Study Guide and Review

1. true **3.** true **5.** $x^2 - 11x + 30 = 0$ **7.** $x^2 + 2x - 8 = 0$

9. $6x^2 - 31x + 5 = 0$ **11.** $\{-3, 4\}$

13. $\left\{\frac{1}{3}, 5\right\}$ **15.** $2i\sqrt{2}$ **17.** $2 + 5i$ **19.** $7 - j$ ohms

21. $\pm 2i$ **23.** $\pm i\sqrt{2}$

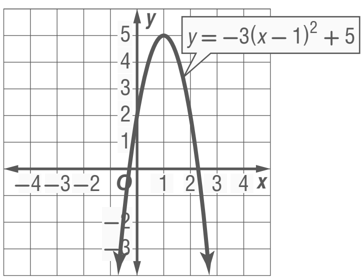
25a. 0 **25b.** 1 real rational root **25c.** $\{5\}$ **27a.** 153

27b. 2 irrational real roots **27c.** $\left\{\frac{-3 \pm 3\sqrt{17}}{4}\right\}$

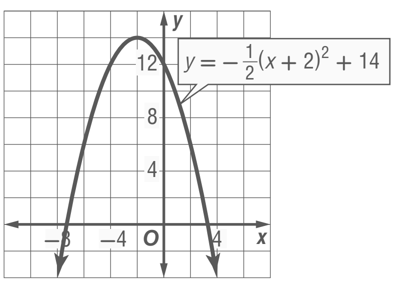
29a. -32 **29b.** 2 complex roots **29c.** $\{1 \pm 2i\sqrt{2}\}$

31a. -47 **31b.** 2 complex roots **31c.** $\left\{\frac{-5 \pm i\sqrt{47}}{4}\right\}$

33. $y = -3(x - 1)^2 + 5$; (1, 5); $x = 1$; opens down

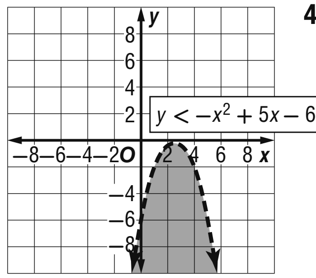


35. $y = -\frac{1}{2}(x + 2)^2 + 14$; $(-2, 14)$; $x = -2$; opens down

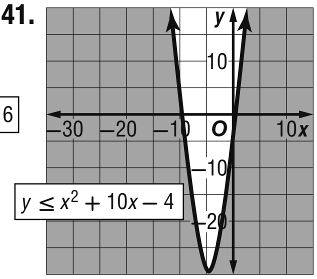


37. $f(x) = -x^2 + 10x$; 5 and 5

39.



41.



43. $\{x \mid x < -6 \text{ or } x > -2\}$

45. $\left\{x \mid x < -4 \text{ or } x > \frac{5}{2}\right\}$ **47.** $\left\{x \mid x < \frac{2}{3} \text{ or } x > 2\right\}$

CHAPTER 4

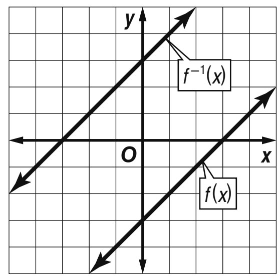
Exponential and Logarithmic Functions and Relations

Chapter 4 Get Ready

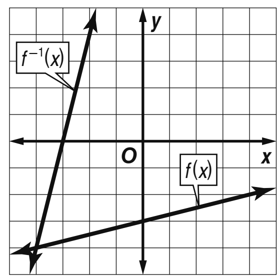
1. a^{12}

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

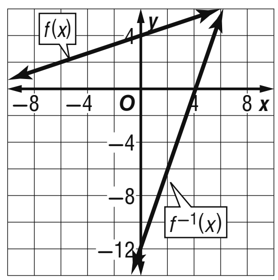
7. $f^{-1}(x) = x + 3$



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



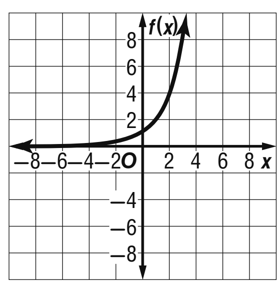
11. $f^{-1}(x) = 3x - 12$



13. no

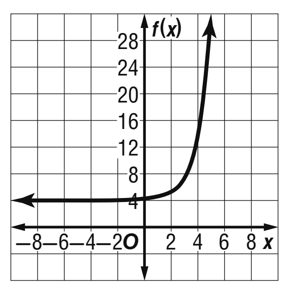
Lesson 4-1

1.



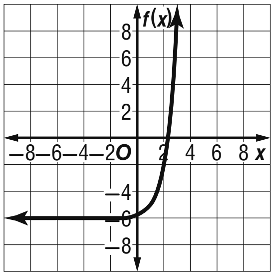
D = {all real numbers}; R = $\{f(x) \mid f(x) > 0\}$

3.



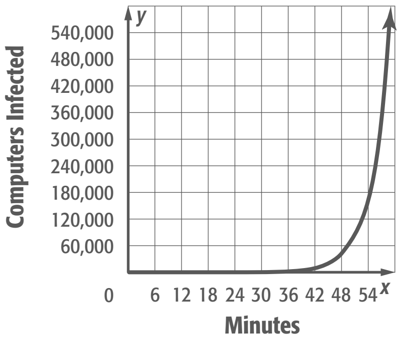
D = {all real numbers}; R = $\{f(x) \mid f(x) > 4\}$

5.

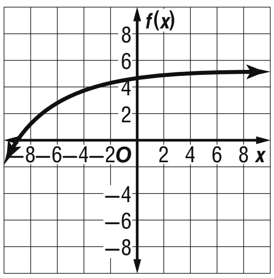


D = {all real numbers};
R = $\{f(x) \mid f(x) > -6\}$

7.

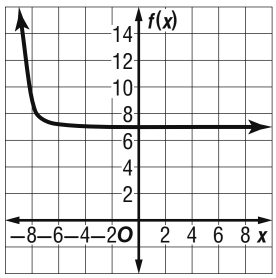


9.



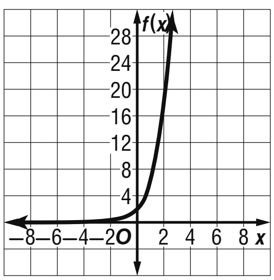
D = {all real numbers};
R = $\{f(x) \mid f(x) < 5\}$

11.



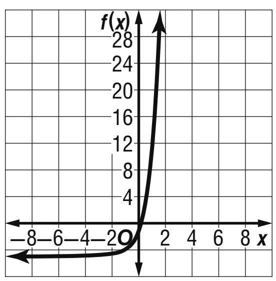
D = {all real numbers};
R = $\{f(x) \mid f(x) > 7$

13.



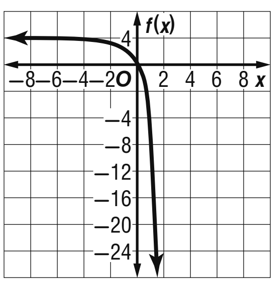
D = {all real numbers};
R = $\{f(x) \mid f(x) > 0\}$

15.



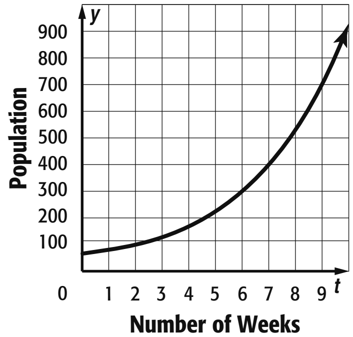
D = {all real numbers};
R = $\{f(x) \mid f(x) > -5\}$

17.

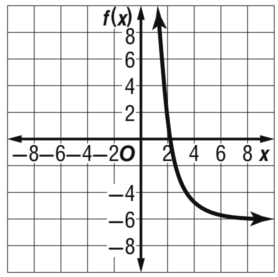


D = {all real numbers};
R = $\{f(x) \mid f(x) < 4\}$

19.

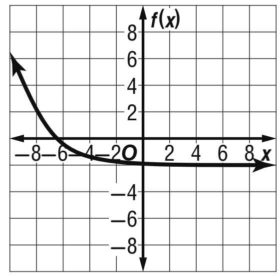


21.



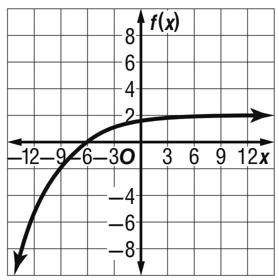
D = {all real numbers};
R = $\{f(x) \mid f(x) > -6\}$

23.



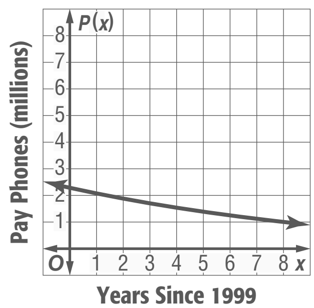
D = {all real numbers};
R = $\{f(x) \mid f(x) > -2\}$

25.



D = {all real numbers};
R = $\{f(x) \mid f(x) < 2\}$

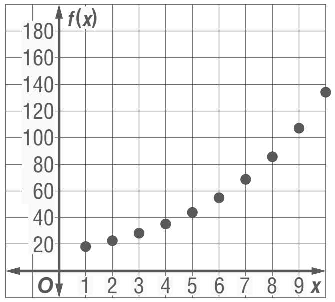
27a. decay; 0.9



27b. The $P(x)$-intercept represents the number of pay phones in 1999. The asymptote is the x-axis. The number of pay phones can approach 0, but will never equal 0. This makes sense as there will probably always be a need for some pay phones.

29a. $f(x) = 18(1.25)^{x-1}$

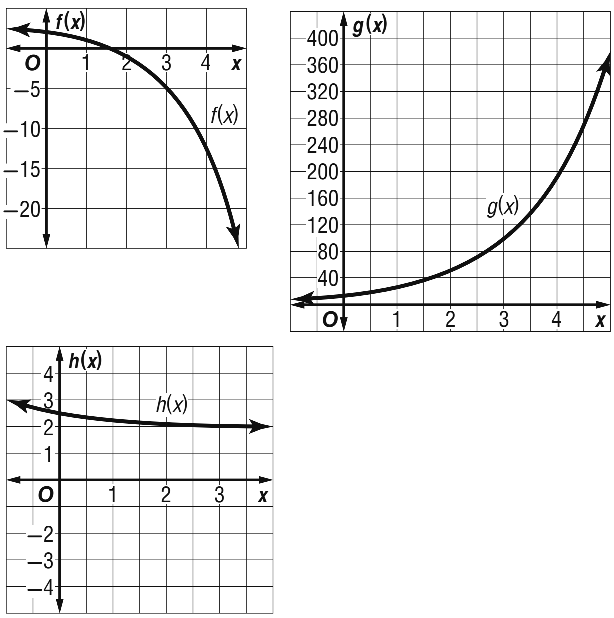
29b. growth; 1.25



29c. 134

31. $g(x) = 4(2)^{x-3}$ or $g(x) = \frac{1}{2}(2^x)$

33a.



33b. Sample answer: $f(x)$; the graph of $f(x)$ is a reflection along the x-axis and the output values in the table are negative.

33c. $g(x)$ and $h(x)$

33d. Sample answer: $f(x)$ and $g(x)$ are growth and $h(x)$ is decay; The absolute value of the output is increasing for the growth functions and decreasing for the decay function.

35. Vince; the graphs of the function would be the same.

37. Sample answer: 10

39. 12 **41.** H **43.** A **45.** D **47.** about 204.88 ft **49.** $27x^6$

51. $\frac{16}{15}c^4d^2f$

Lesson 4-2

1. 12 **3.** –10 **5.** **5a.** $c = 2^{\frac{t}{15}}$ **5b.** 16 cells

7. $\{x \mid x \geq 4.5\}$ **9.** 0 **11.** –7

13. $\frac{5}{3}$ **15a.** $y = 10{,}000(1.045)^x$ **15b.** about $26,336.52

17. $y = 256(0.75)^x$ **19.** $y = 144(3.5)^x$ **21.** $16,755.63

23. $97,362.61

25. $\left\{b \,\middle|\, b > \frac{1}{5}\right\}$ **27.** $\{d \mid d \geq -1\}$ **29.** $\left\{w \,\middle|\, w < \frac{2}{5}\right\}$

31a. $a = 1.16w^{1.31}$ **31b.** about 3268 yd^2

33. $\frac{1}{7}$ **35.** $-\frac{4}{13}$ **37.** 1 **39a.** $d = 1.30h^{\frac{3}{2}}$

39b. about 1001 cm **41a.** 2, 4, 8, 16

41b.

Cuts	Pieces
1	2
2	4
3	8
4	16

41c. $y = 2^x$ **41d.** $y = 0.003(2)^x$

41e. about 3,221,225.47 in.

43. Sample answer: Beth; Liz added the exponents instead of multiplying them when taking the power of a power.

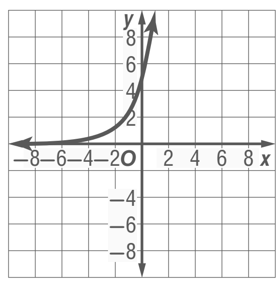
45. Reducing the term will be more beneficial. The multiplier is 1.3756 for the 4-year and 1.3828 for the 6.5%.

47. Sample answer: $4^x \leq 4^2$

49. Sample answer: Divide the final amount by the initial amount. If n is the number of time intervals that pass, take the nth root of the answer.

51. F **53.** E

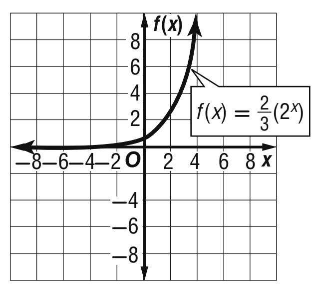
55.



57. $4m^2n^2(m + 4n - 2mn^2)$

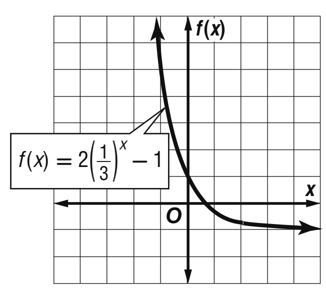
59. $(x + 3y)(x - 4)$ **61.** $y = (x - 3)^2 + 2$

63.



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

65.



D = {all real numbers}, R = $\{f(x) \mid f(x) > -1\}$

67. $x^2 - 1$; $x^2 - 6x + 11$ **69.** $-15x - 5$; $-15x + 25$

71. $|x + 4|$; $|x| + 4$

Lesson 4-3

1. $2\sqrt{6}$ **3.** 10 **5.** $3\sqrt{6}$ **7.** $2x^2y^3\sqrt{15y}$ **9.** $3b^2|c|\sqrt{11ab}$

11. $\frac{9 - 3\sqrt{5}}{4}$ **13.** $\frac{2 + 2\sqrt{10}}{-9}$ **15.** $\frac{24 + 4\sqrt{7}}{29}$ **17.** $2\sqrt{13}$

19. $6\sqrt{2}$ **21.** $9\sqrt{3}$ **23.** $5\sqrt{2}$ **25.** $12\sqrt{14}$ **27.** $15|t|$

29. $2|a|b\sqrt{7b}$ **31.** $21m\sqrt{7mp}$ **33.** $2a^3b\sqrt{5b}$

35a. $v = 8\sqrt{h}$ **35b.** about 92.6 ft/s **37.** $\frac{4\sqrt{2}}{t^2}$

39. $\frac{2c\sqrt{51ac}}{9|a|}$ **41.** $\frac{3\sqrt{15}}{20}$ **43.** $\frac{35 - 7\sqrt{3}}{22}$ **45.** $\frac{6\sqrt{3} + 9\sqrt{2}}{2}$

47. $\frac{5\sqrt{6} - 5\sqrt{3}}{3}$ **49a.** $I = \frac{\sqrt{PR}}{R}$ **49b.** about 3.9 amps

51.

Distance	3	6	9	12	15
Height	6	24	54	96	150

53a. 3 **53b.** $2\sqrt[3]{5}$ **53c.** $5\sqrt[3]{6}$

55. Sample answer: $1 + \sqrt{2}$ and $1 - \sqrt{2}$; $(1 + \sqrt{2}) \bullet (1 - \sqrt{2}) = 1 - 2 = -1$

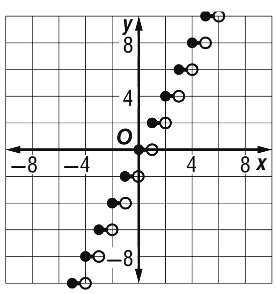
57. No radicals can appear in the denominator of a fraction. So, rationalize the denominator to get rid of the radicand in the denominator. Then check if any of the radicands have perfect square factors other than 1. If so, simplify. **59.** H

61. 507.50 **63.** $2h^2 - 16$

65. $\frac{-1 \pm \sqrt{5}}{4}$ **67.** $\frac{5 \pm \sqrt{145}}{6}$ **69.** $(3x + 7)(x - 6)$

71. prime **73.** exponential

75. D = {all real numbers};
R = {all integer multiples of 2}



77. $\frac{5}{3}$ **79.** $2^3 \cdot 3$ **81.** $2^2 \cdot 3^2 \cdot 5$ **83.** $2^2 \cdot 3 \cdot 5$

Lesson 4-4

1. $9\sqrt{5}$ **3.** $-5\sqrt{7}$ **5.** $8\sqrt{5}$ **7.** $5\sqrt{2} + 2\sqrt{3}$

9. $72\sqrt{3}$ **11.** $\sqrt{21} + 3\sqrt{6}$ **13.** $14.5 + 3\sqrt{15}$

15. $11\sqrt{6}$ **17.** $3\sqrt{2}$ **19.** $5\sqrt{10}$ **21.** $60 + 32\sqrt{10}$

23. $3\sqrt{5} + 6 - \sqrt{30} - 2\sqrt{6}$ **25.** $5\sqrt{5} + 5\sqrt{2}$ **27.** $\frac{-4\sqrt{5}}{5}$

29. $\sqrt{2}$ **31.** $14 - 6\sqrt{5}$ **33a.** 0 ft/s

33b. Sample answer: In the formula, we are taking the square root of the difference, not the square root of each term.

35. $\sqrt{170}$; about 13 amps **37.** Irrational; irrational; no rational number could be added to or multiplied by an irrational number so that the result is rational. **39.** Sample answer: You can use the FOIL method. You multiply the first terms within the parentheses. Then you multiply the outer terms within the parentheses. Then you would multiply the inner terms within the parentheses. And, then you would multiply the last terms within each parentheses. Combine any like terms and simplify any radicals.
For example,
$(\sqrt{2} + \sqrt{3})(\sqrt{5} + \sqrt{7}) =$
$\sqrt{10} + \sqrt{14} + \sqrt{15} + \sqrt{21}$.

41. C **43.** C **45.** $2\sqrt{6}$ **47.** $5ab^2\sqrt{2ab}$ **49.** $3cd^2f^2\sqrt{7cf}$ **51.** $(80 + 2x)(100 + 2x)$; $4x^2 + 360x + 8000$ **53.** -45.3 **55.** -80 **57.** 1.8

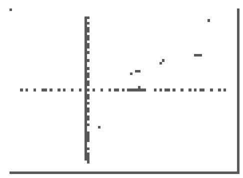
Lesson 4-5

1. $r = \frac{\sqrt{\pi x}}{2\pi}$ **3.** 2 **5.** 10 **7.** 6 **9.** 100 **11.** 39

13. 17 **15.** 3 **17.** 6 **19.** 7 **21a.** 52 ft **21b.** Increases; sample answer: If the length is longer, the quotient and square root will be a greater number than before.

23. no solution **25.** 235.2 **27.** 3

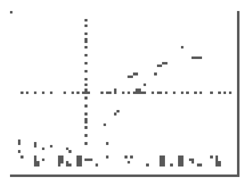
29a.



[−10, 20] scl: 1 by [−10, 10] scl: 1

29b. See students' work.

29c.



[−10, 20] scl: 1 by [−10, 10] scl: 1

29d. About 10.83; they are the same.

31. Jada; Fina had the wrong sign for $2b$ in the fourth step.

33. Sample answer: In the first equation, you have to isolate the radical first by subtracting 1 from each side. Then square each side to find the value of x. In the second equation, the radical is already isolated, so square each side to start. Then subtract 1 from each side to solve for x. **35.** Sometimes; the equation is true for $x \geq 2$, but false for $x < 2$. **37.** Sample answer: Add or subtract any expressions that are not in the radicand from each side. Multiply or divide any values that are not in the radicand to each side. Square each side of the equation. Solve for the variable as you did previously. See students' examples. **39.** C **41.** D **43.** $4\sqrt{3}$ **45.** $42\sqrt{2}$

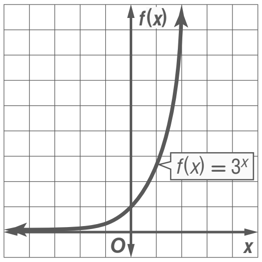
47. $\frac{c^2\sqrt{5cd}}{2d^3}$ **49.** about 1.3 s and 4.7 s **51.** $(2p+3)(3p-2)$ **53.** prime **55.** $(2a+3)(a-6)$

57. 1,000,000 **59.** $64v^2$ **61.** $1000y^6$

Chapter 4 Study Guide and Review

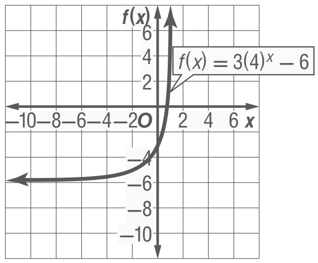
1. exponential growth **3.** decay factor

5.



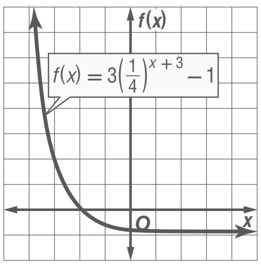
D = {all real numbers}
R = {f(x) | f(x) > 0}

7.



D = {all real numbers}
R = {f(x) | f(x) > −6}

9.



D = {all real numbers}
R = {f(x) | f(x) > −1}

11a. $f(x) = 120{,}000(0.97)^x$ **11b.** about 88,491

13. −7 **15.** $\frac{9}{41}$ **17.** $x \leq -\frac{2}{5}$ **19.** $6|x|y^3\sqrt{y}$

21. $3\sqrt{2}$ **23.** $21 - 8\sqrt{5}$ **25.** $\frac{5\sqrt{2}}{|a|}$ **27.** $-6 - 3\sqrt{5}$

29. about 2.15 hours or 2 hours and 9 minutes

31. $4\sqrt{3}x$ **33.** $5\sqrt{2} + 3\sqrt{6}$

35. $24\sqrt{10} + 8\sqrt{2} + 6\sqrt{15} + 2\sqrt{3}$ **37.** no solution

39. 32 **41.** 12 **43.** 1600 ft

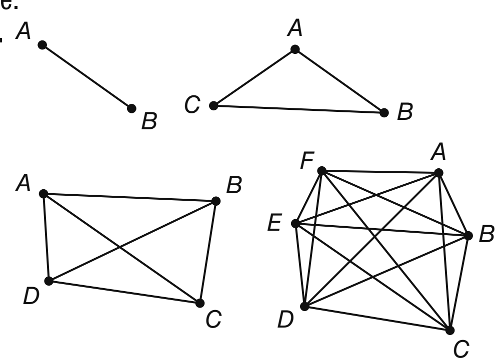
CHAPTER 5
Reasoning and Proof

Chapter 5 Get Ready

1. 31 **3.** 14 **5.** 12 **7.** $x^2 + 3$ **9.** -7
11. 10.8 **13.** $4x = 52$; \$13 **15.** $\angle CXD$, $\angle DXE$ **17.** 38

Lesson 5-1

1. The left side and front side have a common edge line *r*. Planes *P* and *Q* only intersect along line *r*. Postulate 2.7, which states that if two planes intersect, then their intersection is a line.
3. The front bottom edge of the figure is line *n* which contains points *D*, *C*, and *E*. Postulate 2.3, which states a line contains at least two points.
5. Points *D* and *E*, which are on line *n*, lie in plane *Q*. Postulate 2.5, which states that if two points lie in a plane, then the entire line containing those points lies in that plane.
7. Sometimes; if three planes intersect, then their intersection may be a line or a point.
9. Always; Postulate 2.1 states that through any two points, there is exactly one line.
11. Postulate 2.3; a line contains at least two points.
13. Postulate 2.4; a plane contains at least three noncollinear points.
15. Since *C* is the midpoint of $\overline{AE}$ and $\overline{DB}$, $CA = CE = \frac{1}{2}AE$ and $CD = CB = \frac{1}{2}DB$ by the definition of midpoint. We are given $\overline{AE} \cong \overline{DB}$, so $AE = DB$ by the definition of congruent segments. By the multiplication property, $\frac{1}{2}DB = \frac{1}{2}AE$. So, by substitution, $AC = CB$.
17. The edges of the sides of the bottom layer of the cake intersect. Plane *P* and *Q* of this cake intersect only once in line m. Postulate 2.7; if two planes intersect, then their intersection is a line.
19. The top edge of the bottom layer of the cake is a straight line *n*. Points *C*, *D*, and *K* lie along this edge, so they lie along line *n*. Postulate 2.3; a line contains at least two points.
21. The bottom right part of the cake is a side. The side contains points *K*, *E*, *F*, and *G* and forms a plane. Postulate 2.2; through any three noncollinear points, there is exactly one plane.
23. The top edges of the bottom layer form intersecting lines. Lines *h* and *g* of this cake intersect only once at point *J*. Postulate 2.6; if two lines intersect, then their intersection is exactly one point.
25. Never; Postulate 2.1 states through any two points, there is exactly one line.
27. Always; Postulate 2.5 states if two points lie in a plane, then the entire line containing those points lies in that plane.
29. Sometimes; the points must be noncollinear.
31. Given: *L* is the midpoint of $\overline{JK}$.
$\overline{JK}$ intersects $\overline{MK}$ at *K*. $\overline{MK} \cong \overline{JL}$
Prove: $\overline{LK} \cong \overline{MK}$
Proof: We are given that *L* is the midpoint of $\overline{JK}$ and $\overline{MK} \cong \overline{JL}$. By the Midpoint Theorem, $\overline{JL} \cong \overline{LK}$. By *LK* the Transitive Property of Equality, $\overline{LK} \cong \overline{MK}$.
33a. Southside Blvd.; sample answer: Since there is a line between any two points, and Southside Blvd. is the line between point *A* and point *B*, it is the shortest route between the two.
33b. I-295 **35.** Postulate 2.3; a line contains at least two points.
37. Postulate 2.1; through any two points, there is exactly one line.
39. Postulate 2.4; a plane contains at least three noncollinear points.
41. Postulate 2.7; if two planes intersect, then their intersection is a line.
43a.



43b.

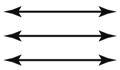
Number of Computers	Number of Connections
2	1
3	3
4	6
5	10
6	15

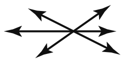
43c. $n - 1$ **43d.** $\frac{n(n-1)}{2}$

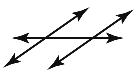
45. Lisa is correct. Sample answer: The proof should begin with the given, which is that $\overline{AB}$ is congruent to $\overline{BD}$ and A, B, and D are collinear. Therefore, Lisa began the proof correctly.

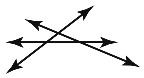
47a. Plane Q is perpendicular to plane P. **47b.** Line a is perpendicular to plane P.

49. Sometimes; three coplanar lines may have 0, 1, 2, or 3 points of intersection, as shown in the figures below.


0 points


1 point


2 points


3 points

Postulates 2.1 – 2.5 were used. Through points A and B there is exactly one line, n, satisfying Postulate 2.1. For the noncollinear points A, B, and C there is exactly one plane, P, satisfying Postulate 2.2. Line n contains points A and B, satisfying Postulate 2.3. Plane P contains the noncollinear points A, B, and C, satisfying Postulate 2.4. Line n, containing points A and B, lies entirely in plane P, satisfying Postulate 2.5.

51. A **53.** H **55.** $-6.1, 2.1$ **57.** 4 **59.** $d(5d - 7)(5d + 7)$

61. $(13^a2b^3 - 11c^4)(13a^2b^3 + 11c^4)$

63. $(3a + 5)(3a - 5)(2a + 3)$ **65.** $-\frac{5}{2}, 2$

67. $13 - 4i$ **71.** 5.5 **73.** $2, -2$

Lesson 5-2

1. Trans. Prop. **3.** Sym. Prop.

5.

Statements	Reasons
a. ___?___ $\frac{y+2}{3} = 3$	**a.** Given
b. $3\left(\frac{y+2}{3}\right) = 3(3)$	**b.** ___?___ Mult. Prop.
c. ___?___ $y + 2 = 9$	**c.** ___?___ Subs.
d. $y = 7$	**d.** Subtraction Property

7. Given: $\overline{AB} \cong \overline{CD}$

Prove: $x = 7$

Proof:

Statements (Reasons)

1. $\overline{AB} \cong \overline{CD}$ (Given)
2. $AB = CD$ (Def. of congruent segments)
3. $4x - 6 = 22$ (Subs. Prop.)
4. $4x = 28$ (Add. Prop.)
5. $x = 7$ (Div. Prop.)

9. Subt. Prop. **11.** Add. Prop. **13.** Dist. Prop. **15.** Trans. Prop.

17.

Statements	Reasons
a. $\frac{8-3x}{4} = 32$	**a.** Given
b. $4\left(\frac{8-3x}{4}\right) = 4(32)$	**b.** ___?___ Mult. Prop.
c. $8 - 3x = 128$	**c.** ___?___ Subs.
d. ___?___ $-3x = 120$	**d.** Subtraction Property
e. $x = -40$	**e.** ___?___ Div. Prop.

19. Given: $-\frac{1}{3}n = 12$

Prove: $n = -36$

Proof:

Statements (Reasons)

1. $-\frac{1}{3}n = 12$ (Given)
2. $-3\left(-\frac{1}{3}n\right) = -3(12)$ (Mult. Prop.)
3. $n = -36$ (Subs.)

21a. Given: $d = vt + \frac{1}{2}at^2$

Prove: $a = \frac{2d - 2vt}{t^2}$

Proof:

Statements (Reasons)

1. $d = vt + \frac{1}{2}at^2$ (Given)
2. $d - vt = vt - vt + \frac{1}{2}at^2$ (Subt. Prop.)
3. $d - vt = \frac{1}{2}at^2$ (Subs.)
4. $2(d - vt) = 2\left(\frac{1}{2}at^2\right)$ (Mult. Prop.)
5. $2(d - vt) = at^2$ (Subs.)
6. $2d - 2vt = at^2$ (Dist. Prop.)
7. $\frac{2d - 2vt}{t^2} = \frac{at^2}{t^2}$ (Div. Prop.)
8. $\frac{2d - 2vt}{t^2} = a$
9. $a = \frac{2d - 2vt}{t^2}$ (Sym. Prop.)

22b. 3 ft/s^2 ; Subs.

23. Given: $\overline{DF} \cong \overline{EG}$

Prove: $x = 10$

Proof:

Statements (Reasons)

1. $\overline{DF} \cong \overline{EG}$ (Given)
2. $DF = EG$ (Def. of $\cong$ segs)
3. $11 = 2x - 9$ (Subs.)
4. $20 = 2x$ (Add. Prop.)
5. $10 = x$ (Div. Prop.)
6. $x = 10$ (Symm. Prop.)

25. **Given:** $\angle Y \cong \angle Z$

Prove: $x = 100$

Proof:

Statements (Reasons)

1. $\angle Y \cong \angle Z$ (Given)
2. $m\angle Y = m\angle Z$ (Def. of $\cong$ $\angle$s)
3. $x + 10 = 2x - 90$ (Subs.)
4. $10 = x - 90$ (Subt. Prop.)
5. $100 = x$ (Add. Prop.)
6. $x = 100$ (Sym. Prop.)

27a. **Given:** $V = \frac{P}{I}$

Prove: $\frac{V}{2} = \frac{P}{2I}$

Proof:

Statements (Reasons)

1. $V = \frac{P}{I}$ (Given)
2. $\frac{1}{2} \cdot V = \frac{1}{2} \cdot \frac{P}{I}$ (Mult. Prop.)
3. $\frac{V}{2} = \frac{P}{2I}$ (Mult. Prop.)

27b. **Given:** $V = \frac{P}{I}$

Prove: $2V = \frac{2P}{I}$

Proof:

Statements (Reasons)

1. $V = \frac{P}{I}$ (Given)
2. $2 \cdot V = 2 \cdot \frac{P}{I}$ (Mult. Prop.)
3. $2V = \frac{2P}{I}$ (Mult. Prop.)

29. **Given:** $c^2 = a^2 + b^2$

Prove: $a = \sqrt{c^2 - b^2}$

Proof:

Statements (Reasons)

1. $a^2 + b^2 = c^2$ (Given)
2. $a^2 + b^2 - b^2 = c^2 - b^2$ (Subt. Prop.)
3. $a^2 = c^2 - b^2$ (Subs.)
4. $a = \pm\sqrt{c^2 - b^2}$ (Sq. Root Prop.)
5. $a = \sqrt{c^2 - b^2}$ (Length cannot be negative.)

31. The relation "is taller than" is not an equivalence relation because it fails the Reflexive and Symmetric properties. You cannot be taller than yourself (reflexive); if you are taller than your friend, then it does not imply that your friend is taller than you (symmetric).

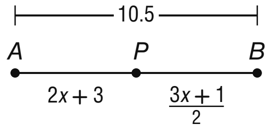
33. The relation "$\neq$" is not an equivalence relation because it fails the Reflexive Property, since $a \neq a$ is not true.

35. The relation "$\approx$" is not an equivalence relation because it fails the Reflexive Property, since $a \approx a$ is not true.

37. **Given:** $AP = 2x + 3$

$PB = \frac{3x + 1}{2}$

$AB = 10.5$



Prove: $\frac{AP}{AB} = \frac{2}{3}$

Proof:

Statements (Reasons)

1. $AP = 2x + 3$, $PB = \frac{3x + 1}{2}$, $AB = 10.5$ (Given)
2. $AP + PB = AB$ (Def. of a segment)
3. $2x + 3 + \frac{3x + 1}{2} = 10.5$ (Subt.)
4. $2 \cdot \left(2x + 3 + \frac{3x + 1}{2}\right) = 2 \cdot 10.5$ (Mult. Prop.)
5. $2 \cdot \left(2x + 3 + \frac{3x + 1}{2}\right) = 21$ (Subs. Prop.)
6. $2 \cdot 2x + 2 \cdot 3 + 2 \cdot \frac{3x + 1}{2} = 21$ (Dist. Prop.)
7. $4x + 6 + 3x + 1 = 21$ (Mult. Prop.)
8. $7x + 7 = 21$ (Add. Prop.)
9. $7x + 7 - 7 = 21 - 7$ (Subt. Prop.)
10. $7x = 14$ (Subs.)
11. $x = 2$ (Div. Prop.)
12. $AP = 2(2) + 3$ (Subs.)
13. $AP = 4 + 3$ (Mult. Prop.)
14. $AP = 7$ (Add. Prop.)
15. $\frac{AP}{AB} = \frac{7}{10.5}$ (Subs.)
16. $\frac{AP}{AB} = 0.\overline{6}$ (Div. Prop.)
17. $\frac{2}{3} = 0.\overline{6}$ (Div. Prop.)
18. $\frac{AP}{AB} = \frac{2}{3}$ (Trans. Prop.)

39. Sometimes; sample answer: If $a^2 = 1$ and $a = 1$, then $b = \sqrt{1}$ or 1. The statement is also true if $a = -1$ and $b = 1$. If $b = 1$, then $\sqrt{b} = 1$ since the square root of a number is nonnegative. Therefore, the statement is sometimes true.

41. An informal or paragraph proof is a kind of proof in which the steps are written out in complete sentences, in paragraph form. This type of proof is identical in content, but different in form, from a two-column proof, in which the statements (conclusions) are listed in one column, and the reasons for why each statement is true are listed in another column. See students' work.

43. 83 **45.** E

47. Never; the sum of two supplementary angles is 180°, so two obtuse angles can never be supplementary.

49. $(-1, -9)$; $x = -1$; -5 **51.** $(4, -7)$; $x = 4$; 9

53. $(-3, -3)$ **55.** $(-4, 0)$ **57.** $(0, 1)$ **59.** 2.8 cm **61.** $1\frac{1}{4}$ in.

Lesson 5-3

1.

Statements	Reasons
a. $\overline{LK} \cong \overline{NM}$, $\overline{KJ} \cong \overline{MJ}$	**a.** ___?___ Given
b. ___?___ $LK = NM$, $KJ = MJ$	**b.** Def. of congruent segments
c. $LK + KJ = NM + MJ$	**c.** ___?___ Add. Prop.
d. ___?___ $LJ = LK + KJ$; $NJ = NM + MJ$	**d.** Segment Addition Postulate
e. $LJ = NJ$	**e.** ___?___ Subs.
f. $\overline{LJ} \cong \overline{NJ}$	**f.** ___?___ Def. $\cong$ segs.

3. Given: $\overline{AR} \cong \overline{CR}$; $\overline{DR} \cong \overline{BR}$

Prove: $AR + DR = CR + BR$

Proof:

Statements (Reasons)

1. $\overline{AR} \cong \overline{CR}$; $\overline{DR} \cong \overline{BR}$ (Given)
2. $AR = CR$, $DR = BR$ (Def. of $\cong$ segs)
3. $AR + DR = CR + DR$ (Add. Prop.)
4. $AR + DR = CR + BR$ (Subs.)

5. Given: $\overline{AB} \cong \overline{CD}$, $AB + CD = EF$

Prove: $2AB = EF$

Statements (Reasons)

1. $\overline{AB} \cong \overline{CD}$, $AB + CD = EF$ (Given)
2. $AB = CD$ (Def. of $\cong$ segs.)
3. $AB + AB = EF$ (Subs.)
4. $2AB = EF$ (Subs. Prop.)

7. Given: $\overline{AB}$

Prove: $\overline{AB} \cong \overline{AB}$

Proof:

Statements (Reasons)

1. $\overline{AB}$ (Given)
2. $AB = AB$ (Refl. Prop.)
3. $\overline{AB} \cong \overline{AB}$ (Def. of $\cong$ segs.)

9. Given: $\overline{SC} \cong \overline{HR}$ and $\overline{HR} \cong \overline{AB}$

Prove: $\overline{SC} \cong \overline{AB}$

Proof:

Statements (Reasons)

1. $\overline{SC} \cong \overline{HR}$ and $\overline{HR} \cong \overline{AB}$ (Given)
2. $SC = HR$ and $HR = AB$ (Def. of $\cong$ segs.)
3. $SC = AB$ (Trans. Prop.)
4. $\overline{SC} \cong \overline{AB}$ (Def. of $\cong$ segs.)

11. Given: E **is the midpoint of** $\overline{DF}$ **and** $\overline{CD} \cong \overline{FG}$.

Prove: $\overline{CE} \cong \overline{EG}$

Proof:

Statements (Reasons)

1. E is the midpoint of $\overline{DF}$ and $\overline{CD} \cong \overline{FG}$. (Given)
2. $DE = EF$ (Def. of midpoint)
3. $CD = FG$ (Def. of $\cong$ segs.)
4. $CD + DE = EF + FG$ (Add. Prop.)
5. $CE = CD + DE$ and $EG = EF + FG$ (Seg. Add. Post.)
6. $CE = EG$ (Subs.)
7. $\overline{CE} \cong \overline{EG}$ (Def. of $\cong$ segs.)

13a Given: $\overline{AC} \cong \overline{GI}$, $\overline{FE} \cong \overline{LK}$, $AC + CF + FE = GI + IL + LK$

Prove: $\overline{CF} \cong \overline{IL}$

Proof:

Statements (Reasons)

1. $\overline{AC} \cong \overline{GI}$, $\overline{FE} \cong \overline{LK}$, $AC + CF + FE = GI + IL + LK$ (Given)
2. $AC + CF + FE = AC + IL + LK$ (Subs.)
3. $AC - AC + CF + FE = AC - AC + IL + LK$ (Subt. Prop.)
4. $CF + FE = IL + LK$ (Subs. Prop.)
5. $CF + FE = IL + FE$ (Subs.)
6. $CF + FE - FE = IL + FE - FE$ (Subt. Prop.)
7. $CF = IL$ (Subs. Prop.)
8. $\overline{CF} \cong \overline{IL}$ (Def. of $\cong$ segs.)

13b. Sample answer: I measured $\overline{CF}$ and $\overline{IL}$, and both were 1.5 inches long, so the two segments are congruent.

15a. Given: $\overline{SH} \cong \overline{TF}$; P is the midpoint of $\overline{SH}$ and $\overline{TF}$.

Prove: $\overline{SP} \cong \overline{TP}$

Proof:

Statements (Reasons)

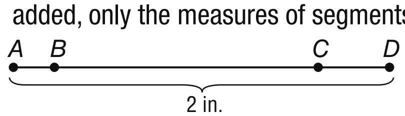
1. $\overline{SH} \cong \overline{TF}$; P is the midpoint of $\overline{SH}$, P is the midpoint of $\overline{TF}$. (Given)
2. $SH = TF$ (Def. of $\cong$ Segs.)
3. $SP = PH$, $TP = PF$ (Def. of Midpoint)
4. $SH = SP + PH$, $TF = TP + PF$ (Seg. Add. Post.)
5. $SP + PH = TP + PF$ (Subs.)
6. $SP + SP = TP + TP$ (Subs.)
7. $2SP = 2TP$ (Subs.)
8. $SP = TP$ (Div. Prop.)
9. $\overline{SP} \cong \overline{TP}$ (Def. of $\cong$ segs.)

15b. 90 ft

17. Neither; Since $\overline{AB} \cong \overline{CD}$ and $\overline{CD} \cong \overline{BF}$, then $\overline{AB} \cong \overline{BF}$ by the Transitive Property of Congruence.

19. No; congruence refers to segments. Segments cannot be added, only the measures of segments.

21.



23. D **25.** 18

27. Given: $AC = DF$, $AB = DE$

Prove: $BC = EF$

Proof:

Statements (Reasons)

1. $AC = DF$, $AB = DE$ (Given)

2. $AC = AB + BC$; $DF = DE + EF$ (Seg. Add. Post.)
3. $AB + BC = DE + EF$ (Subs.)
4. $BC = EF$ (Subt. Prop.)

29a. 1.25 seconds **29b.** about 1.14 seconds **31.** $9\sqrt{2}$
33. $3y^4\sqrt{5}x$ **35.** 8

Lesson 5-4

1. $m\angle 1 = 90$, $m\angle 3 = 64$; Comp. Thm.

3. $m\angle 4 = 114$, $m\angle 5 = 66$; Suppl. Thm.

5. Given: $\angle 2 \cong \angle 6$

Prove: $\angle 4 \cong \angle 8$

Proof:

Statements (Reasons)

1. $\angle 2 \cong \angle 6$ (Given)
2. $m\angle 2 + m\angle 4 = 180$, $m\angle 6 + m\angle 8 = 180$ (Suppl. Thm.)
3. $m\angle 2 + m\angle 8 = 180$ (Subs.)
4. $m\angle 2 - m\angle 2 + m\angle 4 = 180 - m\angle 2$, $m\angle 2 - m\angle 2 + m\angle 8 = 180 - m\angle 2$ (Subt. Prop.)
5. $m\angle 4 = 180 - m\angle 2$, $m\angle 8 = 180 - m\angle 2$ (Subt. Prop.)
6. $m\angle 4 = m\angle 8$ (Subs.)
7. $\angle 4 \cong \angle 8$ (Def. $\cong$ $\angle$s)

7. Given: $\angle 4 \cong \angle 7$

Prove: $\angle 5 \cong \angle 6$

Proof:

Statements (Reasons)

1. $\angle 4 \cong \angle 7$ (Given)
2. $\angle 4 \cong \angle 5$ and $\angle 6 \cong \angle 7$ (Vert. $\angle$s Thm.)
3. $\angle 7 \cong \angle 5$ (Subs.)
4. $\angle 5 \cong \angle 6$ (Subs.)

9. $m\angle 3 = 62$, $m\angle 1 = m\angle 4 = 45$ ($\cong$ Comp. and Supp. Thm.)
11. $m\angle 9 = 156$, $m\angle 10 = 24$ ($\cong$ Supp. Thm.)
13. $m\angle 6 = 73$, $m\angle 7 = 107$, $m\angle 8 = 73$ ($\cong$ Supp. Thm. and Vert. $\angle$s Thm.)

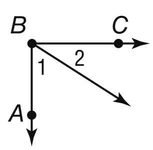
15. Proof:

Statements (Reasons)

1. $\angle 5 \cong \angle 6$ (Given)
2. $m\angle 5 = m\angle 6$ (Def. of $\cong$ $\angle$s)
3. $\angle 4$ and $\angle 5$ are supplementary. (Def. of linear pairs)
4. $m\angle 4 + m\angle 5 = 180$ (Def. of supp. $\angle$s)
5. $m\angle 4 + m\angle 6 = 180$ (Subs.)
6. $\angle 4$ and $\angle 6$ are supplementary. (Def. of supp. $\angle$s)

17. Given: $\angle ABC$ **is a right angle.**

Prove: $\angle 1$ and $\angle 2$ are complementary $\angle$s.

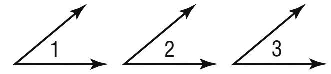


Proof:

Statements (Reasons)

1. $\angle ABC$ is a right angle. (Given)
2. $m\angle ABC = 90$ (Def. of rt. $\angle$s)
3. $m\angle ABC = m\angle 1 + m\angle 2$ ($\angle$ Add. Post.)
4. $90 = m\angle 1 + m\angle 2$ (Subst.)
5. $\angle 1$ and $\angle 2$ are complementary angles. (Def. of comp. $\angle$s)

19. Given: $\angle 1 \cong \angle 2$, $\angle 2 \cong \angle 3$



Prove: $\angle 1 \cong \angle 3$

Proof:

Statements (Reasons)

1. $\angle 1 \cong \angle 2$, $\angle 2 \cong \angle 3$ (Given)
2. $m\angle 1 = m\angle 2$, $m\angle 2 = m\angle 3$ (Def. of $\cong$ $\angle$s)
3. $m\angle 1 = m\angle 3$ (Trans. Prop.)
4. $\angle 1 \cong \angle 3$ (Def. of $\cong$ $\angle$s)

21. Given: $\angle 1 \cong \angle 4$

Prove: $\angle 2 \cong \angle 3$

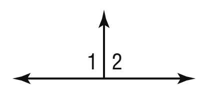
Proof:

Statements (Reasons)

1. $\angle 1 \cong \angle 4$ (Given)
2. $\angle 1 \cong \angle 2$, $\angle 3 \cong \angle 4$ (Vert. $\angle$s are $\cong$.)
3. $\angle 1 \cong \angle 3$ (Trans. Prop.)
4. $\angle 2 \cong \angle 3$ (Subs.)

23. Given: $\angle 1$ **and** $\angle 2$ **are rt.** $\angle$**s.**

Prove: $\angle 1 \cong \angle 2$

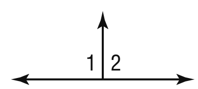


Proof:

Statements (Reasons)

1. $\angle 1$ and $\angle 2$ are rt. $\angle$s. (Given)
2. $m\angle 1 = 90$, $m\angle 2 = 90$ (Def. of rt. $\angle$s)
3. $m\angle 1 = m\angle 2$ (Subs.)
4. $\angle 1 \cong \angle 2$ (Def. of $\cong$ $\angle$s)

25. Given: $\angle 1 \cong \angle 2$, $\angle 1$ **and** $\angle 2$ **are supplementary.**



Prove: $\angle 1$ and $\angle 2$ are rt. $\angle$s.

Proof:

Statements (Reasons)

1. $\angle 1 \cong \angle 2$, $\angle 1$ and $\angle 2$ are supplementary. (Given)
2. $m\angle 1 + m\angle 2 = 180$ (Def. of $\angle$s)
3. $m\angle 1 = m\angle 2$ (Def. of $\cong$ $\angle$s)
4. $m\angle 1 + m\angle 1 = 180$ (Subs.)
5. $2(m\angle 1) = 180$ (Subs.)
6. $m\angle 1 = 90$ (Div. Prop.)
7. $m\angle 2 = 90$ (Subs. (steps 3, 6))
8. $\angle 1$ and $\angle 2$ are rt. $\angle$s. (Def. of rt. $\angle$s)

27. Since the path of the pendulum forms a right angle, $\angle ABC$ is a right angle, or measures 90. $\overrightarrow{BR}$ divides $\angle ABC$ into $\angle ABR$ and $\angle CBR$. By the Angle Addition Postulate, $m\angle ABR + m\angle CBR = m\angle ABC$, and, using substitution, $m\angle ABR + m\angle CBR = 90$. Substituting again, $m\angle 1 + m\angle 2 = 90$. We are given that $m\angle 1$ is 45, so, substituting, $45 + m\angle 2 = 90$. Using the Subtraction Property, $45 - 45 + m\angle 2 = 90 - 45$, or $m\angle 2 = 45$. Since $m\angle 1$ and $m\angle 2$ are equal, $\overrightarrow{BR}$ is the bisector of $\angle ABC$ by the definition of angle bisector.

29. Given: $\angle 2$ **is a right angle.**

Prove: $\ell \perp m$

Proof:

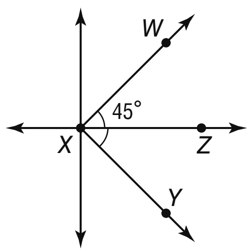
Statements (Reasons)

1. $\angle 2$ is a right angle. (Given)
2. $m\angle 2 = 90$ (Def. of a rt. $\angle$)
3. $\angle 2 \cong \angle 3$ (Vert. $\angle$s are $\cong$.)
4. $m\angle 3 = 90$ (Subs.)
5. $m\angle 1 + m\angle 2 = 180$ (Supp. Th.)
6. $m\angle 1 + 90 = 180$ (Subs.)
7. $m\angle 1 + 90 - 90 = 180 - 90$ (Subt. Prop.)
8. $m\angle 1 = 90$ (Subs.)
9. $\angle 1 \cong \angle 4$ (Vert. $\angle$s are $\cong$.)
10. $\angle 4 \cong \angle 1$ (Symm. Prop.)
11. $m\angle 4 = m\angle 1$ (Def. of $\cong$ $\angle$s)
12. $m\angle 4 = 90$ (Subs.)
13. $\ell \perp m$ (Perpendicular lines intersect to form four right angles.)

31. Given: $\overline{XZ}$ bisects $\angle WXY$, and $m\angle WXZ = 45$.

Prove: $\angle WXY$ is a right angle.

Proof:



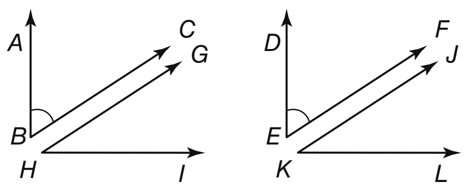
Statements (Reasons)

1. $\overline{XZ}$ bisects $\angle WXY$, and $m\angle WXZ = 45$. (Given)
2. $\angle WXZ \cong \angle ZXY$ (Def. of $\angle$ bisector)
3. $m\angle WXZ = m\angle ZXY$ (Def. of $\cong$ $\angle$s)
4. $m\angle ZXY = 45$ (Subs.)
5. $m\angle WXY = m\angle WXZ + m\angle ZXY$ ($\angle$ Add. Post.)
6. $m\angle WXY = 45 + 45$ (Subs.)
7. $m\angle WXY = 90$ (Subs.)
8. $\angle WXY$ is a right angle. (Def. of rt. $\angle$)

33. Each of these theorems uses the words "or to congruent angles" indicating that this case of the theorem must also be proven true. The other proofs only addressed the "to the same angle" case of the theorem.

Given: $\angle ABC \cong \angle DEF$, $\angle GHI$ is complementary to $\angle ABC$, $\angle JKL$ is complementary to $\angle DEF$.

Prove: $\angle GHI \cong \angle JKL$



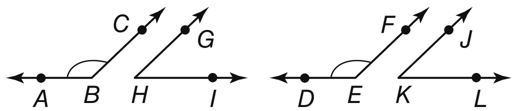
Proof:

Statements (Reasons)

1. $\angle ABC \cong \angle DEF$, $\angle GHI$ is complementary to $\angle ABC$, $\angle JKL$ is complementary to $\angle DEF$. (Given)
2. $m\angle ABC + m\angle GHI = 90$, $\angle DEF + \angle JKL = 90$ (Def. of compl. $\angle$s)
3. $m\angle ABC + m\angle JKL = 90$ (Subs.)
4. $90 = m\angle ABC + m\angle JKL$ (Symm. Prop.)
5. $m\angle ABC + m\angle GHI = m\angle ABC + m\angle JKL$ (Trans. Prop.)
6. $m\angle ABC - m\angle ABC + m\angle GHI = m\angle ABC - m\angle ABC + m\angle JKL$ (Subt. Prop.)
7. $m\angle GHI = m\angle JKL$ (Subs. Prop.)
8. $\angle GHI \cong \angle JKL$ (Def. of $\cong$ $\angle$s)

Given: $\angle ABC \cong \angle DEF$, $\angle GHI$ is supplementary to $\angle ABC$, $\angle JKL$ is supplementary to $\angle DEF$.

Prove: $\angle GHI \cong \angle JKL$



Proof:

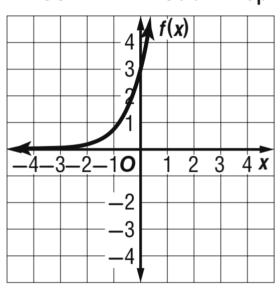
Statements (Reasons)

1. $\angle ABC \cong \angle DEF$, $\angle GHI$ is supplementary to $\angle ABC$, $\angle JKL$ is supplementary to $\angle DEF$. (Given)
2. $m\angle ABC + m\angle GHI = 180$, $m\angle DEF + m\angle JKL = 180$ (Def. of compl. $\angle$s)
3. $m\angle ABC + m\angle JKL = 180$ (Subs.)
4. $180 = m\angle ABC + m\angle JKL$ (Symm. Property)
5. $m\angle ABC + m\angle GHI = m\angle ABC + m\angle JKL$ (Trans. Prop.)
6. $m\angle ABC - m\angle ABC + m\angle GHI = m\angle ABC - m\angle ABC + m\angle JKL$ (Subt. Prop.)
7. $m\angle GHI = m\angle JKL$ (Subs. Prop.)
8. $\angle GHI \cong \angle JKL$ (Def. of $\cong$ $\angle$s)

35. Sample answer: Since protractors have the scale for both acute and obtuse angles along the top, the supplement is the measure of the given angle on the other scale.

37. A **39.** B **41.** Subt. Prop. **43.** Subs.

45.

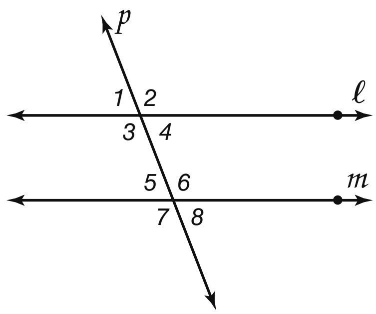


47. -5D = {all real numbers}; R = $\{f(x) \mid f(x) > 0\}$ **49.** line n **51.** point W **53.** Yes; it intersects both m and n when all three lines are extended.

Lesson 5-5

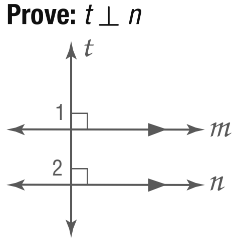
1. 94; Corresponding Angle Postulate
3. 86; Corresponding Angle Postulate and Supplement Angle Thm.

5. 79; Vertical Angle Thm. Cons. Int. $\angle$s Thm.
7. $m\angle 2 = 93$, $m\angle 3 = 87$, $m\angle 4 = 87$
9. $x = 114$ by the Alt. Ext. $\angle$s Thm. **11.** 22; Corr. $\angle$s Post.
13. 158; Def. Supp. $\angle$s **15.** 18; Corr. $\angle$s Post.
17. 162; Supplement Angles Thm. **19.** 18; Alt. Ext. $\angle$s Post.
21. congruent; Corresponding Angles
23. supplementary; since $\angle 3$ and $\angle 5$ are a linear pair, they are supplementary. $\angle 4$ and $\angle 5$ are congruent because they are alternate exterior angles, so $\angle 3$ is supplementary to $\angle 4$.
25. $x = 40$ by the Corresponding Angles Postulate; $y = 50$ by the Supplement Theorem
27. $x = 42$ by the Consecutive Interior Angles Theorem; $y = 14$ by the Consecutive Interior Angles Theorem
29. $x = 60$ by the Consecutive Interior Angles Theorem; $y = 10$ by the Supplement Theorem
31. Congruent; Alternate Interior Angles
33. Congruent; vertical angles are congruent
35. **Given:** $\ell \parallel m$
Prove: $\angle 1 \cong \angle 8$
$\angle 2 \cong \angle 7$



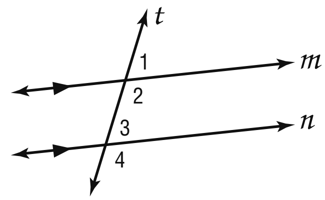
Proof:
Statements (Reasons)
1. $\ell \parallel m$ (Given)
2. $\angle 1 \cong \angle 5$, $\angle 2 \cong \angle 6$ (Corr. $\angle$s Post.)
3. $\angle 5 \cong \angle 8$, $\angle 6 \cong \angle 7$ (Vertical $\angle$s Thm.)
4. $\angle 1 \cong \angle 8$, $\angle 2 \cong \angle 7$ (Trans. Prop.)

37. **Given:** $m \parallel n$, $t \perp m$
Prove: $t \perp n$



Proof:
Statements (Reasons)
1. $m \parallel n$, $t \perp m$ (Given)
2. $\angle 1$ is a right angle. (Def. of $\perp$)
3. $m\angle 1 = 90$ (Def. of rt. $\angle$s)
4. $\angle 1 \cong \angle 2$ (Corr. $\angle$s Post.)
5. $m\angle 1 = m\angle 2$ (Def. of $\cong$ $\angle$s)
6. $m\angle 2 = 90$ (Subs.)
7. $\angle 2$ is a right angle. (Def. of rt. $\angle$s)
8. $t \perp n$ (Def. of $\perp$ lines)

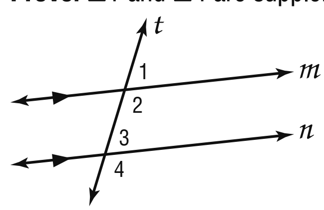
39. 130
41a. Sample answer for m and n:



41b. Sample answer:

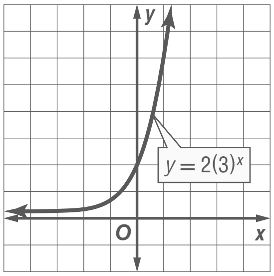
$m\angle 1$	$m\angle 2$	$m\angle 3$	$m\angle 4$
60	120	60	120
45	135	45	135
70	110	70	110
90	90	90	90
25	155	25	155
30	150	30	150

41c. Sample answer: Angles on the exterior of a pair of parallel lines located on the same side of the transversal are supplementary.
41d. Inductive; a pattern was used to make a conjecture.
41e. **Given:** parallel lines m and n cut by transversal t
Prove: $\angle 1$ and $\angle 4$ are supplementary.

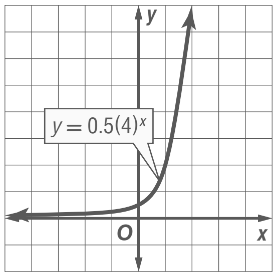


Proof:
1. Lines m and n are parallel and cut by transversal t. (Given)
2. $m\angle 1 + m\angle 2 = 180$ (Suppl. Thm.)
3. $\angle 2 \cong \angle 4$ (Corr. $\angle$s are $\cong$.)
4. $m\angle 2 = m\angle 4$ (Def. of congruence.)
5. $m\angle 1 + m\angle 4 = 180$ (Subs.)
6. $\angle 1$ and $\angle 4$ are supplementary. (Def. of supplementary $\angle$s.)

43. In both theorems, a pair of angles is formed when two parallel lines are cut by a transversal. However, in the Alternate Interior Angles Theorem, each pair of alternate interior angles that is formed are congruent, whereas in the Consecutive Interior Angles Theorem, each pair of angles formed is supplementary.
45. $x = 171$ or $x = 155$; $y = 3$ or $y = 5$
47. C **49.** I and II
51. D = {all real numbers},
R = $\{y \mid y > 0\}$



53. D = {all real numbers}, R = $\{y \mid y > 0\}$



55. $m\angle 1 = 113$
57. $m\angle 3 = 90$, $m\angle 5 = 58$
59. $\frac{1}{2}$ **61.** $-\frac{5}{7}$ **63.** $\frac{4}{3}$

Lesson 5-6

1. $j \parallel k$; Converse of Corresponding Angles Postulate

3. $\ell \parallel m$; Alternate Exterior Angles Converse

5. 20 **7.** Yes; sample answer: Since the alternate exterior angles are congruent, the backrest and footrest are parallel.

9. $u \parallel v$; Alternate Exterior Angles Converse

11. $r \parallel s$; Consecutive Interior Angles Converse

13. $u \parallel v$; Alternate Interior Angles Converse

15. $r \parallel s$; Converse of Corresponding Angles Postulate

17. 22; Conv. Corr. ∠s Post. **19.** 43; Consec. Int. ∠s Conv.

21. 36; Alt. Ext. ∠s Conv.
23a. ∠1 and ∠2 are supplementary.
23b. Def. of linear pair.
23c. ∠2 and ∠3 are supplementary.
23d. ≅ Suppl. Thm.
23e. Converse of Corr. ∠s Post.
25. Proof:

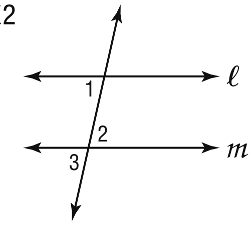
Statements (Reasons)
1. ∠1 ≅ ∠3, $\overline{AC} \parallel \overline{BD}$ (Given)
2. ∠2 ≅ ∠3 (Corr. ∠s postulate)
3. ∠1 ≅ ∠2 (Trans. Prop.)
4. $\overline{AC} \parallel \overline{BD}$ (If alternate ∠s are ≅, then lines are ∥.)

27. Proof:

Statements (Reasons)
1. ∠ABC ≅ ∠ADC, $m\angle A + m\angle ABC = 180$ (Given)
2. $m\angle ABC = m\angle ADC$ (Def. of ≅ ∠s)
3. $m\angle A + m\angle ADC = 180$ (Substitution)
4. ∠A and ∠ADC are supplementary. (Def. of suppl. ∠s)
5. $\overline{AB} \parallel \overline{CD}$ (If consec. int. ∠s are suppl., then lines are ∥.)

29. The Converse of the Perpendicular Transversal Theorem states that two coplanar lines perpendicular to the same line are parallel. Since the slots are perpendicular to each of the sides, the slots are parallel.

31. Given: ∠1 ≅ ∠2
Prove: $\ell \parallel m$



Statements (Reasons)
1. ∠1 ≅ ∠2 (Given)
2. ∠2 ≅ ∠3 (Vertical ∠s are ≅)
3. ∠1 ≅ ∠3 (Transitive Prop.)
4. $\ell \parallel m$ (If corr ∠s are ≅, then lines are ∥.)

33. $r \parallel s$; Sample answer: The corresponding angles are congruent. Since the measures of the angles are equal, the lines are parallel.

35. $r \parallel s$; Sample answer: The alternate exterior angles are congruent. Since the measures of the angles are equal, the lines are parallel.

37. Daniela; ∠1 and ∠2 are alternate interior angles for $\overline{WX}$ and $\overline{YZ}$, so if alternate interior angles are congruent, then the lines are parallel.

39. Sample answer:

Given: $a \parallel b$ and $b \parallel c$

Prove: $a \parallel c$

Statements (Reasons)
1. $a \parallel b$ and $b \parallel c$ (Given)
2. ∠1 ≅ ∠3 (Alt. Int. ∠s Thm.)
3. ∠3 ≅ ∠2 (Vert. ∠s are ≅)
4. ∠2 ≅ ∠4 (Alt. Int. ∠s Thm.)
5. ∠1 ≅ ∠4 (Trans. Prop.)
6. $a \parallel c$ (Alt. Int. ∠s Conv. Thm.)

41a. We know that $m\angle 1 + m\angle 2 = 180$. Since ∠2 and ∠3 are linear pairs, $m\angle 2 + m\angle 3 = 180$. By substitution, $m\angle 1 + m\angle 2 = m\angle 2 + m\angle 3$. By subtracting $m\angle 2$ from both sides we get $m\angle 1 = m\angle 3$. ∠1 ≅ ∠3, by the definition of congruent angles. Therefore, $a \parallel c$ since the corresponding angles are congruent.

41b. We know that $a \parallel c$ and $m\angle 1 + m\angle 3 = 180$. Since ∠1 and ∠3 are corresponding angles, they are congruent and their measures are equal. By substitution, $m\angle 3 + m\angle 3 = 180$ or $2\,m\angle 3 = 180$. By dividing both sides by 2, we get $m\angle 3 = 90$. Therefore, $t \perp c$ since they form a right angle.

43. Sample answer: In order for supplementary angles to be both supplementary and congruent, they must be 90°, because they must sum to 180° and their angle measures must be equal. That means that the transversal must be perpendicular to the parallel lines.

45. D **47.** J

49. Given: $AB = BC$

Prove: $AC = 2BC$

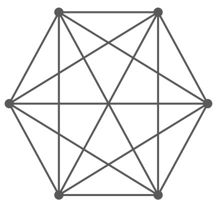
Statements (Reasons)

1. $AB = BC$ (Given)
2. $AC = AB + BC$ (Seg. Add. Post.)
3. $AC = BC + BC$ (Substitution)
4. $AC = 2BC$ (Substitution)

51. $S(p) = -2(p - 20)^2 + 2050$ **53.** $\{x \mid -4 \leq x \leq 7\}$
55. 10, 8.3

Chapter 5 Study Guide and Review

1. false; theorem **3.** true **5.** Never; if two planes intersect, they form a line. **7.** Always; if a plane contains a line, then every point of that line lies in the plane. **9.** 15 handshakes;



11. Subt. Prop. **13.** Reflex. Prop. **15a.** Given **15b.** Dist. Prop. **15c.** Add. Prop. **15d.** Div. Prop. **17.** Trans. Prop.

19. Statements (Reasons)

1. $AB = DC$ (Given)
2. $BC = BC$ (Refl. Prop.)
3. $AB + BC = DC + BC$ (Add. Prop.)
4. $AB + BC = AC$, $DC + BC =$ DB (Seg. Add. Post.)
5. $AC = DB$ (Subs.)

21. 90 **23.** 53
25. 123; Alt. Ext. ∠s Thm
27. 57; $\angle 16 \cong \angle 14$ by Corr. ∠s Post. and ∠9 and ∠16 form a linear pair.
29. 57; $\angle 1 \cong \angle 5$ by Alt. Ext. ∠s Thm and ∠4 and ∠5 form a linear pair.
31. 125 **33.** none
35. $v \parallel z$; Alternate Exterior Angles Converse Thm.

CHAPTER 6
Congruent Triangles

Chapter 6 Get Ready

1. right **3.** obtuse **5.** 84°; alternate exterior angles
7. ≈10.8 **9.** ≈18.0 **11.** 144.2 miles

Lesson 6-1

1. 58 **3.** 80 **5.** 49 **7.** 78 **9.** 61 **11.** 151 **13.** 30
15. $m\angle 1 = 59$, $m\angle 2 = 59$, $m\angle 3 = 99$ **17.** 79 **19.** 21
21. 51 **23.** 78 **25.** 39 **27.** 55 **29.** 35 **31.** $x = 30$; 30, 60 **33.** m∠A = 108, m∠B = m∠C = 36
35. Given: $\triangle MNO$

$\angle M$ is a right angle.

Prove: There can be at most one right angle in a triangle.

Proof: In $\triangle MNO$, M is a right angle. $m\angle M + m\angle N + m\angle O = 180$. $m\angle M = 90$, so $m\angle N + m\angle O = 90$. If N were a right angle, then $m\angle O = 0$. But that is impossible, so there cannot be two right angles in a triangle.

Given: $\triangle PQR$

$\angle P$ is obtuse.

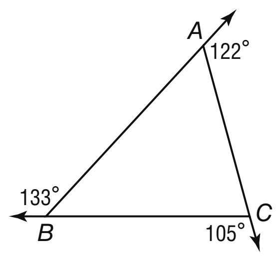
Prove: There can be at most one obtuse angle in a triangle.

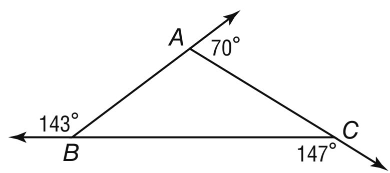
Proof: In $\angle PQR$, $\angle P$ is obtuse. So $m\angle P > 90$. $m\angle P + m\angle Q + m\angle R$ 180. It must be that $m\angle Q + m\angle R < 90$. So, $\angle Q$ and $\angle R$ must be acute.

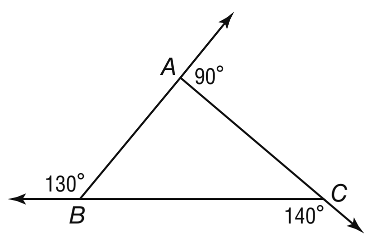
37. $m\angle 1 = 65$, $m\angle 2 = 20$, $m\angle 3 = 95$, $m\angle 4 = 40$, $m\angle 5 = 110$, $m\angle 6 = 45$, $m\angle 7 = 70$, $m\angle 8 = 65$ **39.** 67°, 23°
41. $z < 23$; Sample answer: Since the sum of the measures of the angles of a triangle is 180 and $m\angle X = 157$, $157 + m\angle Y + m\angle Z = 180$, so $m\angle Y + m\angle Z = 23$. If $m\angle Y$ was 0, then $m\angle Z$ would equal 23. But since an angle must have a measure greater than 0, $m\angle Z$ must be less than 23, so $z < 23$.
43. Proof: Statements (Reasons)

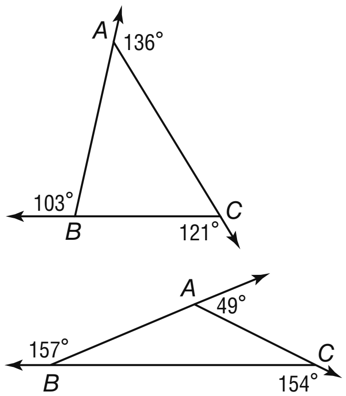
1. $RSTUV$ is a pentagon. (Given)
2. $m\angle S + m\angle 1 + m\angle 2 = 180$; $m\angle 3 + m\angle 4 + m\angle 7 = 180$; $m\angle 6 + m\angle V + m\angle 5 = 180$ (∠ Sum Thm.)
3. $m\angle S + m\angle 1 + m\angle 2 + m\angle 3 + m\angle 4 + m\angle 7 + m\angle 6 + m\angle V + m\angle 5 = 540$ (Add. Prop.)
4. $m\angle VRS = m\angle 1 + m\angle 4 + m\angle 5$; $m\angle TUV = m\angle 7 + m\angle 6$; $m\angle STU = m\angle 2 + m\angle 3$ (∠ Addition)
5. $m\angle S + m\angle STU + m\angle TUV + m\angle V + m\angle VRS = 540$ (Subst.)

45a. Sample answer:







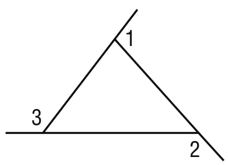


45b. Sample answer:

∠1	∠2	∠3	Sum
122	105	133	360
70	147	143	360
90	140	130	360
136	121	103	360
49	154	157	360

45c. Sample answer: The sum of the measures of the exterior angles of a triangle is 360.

45d.



$m\angle 1 + m\angle 2 + m\angle 3 = 360$

45e. The Exterior Angle Theorem tells us that $m\angle 3 = m\angle BAC + m\angle BCA$, $m\angle 2 = m\angle BAC + m\angle CBA$, $m\angle 1 = m\angle CBA + m\angle BCA$. Through substitution, $m\angle 1 + m\angle 2 + m\angle 3 = m\angle CBA + m\angle BCA + m\angle BAC + m\angle CBA + m\angle BAC + m\angle BCA$. Which can be simplified to $m\angle 1 + m\angle 2 + m\angle 3 = 2m\angle CBA + 2m\angle BCA + 2m\angle BAC$. The Distributive Property can be applied and gives $m\angle 1 + m\angle 2 + m\angle 3 = 2(m\angle CBA + m\angle BCA + m\angle BAC)$. The Triangle Angle-Sum Theorem tells us that $m\angle CBA + m\angle BCA + m\angle BAC = 180$. Through substitution we have $m\angle 1 + m\angle 2 + m\angle 3 = 2(180) = 360$. **47.** The measure of $\angle a$ is the supplement of the exterior angle with measure 110, so $\angle a = 180 - 110$ or 70. Because the angles with measures b and c are congruent, $b = c$. Using the Exterior Angle Theorem, $b + c = 110$. By substitution, $b + b = 110$, so $2b = 110$ and $b = 55$. Because $b = c$, $c = 55$. **49.** $y = 13$, $z = 14$ **51.** Sample answer: Since an exterior angle is acute, the adjacent angle must be obtuse. Since another exterior angle is right, the adjacent angle must be right. A triangle cannot contain both a right and an obtuse angle because it would be more than 180 degrees. Therefore, a triangle cannot have an obtuse, acute, and a right exterior angle. **53.** 100°, 115°, 145° **55.** E **57.** $-18j^3 - 2j^2k^2 - 4jk^2$ **59.** −3, −6 **61.** −5, 3 **63.** $x = 11$, $y = 20$; Since $5x - 2$ and 53 are alternate exterior angles, they are congruent. Therefore $5x - 2 = 53$ and so $x = 11$. Since $6y + 7$ and $5x - 2$ form a straight angle, $6y + 7$ and 53 are supplementary. Therefore $6y + 7 + 53 = 180$ and so $y = 20$. **65.** Substitution Property **67.** Transitive Property

Lesson 6-2

1. $\angle Y \cong \angle S$, $\angle X \cong \angle R$, $\angle XZY \cong \angle RZS$, $\overline{YX} \cong \overline{SR}$, $\overline{YZ} \cong \overline{SZ}$, $\overline{XZ} \cong \overline{RZ}$; $\triangle YXZ \cong \triangle SRZ$

3. $\frac{1}{2}$ in.; Sample answer: The nut is congruent to the opening for the $\frac{1}{2}$ in. socket. **5.** 50 **7.** 16; $\angle N$ corresponds to $\angle X$. By the Third Angles Theorem, $m\angle N = 64$, so $4x = 64$.

9. $\angle X \cong \angle A$, $\angle Y \cong \angle B$, $\angle Z \cong \angle C$, $\overline{XY} \cong \overline{AB}$, $\overline{XZ} \cong \overline{AC}$, $\overline{YZ} \cong \overline{BC}$; $\triangle XYZ \cong \triangle ABC$

11. $\angle R \cong \angle J$, $\angle T \cong \angle K$, $\angle S \cong \angle L$, $\overline{RT} \cong \overline{JK}$, $\overline{TS} \cong \overline{KL}$, $\overline{RS} \cong \overline{JL}$; $\triangle RTS \cong \triangle JKL$

13. 20 **15.** 3 **17.** $\triangle ABC \cong \triangle MNO$; $\triangle DEF \cong \triangle PQR$

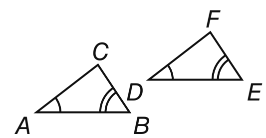
17b. $\overline{AB} \cong \overline{MN}$, $\overline{BC} \cong \overline{NO}$, $\overline{AC} \cong \overline{MO}$, $\overline{DE} \cong \overline{PQ}$, $\overline{EF} \cong \overline{QR}$, $\overline{DF} \cong \overline{PR}$

17c. $\angle A \cong \angle M$, $\angle B \cong \angle N$, $\angle C \cong \angle O$, $\angle D \cong \angle P$, $\angle E \cong \angle Q$, $\angle F \cong \angle R$

19. $x = 4$; $y = 2$

21. Given: $\angle A \cong \angle D$
$\angle B \cong \angle E$

Prove: $\angle C \cong \angle F$



Proof:

Statements (Reasons)

1. $\angle A \cong \angle D$, $\angle B \cong \angle E$ (Given)
2. $m\angle A = m\angle D$, $m\angle B = m\angle E$ (Def. of ≅ ∠s)
3. $m\angle A + m\angle B + m\angle C = 180$, $m\angle D + m\angle E + m\angle F = 180$ (∠ Sum Theorem)
4. $m\angle A + m\angle B + m\angle C = m\angle D + m\angle E + m\angle F$ (Trans. Prop.)
5. $m\angle D + m\angle E + m\angle C = m\angle D + m\angle E + m\angle F$ (Subst.)
6. $m\angle C = m\angle F$ (Subt. Prop.)
7. $\angle C \cong \angle F$ (Def. of ≅ ∠s)

23. Proof:

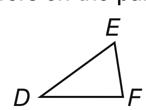
Statements (Reasons)

1. $\overline{BD}$ bisects $\angle B$, $\overline{BD} \perp \overline{AC}$. (Given)
2. $\angle ABD \cong \angle DBC$ (Def. of angle bisector)
3. $\angle ADB$ and $\angle BDC$ are right angles. (⊥ lines form rt. ∠s.)
4. $\angle ADB \cong \angle BDC$ (All rt. ∠s are ≅.)
5. $\angle A \cong \angle C$ (Third ∠ Thm.)

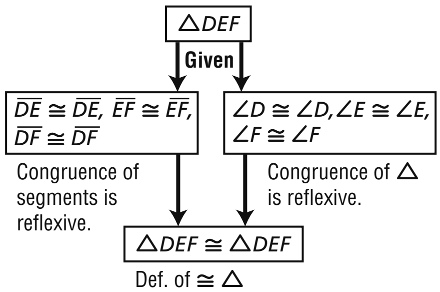
25. Sample answer: Both of the punched flowers are congruent to the flower on the stamp, because it was used to create the images. According to the Transitive Property of Polygon Congruence, the two stamped images are congruent to each other because they are both congruent to the flowers on the punch.

27. Given: $\triangle DEF$

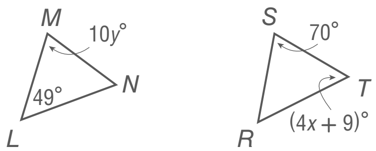
Prove: $\triangle DEF \cong \triangle DEF$



Proof:



29.



$x = 13$; $y = 7$

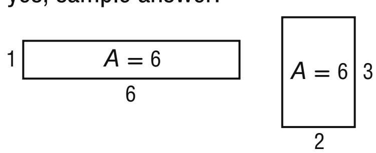
31a. $\overline{AB} \cong \overline{CB}$, $\overline{AB} \cong \overline{DE}$, $\overline{AB} \cong \overline{FE}$, $\overline{CB} \cong \overline{DE}$, $\overline{CB} \cong \overline{FE}$, $\overline{DE} \cong \overline{FE}$, $\overline{AC} \cong \overline{DF}$ **31b.** 40 ft **31c.** 80

33. If two triangles are congruent, then their areas are equal.

33b. If the areas of a pair of triangles are equal, then the triangles are congruent; false; If one triangle has a base of 2 and a height of 6 and a second triangle has a base of 3 and a height of 4, then their areas are equal, but they are not congruent.

33c. No; sample answer: Any pair of equilateral triangles that have the same base also have the same height, so it is not possible to draw a pair of equilateral triangles with the same area that are not congruent.

33d. yes; sample answer:



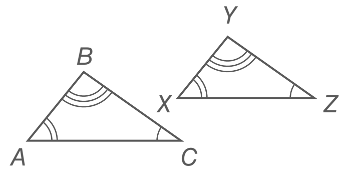
33e. No; any pair of squares that have the same area have the same side length, which is the square root of the area. If their areas are equal, they are congruent.

33f. Regular *n*-gons; If two regular *n*-gons are congruent, then they have the same area. All regular *n*-gons have the same shape, but may have different sizes. If two regular *n*-gons have the same area, then they not only have the same shape but also the same size. Therefore, they are congruent.

35. diameter, radius, or circumference; Sample answer: Two circles are the same size if they have the same diameter, radius, or circumference, so she can determine if the hoops are congruent if she measures any of them.

37. Both; Sample answer: ∠*A* corresponds with ∠*Y*, ∠*B* corresponds with ∠*X*, and ∠*C* corresponds with ∠*Z*. △*CAB* is the same triangle as △*ABC* and △*ZXY* is the same triangle as △*XYZ*.

39. $x = 16$, $y = 8$ **41.** False; ∠*A* ≅ ∠*X*, ∠*B* ≅ ∠*Y*, ∠*C* ≅ ∠*Z*, but corresponding sides are not congruent.



43. Sometimes; Equilateral triangles will be congruent if one pair of corresponding sides are congruent. **45.** 5

47. C **49.** 59 **51.** $m\angle 2 = 45$, $m\angle 3 = 135$, $m\angle 4 = 45$

53. Sometimes; If point *B* also lies in plane *P*, then $\overrightarrow{AB}$ lies in plane *P*. If point *B* does not lie in plane *P*, then $\overrightarrow{AB}$ does not lie in plane *P*.

55.

Statements	Reasons
a. ___?___ $\overline{MN} \cong \overline{PQ}$, $\overline{PQ} \cong \overline{RS}$	**a.** Given
b. $MN = PQ$, $PQ = RS$	**b.** ___?___ Def. ≅ segments
c. ___?___ $MN = RS$	**c.** ___?___ Transitive Prop. (=)
d. $\overline{MN} \cong \overline{RS}$	**d.** Definition of congruent segments

Lesson 6-3

1a. two

1b. Given: $AB = CD$; $DA = BC$

Prove: △*ABC* ≅ △*CDA*

Proof:

Statements (Reasons)

1. $AB = CD$; $DA = BC$ (Given)
2. $\overline{AB} \cong \overline{CD}$, $\overline{BC} \cong \overline{DA}$ (Def. of ≅)
3. $\overline{AC} \cong \overline{CA}$ (Reflex. Prop. ≅)
4. △*ABC* ≅ △*CDA* (SSS)

1c. Sample answer: Since all of the squares in the pattern are congruent, all of the triangles that form the squares are congruent. The bases form two lines and the legs are transversals. The corresponding angles are congruent, so the lines formed by the bases are parallel.

3. Sample answer: We are given that $\overline{LP} \cong \overline{NO}$ and ∠*LPM* ≅ ∠*NOM*. Since △*MOP* is equilateral, $\overline{MO} \cong \overline{MP}$ by the definition of an equilateral triangle. Therefore, △*LMP* is congruent to △*NMO* by the Side-Angle-Side Congruence Postulate.

5. Proof: We know that $\overline{QR} \cong \overline{SR}$ and $\overline{ST} \cong \overline{QT}$. $\overline{RT} \cong \overline{RT}$ by the Reflexive Property. Since $\overline{QR} \cong \overline{SR}$, $\overline{ST} \cong \overline{QT}$, and $\overline{RT} \cong \overline{RT}$, △*QRT* ≅ △*SRT* by SSS.

7. Given: $\overline{AB} \cong \overline{ED}$, $\angle ABC$ and $\angle EDC$ are right angles, and C is the midpoint of $\overline{BD}$.

Prove: $\triangle ABC \cong \triangle EDC$

Proof:

Statements (Reasons)

1. $\overline{AB} \cong \overline{ED}$, $\angle ABC$ and $\angle EDC$ are right angles, and C is the midpoint of $\overline{BD}$. (Given)
2. $\angle ABC \cong \angle EDC$ (All rt. ∡ $\cong$)
3. $\overline{BC} \cong \overline{CD}$ (Midpoint Thm.)
4. $\overline{CD} \cong \overline{DC}$ (Reflex. Prop. $\cong$)
5. $\overline{BC} \cong \overline{DC}$ (Trans. Prop.)
6. $\triangle ABC \cong \triangle EDC$ (SAS)

9. $MN = \sqrt{10}$, $NO = \sqrt{10}$, $MO = \sqrt{20}$, $QR = \sqrt{2}$, $RS = \sqrt{50}$, and $QS = 6$. The corresponding sides are not congruent, so the triangles are not congruent.

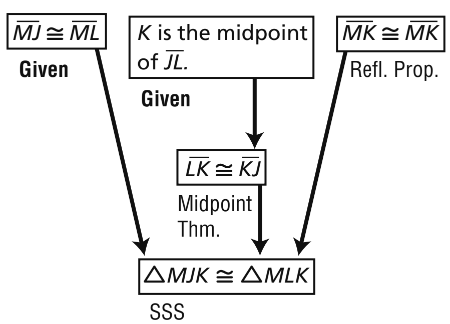
11. $MN = \sqrt{10}$, $NO = \sqrt{10}$, $MO = \sqrt{20}$, $QR = \sqrt{10}$, $RS = \sqrt{10}$, and $QS = \sqrt{20}$. Each pair of corresponding sides has the same measure, so they are congruent. $\triangle MNO \cong \triangle QRS$ by SSS.

13. Since R is the midpoint of $\overline{QS}$ and $\overline{PT}$, $\overline{PR} \cong \overline{RT}$ and $\overline{RQ} \cong \overline{RS}$ by definition of a midpoint. $\angle PRQ \cong \angle TRS$ by the Vertical Angles Theorem. So, $\triangle PRQ \cong \triangle TRS$ by SAS.

15. Proof: We know that $\overline{WY}$ bisects $\angle Y$, so $\angle XYW \cong \angle ZYW$. Also, $\overline{YW} \cong \overline{YW}$ by the Reflexive Property. Since $\triangle XYZ$ is equilateral it is a special type of isosceles triangle, so $\overline{XY} \cong \overline{ZY}$. By the Side-Angle-Side Congruence Postulate, $\triangle XYW \cong \triangle ZYW$. By CPCTC, $\overline{XW} \cong \overline{ZW}$.

17. not possible **19.** SAS

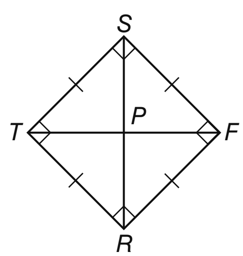
21. Proof:



23a. Given: $\overline{TS} \cong \overline{SF} \cong \overline{FR} \cong \overline{RT}$ $\angle TSF$, $\angle SFR$, $\angle FRT$, and $\angle RTS$ are right angles.

Prove: $\overline{RS} \cong \overline{TF}$

Proof:



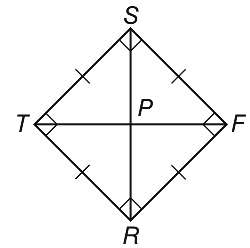
Statements (Reasons)

1. $\overline{TS} \cong \overline{SF} \cong \overline{FR} \cong \overline{RT}$ (Given)
2. $\angle TSF$, $\angle SFR$, $\angle FRT$, and $\angle RTS$ are right angles. (Given)
3. $\angle STR \cong \angle TRF$ (All rt ∡ are $\cong$.)
4. $\triangle STR \cong \triangle TRF$ (SAS)
5. $\overline{RS} \cong \overline{TF}$ (CPCTC)

23b. Given: $\overline{TS} \cong \overline{SF} \cong \overline{FH} \cong \overline{HT}$; $\angle TSF$, $\angle SFH$, $\angle FHT$, and $\angle HTS$ are right ∡.

Prove: $\angle SRT \cong \angle SRF$

Proof:



Statements (Reasons)

1. $\overline{TS} \cong \overline{SF} \cong \overline{FR} \cong \overline{RT}$ (Given)
2. $\angle TSF$, $\angle SFR$, $\angle FRT$, and $\angle RTS$ are right angles. (Given)
3. $\angle STR \cong \angle SFR$ (All rt ∡ are $\cong$.)
4. $\triangle STR \cong \triangle SFR$ (SAS)
5. $\angle SRT \cong \angle SRF$ (CPCTC)

25. Proof:

Statements (Reasons)

1. $\triangle EAB \cong \triangle DCB$ (Given)
2. $\overline{EA} \cong \overline{DC}$ (CPCTC)
3. $\overline{ED} \cong \overline{DE}$ (Reflex. Prop.)
4. $\overline{AB} \cong \overline{CB}$ (CPCTC)
5. $\overline{DB} \cong \overline{EB}$ (CPCTC)
6. $AB = CB$, $DB = EB$ (Def. $\cong$ segments)
7. $AB + DB = CB + EB$ (Add. Prop. $=$)
8. $AD = AB + DB$, $CE = CB + EB$ (Segment addition)
9. $AD = CE$ (Subst. Prop. $=$)
10. $\overline{AD} \cong \overline{CE}$ (Def. $\cong$ segments)
11. $\triangle EAD \cong \triangle DCE$ (SSS)

27. $y = 4$; By CPCTC, $\angle WXZ \cong \angle WXY$, and $\overline{YX} \cong \overline{ZX}$.

29a. Sample answer: Method 1: You could use the Distance Formula to find the length of each of the sides, and then use the Side-Side-Side Congruence Postulate to prove the triangles congruent. Method 2: You could find the slopes of $\overline{ZX}$ and $\overline{WY}$ to prove that they are perpendicular and that $\angle WYZ$ and $\angle WYX$ are both right angles. You can use the Distance Formula to prove that $\overline{XY}$ is congruent to $\overline{ZY}$. Since the triangles share the leg $\overline{WY}$, you can use the Side-Angle-Side Congruence Postulate; Sample answer: I think that method 2 is more efficient, because you only have two steps instead of three.

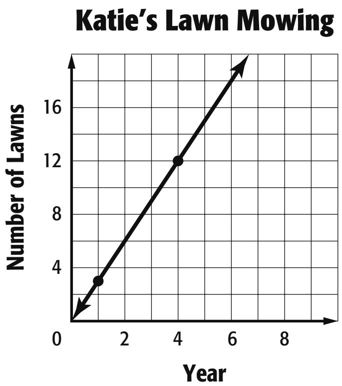
29b. Sample answer: Yes; the slope of $\overline{WY}$ is –1 and the slope of $\overline{ZX}$ is 1, and –1 and 1 are opposite reciprocals, so $\overline{WY}$ is perpendicular to $\overline{ZX}$. Since they are perpendicular, $\angle WYZ$ and $\angle WYX$ are both 90°. Using the Distance Formula, the length of $\overline{ZY}$ is $\sqrt{(4-1)^2 + (5-2)^2}$ or $3\sqrt{2}$, and the length of $\overline{XY}$ is $\sqrt{(7-4)^2 + (8-5)^2}$ or $3\sqrt{2}$. Since $\overline{WY}$ is congruent to $\overline{WY}$, $\triangle WYZ$ is congruent to $\triangle WYX$ by the Side-Angle-Side Congruence Postulate.

31. Shada; for SAS the angle must be the included angle and here it is not included.

33. Case 1: You know the hypotenuses are congruent and one of the legs are congruent. Then the Pythagorean Theorem says that the other legs are congruent so the triangles are congruent by SSS. Case 2: You know the legs are congruent and the right angles are congruent, then the triangles are congruent by SAS.

35. F **37.** D **39.** 18

41a.



41b. Sample answer: The number of new lawns that Katie adds to her business each year. **41c.** 18 **43.** Transitive Prop.
45. Substitution Prop.

Lesson 6-4

1. Proof:

Statements (Reasons)

1. $\overline{CB}$ bisects $\angle ABD$ and $\angle ACD$. (Given)
2. $\angle ABC \cong \angle DBC$ (Def. of $\angle$ bisector)
3. $\overline{BC} \cong \overline{BC}$ (Refl. Prop.)
4. $\angle ACB \cong \angle DCB$ (Def. of $\angle$ bisector)
5. $\triangle ABC \cong \triangle DBC$ (ASA)

3. Proof: We are given $\angle K \cong \angle M$, $\overline{JK} \cong \overline{JM}$, and $\overline{JL}$ bisects $\angle KLM$. Since JL bisects $\angle KLM$, we know $\angle KLJ \cong \angle MLJ$. So, $\triangle JKL \cong \triangle JML$ is congruent by the Angle-Angle-Side Congruence Theorem.

5. We know $\angle BAE$ and $\angle DCE$ are congruent because they are both right angles. $\overline{AE}$ is congruent to $\overline{EC}$ by the Midpoint Theorem. From the Vertical Angles Theorem, $\angle DEC \cong \angle BEA$. By ASA, the surveyor knows that $\triangle DCE \cong \triangle BAE$. By CPCTC, $\overline{DC} \cong \overline{AB}$, so the surveyor can measure $\overline{DC}$ and know the distance between A and B.

5b. 550 m; Since $DC = 550$ m and $DC \cong AB$, then by the definition of congruence, $AB = 550$ m.

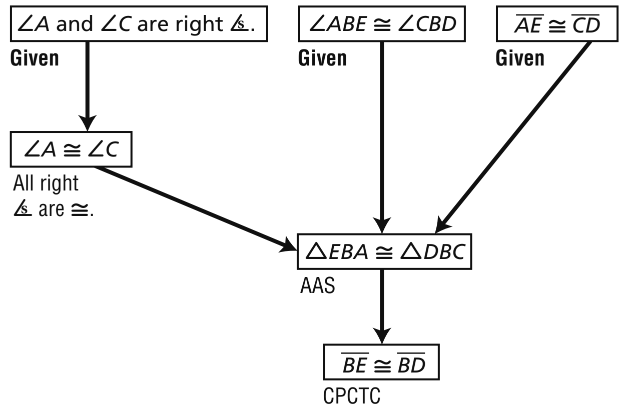
7. Proof: It is given that $\angle W \cong \angle Y$, $\overline{WZ} \cong \overline{YZ}$, and $\overline{XZ}$ bisects $\angle WZY$. By the definition of angle bisector, $\angle WZX \cong \angle YZX$. The Angle-Side-Angle Congruence Postulate tells us that $\triangle XWZ \cong \triangle XYZ$.

9. Proof:

Statements (Reasons)

1. V is the midpoint of $\overline{YW}$; $\overline{UY} \parallel \overline{XW}$. (Given)
2. $\overline{YV} \cong \overline{VW}$ (Midpoint Theorem)
3. $\angle VWX \cong \angle VYU$ (Alt. Int. $\angle$ Thm.)
4. $\angle VUY \cong \angle VXW$ (Alt. Int. $\angle$ Thm.)
5. $\triangle UVY \cong \triangle XVW$ (AAS)

11. Proof:



13a. $\angle HJK \cong \angle GFK$ since all right angles are congruent. We are given that $\overline{JK} \cong \overline{KF}$. $\angle HKJ$ and $\angle FKG$ are vertical angles, so $\angle HKJ \cong \angle FKG$ by the Vertical Angles Theorem. By ASA, $\triangle HJK \cong \triangle GFK$, so $\overline{FG} \cong \overline{HJ}$ by CPCTC. **13b.** No; $HJ = 1350$ m, so $FG = 1350$ m. If the regatta is to be 1500 m, the lake is not long enough, since $1350 < 1500$. **15.** $y = 5$

17. Proof: We are given that $\overline{AE}$ is perpendicular to $\overline{DE}$, $\overline{EA}$ is perpendicular to $\overline{AB}$, and C is the midpoint of $\overline{AE}$. Since $\overline{AE}$ is perpendicular to $\overline{DE}$, $m\angle CED = 90$. Since $\overline{EA}$ is perpendicular to $\overline{AB}$, $m\angle BAC = 90$. $\angle CED \cong \angle BAC$ because all right angles are congruent. $\overline{AC} \cong \overline{CE}$ from the Midpt. Thm. $\angle ECD \cong \angle ACB$ because they are vertical angles. Angle-Side-Angle gives us that $\triangle CED \cong \triangle CAB$. $\overline{CD} \cong \overline{CB}$ because corresponding parts of congruent triangles are congruent.

19. Proof:

Statements (Reasons)

1. $\angle K \cong \angle M$, $\overline{KP} \perp \overline{PR}$, $\overline{MR} \perp \overline{PR}$ (Given)
2. $\angle KPR$ and $\angle MRP$ are both right angles. (Def. of $\perp$)
3. $\angle KPR \cong \angle MRP$ (All rt. $\angle$s are congruent.)
4. $\overline{PR} \cong \overline{PR}$ (Refl. Prop.)
5. $\triangle KPR \cong \triangle MRP$ (AAS)
6. $\overline{KP} \cong \overline{MR}$ (CPCTC)
7. $\angle KLP \cong \angle MLR$ (Vertical angles are $\cong$.)
8. $\triangle KLP \cong \triangle MLR$ (AAS)
9. $\angle KPL \cong \angle MRL$ (CPCTC)

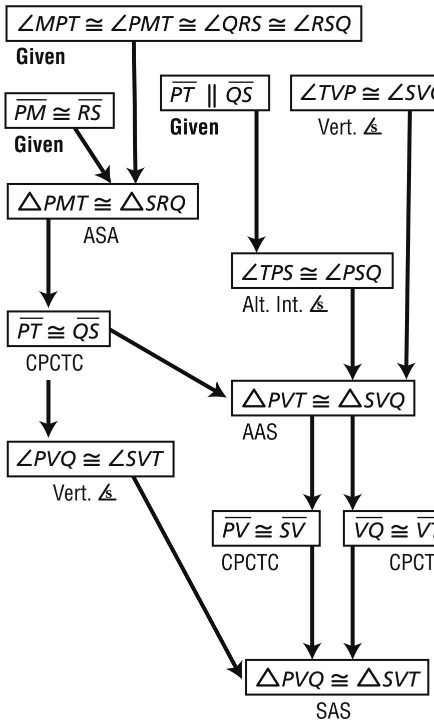
21. Proof:

Statements (Reasons)

1. $m\angle ACB = 44$, $m\angle ADB = 44$, $m\angle CBA = 68$, $m\angle DBA = 68$ (Given)
2. $m\angle ACB = m\angle ADB$, $m\angle CBA = m\angle DBA$ (Subst.)
3. $\angle ACB \cong \angle ADB$, $\angle CBA \cong \angle DBA$ (Def. of $\cong$)
4. $\overline{AB} \cong \overline{AB}$ (Refl. Prop.)
5. $\triangle ADB \cong \triangle ACB$ (AAS)
6. $\overline{AC} \cong \overline{AD}$ (CPCTC)

23. Tyrone; Lorenzo showed that all three corresponding angles were congruent, but AAA is not a proof of triangle congruence.

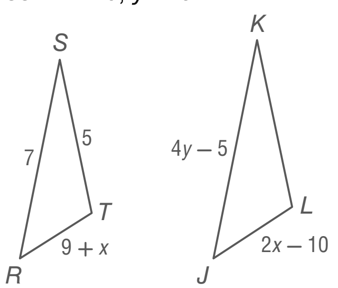
25. Proof:



27. B **29.** J

31. $AB = \sqrt{125}$, $BC = \sqrt{221}$, $AC = \sqrt{226}$, $XY = \sqrt{125}$, $YZ = \sqrt{221}$, $XZ = \sqrt{226}$. The corresponding sides have the same measure and are congruent. $\triangle ABC \cong \triangle XYZ$ by SSS.

33. $x = 19$; $y = 3$



Lesson 6-5

1. $\angle BAC$ and $\angle BCA$ **3.** 12 **5.** 12

7. Proof:

Statements (Reasons)

1. $\triangle ABC$ is isosceles; $\overline{EB}$ bisects $\angle ABC$. (Given)
2. $\overline{AB} \cong \overline{BC}$ (Def. of isosceles)
3. $\angle ABE \cong \angle CBE$ (Def. of $\angle$ bisector)
4. $\overline{BE} \cong \overline{BE}$ (Refl. Prop.)
5. $\triangle ABE \cong \triangle CBE$ (SAS)

9. $\angle ABE$ and $\angle AEB$ **11.** $\angle ACD$ and $\angle ADC$

13. $\overline{BF}$ and $\overline{BC}$ **15.** 60 **17.** 4 **19.** $x = 5$

21. $x = 11$, $y = 11$

23. Proof: We are given that $\triangle HJM$ is an isosceles triangle and $\triangle HKL$ is an equilateral triangle, $\angle JKH$ and $\angle HKL$ are supplementary and $\angle HLK$ and $\angle MLH$ are supplementary. From the Isosceles Triangle Theorem, we know that $\angle HJK \cong \angle HML$. Since $\triangle HKL$ is an equilateral triangle, we know $\angle HLK \cong \angle LKH \cong \angle KHL$ and $\overline{HL} \cong \overline{KL} \cong \overline{HK}$. $\angle JKH$, $\angle HKL$ and $\angle HLK$, $\angle MLH$ are supplementary, and $\angle HKL \cong \angle HLK$, we know $\angle JKH \cong \angle MLH$ by the Congruent Supplements Theorem. By AAS, $\triangle JHK \cong \triangle MLH$. By CPCTC, $\angle JHK \cong \angle MHL$.

25a. 65°; Since $\triangle ABC$ is an isosceles, $\angle ABC \cong \angle ACB$, so $180 - 50 = 130$ and $130 \div 2 = 65$.

25b. Proof: Statements (Reasons)

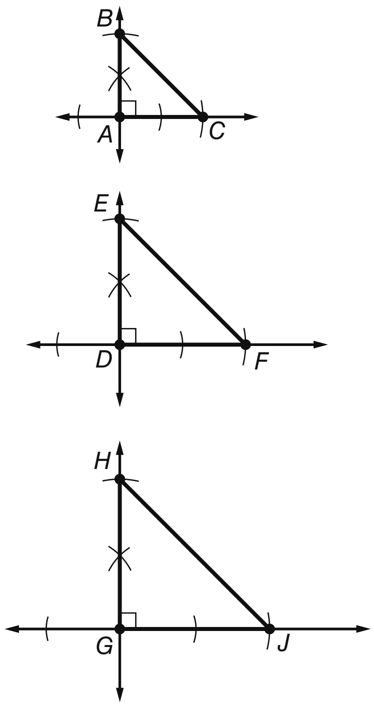
1. $\overline{AB} \cong \overline{AC}$, $\overline{BE} \cong \overline{CD}$ (Given)
2. $AB = AC$, $BE = CD$ (Def. of ≅)
3. $AB + BE = AE$, $AC + CD = AD$ (Seg. Add. Post.)
4. $AB + BE = AC + CD$ (Add. Prop. =)
5. $AE = AD$ (Subst.)
6. $\overline{AE} \cong \overline{AD}$ (Def. of ≅)
7. $\triangle AED$ is isosceles. (Def. of isosceles)

25c. Proof: Statements (Reasons)

1. $\overline{AB} \cong \overline{AC}$, $\overline{BC} \parallel \overline{ED}$, and $\overline{ED} \cong \overline{AD}$ (Given)
2. $\angle ABC \cong \angle ACB$ (Isos. △ Thm.)
3. $m\angle ABC = m\angle ACB$ (Def. of ≅ ∠s)
4. $\angle ABC \cong \angle AED$, $\angle ACB \cong \angle ADE$ (Corr. ∠s)
5. $m\angle ABC = m\angle AED$, $m\angle ACB = m\angle ADE$ (Def. of ≅ ∠s)
6. $m\angle AED = m\angle ACB$ (Subst.)
7. $m\angle AED = m\angle ADE$ (Subst.)
8. $\angle AED \cong \angle ADE$ (Def. of ≅ ∠s)
9. $\overline{AD} \cong \overline{AE}$ (Conv. of Isos. △ Thm.)
10. $\triangle ADE$ is equilateral. (Def. of equilateral △)

25d. One pair of congruent corresponding sides and one pair of congruent corresponding angles; since we know that the triangle is isosceles, if one leg is congruent to a leg of $\triangle ABC$, then you know that both pairs of legs are congruent. Because the base angles of an isosceles triangle are congruent, if you know that one pair of angles are congruent, you know that all pairs of angles are congruent. Therefore, with one pair of congruent corresponding

27.



29. 44 **31.** 136

33. Given: Each triangle is isosceles, $\overline{BG} \cong \overline{HC}$, $\overline{HD} \cong \overline{JF}$, $\angle G \cong \angle H$, and $\angle H \cong \angle J$

Prove: The distance from B to F is three times the distance from D to F.

Proof:

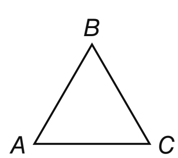
Statements (Reasons)

1. Each triangle is isosceles, $\overline{BG} \cong \overline{HC}$, $\overline{HD} \cong \overline{JF}$, $\angle G \cong \angle H$, and $\angle H \cong \angle J$. (Given)
2. $\angle G \cong \angle J$ (Trans. Prop.)
3. $\overline{BG} \cong \overline{CG}$, $\overline{HC} \cong \overline{HD}$, $\overline{JD} \cong \overline{JF}$ (Def. of Isosceles)
4. $\overline{BG} \cong \overline{JD}$ (Trans. Prop.)
5. $\overline{HC} \cong \overline{JD}$ (Trans. Prop.)
6. $\overline{CG} \cong \overline{JF}$ (Trans. Prop.)
7. $\triangle BCG \cong \triangle CDH \cong \triangle DFJ$ (SAS)
8. $\overline{BC} \cong \overline{CD} \cong \overline{DF}$ (CPCTC)
9. $BC = CD = DF$ (Def. of congruence)
10. $BC + CD + DF = BF$ (Seg. Add. Post.)
11. $DF + DF + DF = BF$ (Subst.)
12. $3DF = BF$ (Addition)

35. Case I

Given: $\triangle ABC$ is an equilateral triangle.

Prove: $\triangle ABC$ is an equiangular triangle.



Proof:

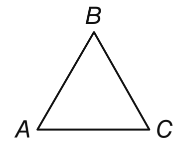
Statements (Reasons)

1. $\triangle ABC$ is an equilateral triangle. (Given)
2. $\overline{AB} \cong \overline{AC} \cong \overline{BC}$ (Def. of equilateral $\triangle$)
3. $\angle A \cong \angle B \cong \angle C$ (Isosceles $\triangle$ Th.)
4. $\triangle ABC$ is an equiangular triangle. (Def. of equiangular)

Case II

Given: $\triangle ABC$ is an equiangular triangle.

Prove: $\triangle ABC$ is an equilateral triangle.



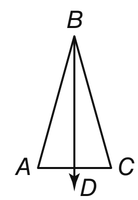
Proof:

Statements (Reasons)

1. $\triangle ABC$ is an equiangular triangle. (Given)
2. $\angle A \cong \angle B \cong \angle C$ (Def. of equiangular $\triangle$)
3. $\overline{AB} \cong \overline{AC} \cong \overline{BC}$ (If 2 ∠s of a $\triangle$ are $\cong$ then the sides opp. those ∠s are $\cong$.)
4. $\triangle ABC$ is an equilateral triangle. (Def. of equilateral

37. Given: $\triangle ABC$; $\angle A \cong \angle C$

Prove: $\overline{AB} \cong \overline{CB}$



Proof:

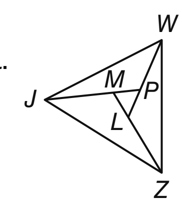
Statements (Reasons)

1. Let $\overrightarrow{BD}$ bisect $\angle ABC$. (Protractor Post.)
2. $\angle ABD \cong \angle CBD$ (Def. of $\angle$ bisector)
3. $\angle A \cong \angle C$ (Given)
4. $\overline{BD} \cong \overline{BD}$ (Refl. Prop.)
5. $\triangle ABD \cong \triangle CBD$ (AAS)
6. $\overline{AB} \cong \overline{CB}$ (CPCTC

39. 14 **41.** 80 **43.** 80

45. Given: $\triangle WJZ$ is equilateral, and $\angle ZWP \cong \angle WJM \cong \angle JZL$.

Prove: $\overline{WP} \cong \overline{ZL} \cong \overline{JM}$



Proof:

We know that $\triangle WJZ$ is equilateral, since an equilateral $\triangle$ is equiangular, $\angle ZWJ \cong \angle WJZ \cong \angle JZW$. So, $m\angle ZWJ = m\angle WJZ = m\angle JZW$, by the definition of congruence. Since $\angle ZWP \cong \angle WJM \cong \angle JZL$, $m\angle ZWP = m\angle WJM = m\angle JZL$, by the definition of congruence. By the Angle Addition Postulate, $m\angle ZWJ = m\angle ZWP + m\angle PWJ$, $m\angle WJZ = m\angle WJM + m\angle MJZ$, $m\angle JZW = m\angle JZL + m\angle LZW$. By substitution, $m\angle ZWP + m\angle PWJ = m\angle WJM + m\angle MJZ = m\angle JZL + m\angle LZW$.

Again by substitution, $m\angle ZWP + m\angle PWJ = m\angle ZWP + m\angle PJZ = m\angle ZWP + m\angle LZW$. By the Subtraction Property, $m\angle PWJ = m\angle PJZ = m\angle LZW$. By the definition of congruence, $\angle PWJ \cong \angle PJZ \cong \angle LZW$. So, by ASA, $\triangle WZL \cong \triangle ZJM \cong \triangle JWP$. By CPCTC, $\overline{WP} \cong \overline{ZL} \cong \overline{JM}$.

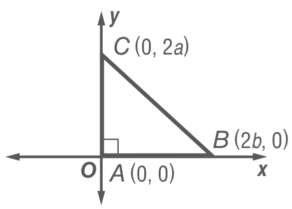
47. Never; the measure of the vertex angle will be 180 − 2 (measure of the base angle) so if the base angles are integers, then 2(measure of the base angle) will be even and 180 − 2(measure of the base angle) will be even **49.** It is not possible because a triangle cannot have more than one obtuse angle.
51. The sum of the measures of the angles must be 180 and the base angles have the same measure, so the measure of the vertex angle will be equal to 180 − 2 (measure of the base angle).
53. 185 **55.** E **57.** $SU = \sqrt{17}$, $TU = \sqrt{2}$, $ST = 5$, $XZ = \sqrt{29}$, $YZ = 2$, $XY = 5$; the corresponding sides are not congruent; the triangles are not congruent. **61.** $m\angle 4 = 90$, $m\angle 5 = 90$, $m\angle 6 = 45$, $m\angle 7 = 45$, $m\angle 8 = 90$; Perpendicular lines intersect to form four right angles and Complement Theorem
63. Proof:

Statement (Reasons)

1. $\angle ACB \cong \angle ABC$ (Given)
2. $\angle XCA$ and $\angle ACB$ are a linear pair. $\angle ABC$ and $\angle ABY$ are a linear pair. (Def. of Linear Pair)
3. $\angle XCA$, $\angle ABC$ and $\angle ABC$, $\angle ABY$ are suppl. (Suppl. Thm.)
4. $\angle XCA \cong \angle YBA$ (∠s suppl. to ≅ ∠s are ≅.)

Lesson 6-6

1.



3. $T(2a, 0)$

5. $DC = \sqrt{(-a-(-a))^2 + (b-0)^2}$ or b

$GH = \sqrt{(a-a)^2 + (b-0)^2}$ or b
Since $DC = GH$, $\overline{DC} \cong \overline{GH}$.

$DF = \sqrt{(0+a)^2 + \left(\frac{b}{2} - b\right)^2}$ or $\sqrt{a^2 + \frac{b^2}{4}}$

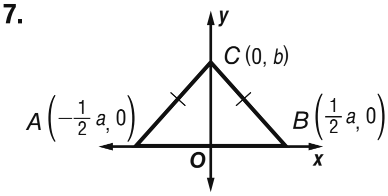
$GF = \sqrt{(a-0)^2 + \left(b - \frac{b}{2}\right)^2}$ or $\sqrt{a^2 + \frac{b^2}{4}}$

$CF = \sqrt{(0+a)^2 + \left(\frac{b}{2} - 0\right)^2}$ or $\sqrt{a^2 + \frac{b^2}{4}}$

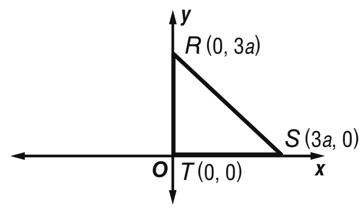
$HF = \sqrt{(a-0)^2 + \left(0 - \frac{b}{2}\right)^2}$ or $\sqrt{a^2 + \frac{b^2}{4}}$

Since $DF = GF = CF = HF$,
$\overline{DF} \cong \overline{GF} \cong \overline{CF} \cong \overline{HF}$.
$\triangle FGH \cong \triangle FDC$ by SSS

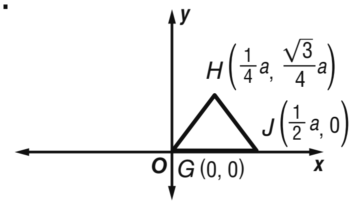
7.



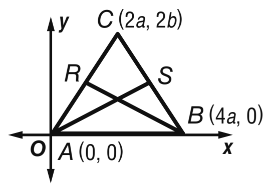
9.



11.



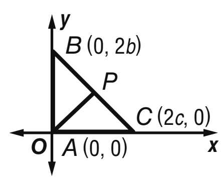
13. $C(a, a)$, $Y(a, 0)$ **15.** $N(0, 0)$, $J(1.5a, b)$, $L(3a, 0)$
17. $H(2b, 2b\ 3)$, $N(0, 0)$, $D(4b, 0)$
19. Given: Isosceles $\triangle ABC$ with $\overline{AC} \cong \overline{BC}$; R and S are midpoints of legs $\overline{AC}$ and $\overline{BC}$.



Prove: $\overline{AS} \cong \overline{BR}$

Proof:
The coordinates of S are $\left(\frac{2a+4a}{2}, \frac{2b+0}{2}\right)$ or $(3a, b)$.
The coordinates of R are $\left(\frac{2a+0}{2}, \frac{2b+0}{2}\right)$ or (a, b).
$AS = \sqrt{(3a-0)^2 + (b-0)^2}$ or $\sqrt{9a^2 + b^2}$
$BR = \sqrt{(4a-a)^2 + (0-b)^2}$ or $\sqrt{9a^2 + b^2}$
Since $AS = BR$, $\overline{AS} \cong \overline{BR}$.

21. Given: Right $\triangle ABC$ with right $\angle BAC$; P is the midpoint of $\overline{BC}$.



Prove: $AP = \frac{1}{2}BC$
Proof:
Midpoint P is $\left(\frac{0+2c}{2}, \frac{2b+0}{2}\right)$ or (c, b).
$AP = \sqrt{(c-0)^2 + (b-0)^2}$ or $\sqrt{c^2 + b^2}$
$BC = \sqrt{(2c-0)^2 + (0-2b)^2} = \sqrt{4c^2 + 4b^2}$ or $2\sqrt{c^2 + b^2}$
$\frac{1}{2}BC = \sqrt{c^2 + b^2}$
So, $AP = \frac{1}{2}BC$.

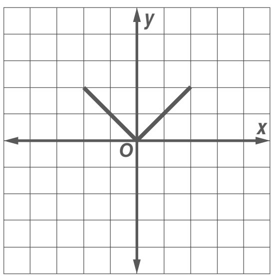
23. The distance between Raleigh and Durham is about 0.2 units, between Raleigh and Chapel Hill is about 4.03 units, and between

Durham and Chapel Hill is about 3.88 units. Since none of these distances are the same, the Research Triangle is scalene.

25. slope of $\overline{XY} = 1$, slope of $\overline{YZ} = -1$, slope of $\overline{ZX} = 0$; since the slopes of two sides of $\triangle XYZ$ are negative reciprocals, $\triangle XYZ$ is a right triangle.

27. The slope between the tents is $-\frac{4}{3}$. The slope between the ranger's station and the tent located at (12, 9) is $\frac{3}{4}$. Since $-\frac{4}{3} \cdot \frac{3}{4} = -1$, the triangle formed by the tents and ranger's station is a right triangle.

29.



The equation of the line along which the first vehicle lies is $y = x$. The slope is 1 because the vehicle travels the same number of units north as it does east of the origin and the y-intercept is 0. The equation of the line along which the second vehicle lies is $y = -x$. The slope is -1 because the vehicle travels the same number of units north as it does west of the origin and the y-intercept is 0.

29b. The paths taken by both the first and second vehicles are 300 yards long. Therefore the paths are congruent. If two sides of a triangle are congruent, then the triangle is isosceles.

29c. First vehicle, $(150\sqrt{2}, 150\sqrt{2})$; second vehicle, $(-150\sqrt{2}, 150\sqrt{2})$; third vehicle, (0, 212); the paths taken by the first two vehicles form the hypotenuse of a right triangle. Using the Pythagorean Theorem, the distance between the third vehicle and the first and second vehicle can be calculated. The third vehicle travels due north and therefore, remains on the y-axis.

29d. The y-coordinates of the first two vehicles are $150\sqrt{2} \approx 212.13$, while the y-coordinate of the third vehicle is 212. Since all three vehicles have approximately the same y-coordinate, they are approximately collinear. The midpoint of the first and second vehicle is $\left(\frac{150\sqrt{2} - 150\sqrt{2}}{2}, \frac{212 + 212}{2}\right)$ or (0, 212), the location of the third vehicle.

31. $(a, 0)$ **33.** $(4a, 0)$

35. Given: $\triangle ABC$ with coordinates $A(0, 0)$, $B(a, b)$, and $C(c, d)$ and $\triangle DEF$ with coordinates $D(0 + n, 0 + m)$, $E(a + n, b + m)$, and $F(c + n, d + m$

Prove: $\triangle DEF \cong \triangle ABC$

Proof:

$AB = \sqrt{(a - 0)^2 + (b - 0)^2}$ or $\sqrt{a^2 + b^2}$

$DE = \sqrt{[a + n - (0 + n)]^2 + [b + m - (0 + m)]^2}$ or $\sqrt{a^2 + b^2}$

Since, $AB = DE$, $\overline{AB} \cong \overline{DE}$.

$BC = \sqrt{(c - a)^2 + (d - b)^2}$ or $\sqrt{c^2 - 2ac + a^2 + d^2 - 2bd + b^2}$

$EF = \sqrt{[c + n - (a + n)]^2 + [d + m - (b + m)]^2}$ or $\sqrt{c^2 - 2ac + a^2 + d^2 - 2bd + b^2}$

Since $BC = EF$, $\overline{BC} \cong \overline{EF}$.

$CA = \sqrt{(c - 0)^2 + (d - 0)^2}$ or $\sqrt{c^2 + d^2}$

$FD = \sqrt{[0 + n - (c + n)]^2 + [0 + m - (d + m)]^2}$ or $\sqrt{c^2 + d^2}$

Since $CA = FD$, $\overline{CA} \cong \overline{FD}$.

Therefore, $\triangle DEF \cong \triangle ABC$ by the SSS Postulate.

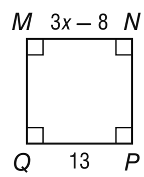
37a. Using the origin as a vertex of the triangle makes calculations easier because the coordinates are (0, 0).

37b. Placing at least one side of the triangle on the x- or y-axis makes it easier to calculate the length of the side since one of the coordinates will be 0.

37c. Keeping a triangle within the first quadrant makes all of the coordinates positive, and makes the calculations easier.

39. D **41.** C

43. Given: $\overline{MN} \cong \overline{QP}$



Prove: $x = 7$

Proof:

<u>Statements (Reasons)</u>

1. $\overline{MN} \cong \overline{QP}$ (Given)
2. $MN = QP$ (Def. of congruent segments)
3. $3x - 8 = 13$ (Subs. Prop.)
4. $3x - 8 + 8 = 13 + 8$ (Add. Prop.)
5. $3x = 21$ (Simplify.)
6. $\frac{3x}{3} = \frac{21}{3}$ (Div. Prop.)
7. $x = 7$ (Simplify.)

45a. $\overline{RQ} \cong \overline{QS}$. **47.** 4.2 **49.** 3.6

Chapter 6 Study Guide and Review

1. true **3.** true **5.** false; base **7.** true **9.** false; coordinate proof **11.** 70 **13.** 82

15. $\angle D \cong \angle J$, $\angle A \cong \angle F$, $\angle C \cong \angle H$, $\angle B \cong \angle G$, $\overline{AB} \cong \overline{FG}$, $\overline{BC} \cong \overline{HG}$, $\overline{DC} \cong \overline{JH}$, $\overline{DA} \cong \overline{JF}$; polygon $ABCD \cong$ polygon $FGHJ$

17. $\triangle BFG \cong \triangle CGH \cong \triangle DHE \cong \triangle AEF$, $\triangle EFG \cong \triangle FGH \cong \triangle GHE \cong \triangle HEF$

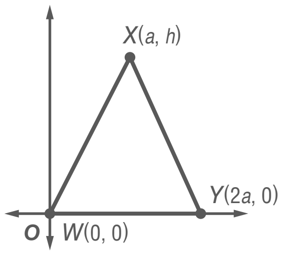
19. No, the corresponding sides of the two triangles are not congruent. **21.** not possible

23. <u>Statements (Reasons)</u>

1. $\overline{AB} \parallel \overline{DC}$ (Given)
2. $\angle A \cong \angle DCE$ (Alternate Interior ∠s Thm.)
3. $\overline{AB} \cong \overline{DC}$ (Given)
4. $\angle ABE \cong \angle D$ (Alternate Interior ∠s Thm.)
5. $\triangle ABE \cong \triangle CDE$ (ASA)

25. 3 **27.** 77.5

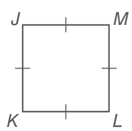
29.



CHAPTER 7
Relationships in Triangles

Chapter 7 Get Ready

1. 9 **3.** 10 ft
5. $JK = KL = LM = MJ$

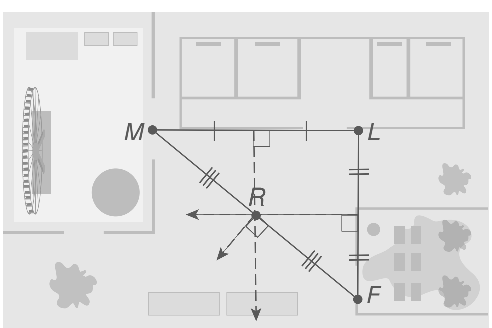


7. Sometimes; the conjecture is true when E is between D and F, otherwise it is false. **9.** $-6 > x$ **11.** $x < 41$

Lesson 7-1

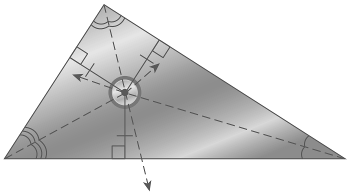
1. 12 **3.** 15 **5.** 8 **7.** 12 **9.** 14 **11.** 6 **13.** 4

15.



17. $\overline{CD}$, $\overline{BD}$ **19.** $\overline{BH}$ **21.** 11 **23.** 88 **25.** 42 **27.** 7.1 **29.** 33

31.



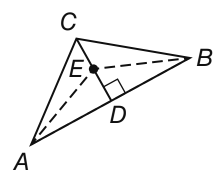
Find the point of concurrency of the angle bisectors of the triangle, the incenter. This point is equidistant from each side of the triangle. **33.** No; we need to know if the perpendicular segments are equal to each other. **35.** No; we need to know whether the hypotenuse of the triangles are congruent.

37. Proof:

<u>Statements (Reasons)</u>

1. $\overline{CA} \cong \overline{CB}$, $\overline{AD} \cong \overline{BD}$ (Given)
2. $\overline{CD} \cong \overline{CD}$ (Congruence of segments is reflexive.)
3. $\triangle ACD \cong \triangle BCD$ (SSS)
4. $\angle ACD \cong \angle BCD$ (CPCTC)
5. $\overline{CE} \cong \overline{CE}$ (Congruence of segments is reflexive.)
6. $\triangle CEA \cong \triangle CEB$ (SAS)
7. $\overline{AE} \cong \overline{BE}$ (CPCTC)
8. E is the midpoint of $\overline{AB}$. (Def. of midpoint)
9. $\angle CEA \cong \angle CEB$ (CPCTC)
10. $\angle CEA$ and $\angle CEB$ form a linear pair. (Def. of linear pair)
11. $\angle CEA$ and $\angle CEB$ are supplementary. (Suppl. Thm.)
12. $m\angle CEA + m\angle CEB = 180$ (Def. of supplementary)
13. $m\angle CEA + m\angle CEA = 180$ (Substitution Prop.)
14. $2m\angle CEA = 180$ (Substitution Prop.)
15. $m\angle CEA = 90$ (Division Prop.)
16. $\angle CEA$ and $\angle CEB$ are rt. ∠. (Def. of rt. ∠)
17. $\overline{CD} \perp \overline{AB}$ (Def. of ⊥)
18. $\overline{CD}$ is the ⊥ bisector of $\overline{AB}$. (Def. of ⊥ bisector)
19. C and D are on the ⊥ bisector of $\overline{AB}$. (Def. of point on a line)

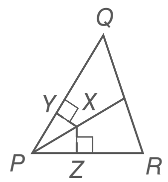
39. Given: $\overline{CD}$ is the ⊥ bisector of $\overline{AB}$.
E is a point on $\overline{CD}$.
Prove: $EA = EB$



Proof: $\overline{CD}$ is the ⊥ bisector of $\overline{AB}$. By definition of bisector, D is the midpoint of $\overline{AB}$. Thus, $\overline{AD} \cong \overline{BD}$ by the Midpoint Theorem. $\angle CDA$ and $\angle CDB$ are right angles by the definition of perpendicular. Since all right angles are congruent, $\angle CDA \cong \angle CDB$. Since E is a point on $\overline{CD}$, $\angle EDA$ and $\angle EDB$ are right angles and are congruent. By the Reflexive Property, $\overline{ED} \cong \overline{ED}$. Thus $\angle EDA \cong \angle EDB$ by SAS. $\overline{EA} \cong \overline{EB}$ because CPCTC, and by definition of congruence, $EA = EB$

41. $y = -\frac{7}{2}x + \frac{15}{4}$; The perpendicular bisector bisects the segment at the midpoint of the segment. The midpoint is $\left(\frac{1}{2}, 2\right)$. The slope of the given segment is $\frac{2}{7}$, so the slope of the perpendicular bisector is $-\frac{7}{2}$.

43. Given: $\overline{PX}$ bisects $\angle QPR$. $\overline{XY} \perp \overline{PQ}$ and $\overline{XZ} \perp \overline{PR}$
Prove: $\overline{XY} \cong \overline{XZ}$



Proof:

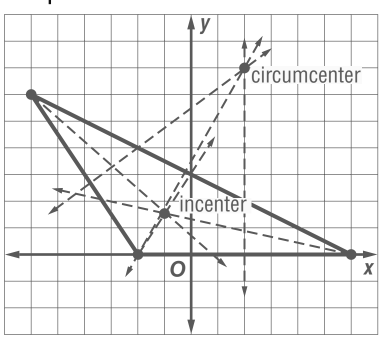
Statements (Reasons)

1. $\overline{PX}$ bisects $\angle QPR$, $\overline{XY} \perp \overline{PQ}$ and $\overline{XZ} \perp \overline{PR}$. (Given)
2. $\angle YPX \cong \angle ZPX$ (Definition of angle bisector)
3. $\angle PYX$ and $\angle PZX$ are right angles. (Definition of perpendicular)
4. $\angle PYX \cong \angle PZX$ (Right angles are congruent.)
5. $\overline{PX} \cong \overline{PX}$ (Reflexive Property)
6. $\triangle PYX \cong \triangle PZX$ (AAS)
7. $\overline{XY} \cong \overline{XZ}$ (CPCTC)

45. The equation of a line of one of the perpendicular bisectors is $y = 3$. The equation of a line of another perpendicular bisector is $x = 5$. These lines intersect at (5, 3). The circumcenter is located at (5, 3).

47. a plane perpendicular to the plane in which $\overline{CD}$ lies and bisecting $\overline{CD}$

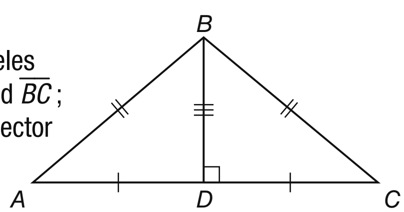
49. Sample answer:



51. always

Given: $\triangle ABC$ is isosceles with legs $\overline{AB}$ and $\overline{BC}$; $\overline{BD}$ is the $\perp$ bisector of $\overline{AC}$.

Prove: $\overline{BD}$ is the angle bisector of $\angle ABC$.



Proof:

Statements (Reasons)

1. $\triangle ABC$ is isosceles with legs $\overline{AB}$ and $\overline{BC}$. (Given)
2. $\overline{AB} \cong \overline{BC}$ (Def. of isosceles $\triangle$)
3. $\overline{BD}$ is the $\perp$ bisector of $\overline{AC}$. (Given)
4. D is the midpoint of $\overline{AC}$. (Def. of segment bisector)
5. $\overline{AD} \cong \overline{DC}$ (Def. of midpoint)
6. $\overline{BD} \cong \overline{BD}$ (Reflexive Property)
7. $\triangle ABD \cong \triangle CBD$ (SSS)
8. $\angle ABD \cong \angle CBD$ (CPCTC)
9. $\overline{BD}$ is the angle bisector of $\angle ABC$. (Def. $\angle$ bisector)

53. Proof:

Statements (Reasons)

1. Plane $\mathcal{Z}$ is an angle bisector of $\angle KJH$; $\overline{KJ} \cong \overline{HJ}$ (Given)
2. $\angle KJM \cong \angle HJM$ (Definition of angle bisector)
3. $\overline{JM} \cong \overline{JM}$ (Reflexive Property)
4. $\triangle KJM \cong \triangle HJM$ (SAS)
5. $\overline{MH} \cong \overline{MK}$ (CPCTC)

55. A **57.** D **59.** $L(a, b)$ **61.** $S(-2b, 0)$ and $R(0, c)$

63. −6 **65.** 0.8, 15.2

67. Proof:

Statements (Reasons)

1. $\triangle MLP$ is isosceles. (Given)
2. $\overline{ML} \cong \overline{PL}$ (Definition of isosceles $\triangle$)
3. $\angle M \cong \angle P$ (Isosceles $\triangle$ Th.)
4. N is the midpoint of $\overline{MP}$. (Given)
5. $\overline{MN} \cong \overline{PN}$ (Def. of midpoint)
6. $\triangle MNL \cong \triangle PNL$ (SAS)
7. $\angle LNM \cong \angle LNP$ (CPCTC)
8. $m\angle LNM = m\angle LNP$ (Def. of $\cong$ ∡s)
9. $\angle LNM$ and $\angle LNP$ are a linear pair. (Def. of a linear pair)
10. $m\angle LNM + m\angle LNP = 180$ (Sum of measures of linear pair of ∡s = 180)
11. $2m\angle LNM = 180$ (Substitution)
12. $m\angle LNM = 90$ (Division)
13. $\angle LNM$ is a right angle. (Def. of rt. $\angle$)
14. $\overline{LN} \perp \overline{MP}$ (Def. of $\perp$)

Lesson 7-2

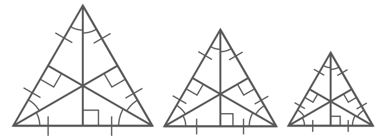
1. 12 **3.** (5, 6) **5.** 4.5 **7.** 13.5 **9.** 6 **11.** (3, 6) **13.** (3, 4) **15.** (−4, −4) **17.** median **19.** median **21.** 3 **23.** $\frac{1}{2}$ **25.** 6; no; because $m\angle ECA = 92$ **27.** altitude **29.** median

31. Given: $\triangle XYZ$ is isosceles. $\overline{WY}$ bisects $\angle Y$.

Prove: $\overline{WY}$ is a median.

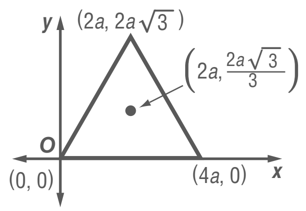
Proof: Since $\triangle XYZ$ is isosceles, $\overline{XY} \cong \overline{YZ}$. By the definition of angle bisector, $\angle XYW \cong \angle ZYW$. $\overline{YW} \cong \overline{YW}$ by the Reflexive Property. So, by SAS, $\triangle XYW \cong \triangle ZYW$. By CPCTC, $\overline{XW} \cong \overline{ZW}$. By the definition of a midpoint, W is the midpoint of $\overline{XZ}$. By the definition of a median, $\overline{WY}$ is a median.

33a.



33b. Sample answer: The four points of concurrency of an equilateral triangle are all the same point.

33c.

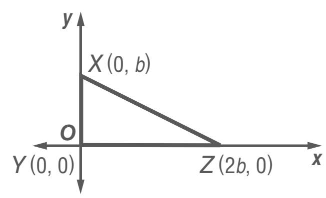


35. 7 **37.** Sample answer: Kareem is correct. According to the Centroid Theorem, $AP = \frac{2}{3}AD$. The segment lengths are transposed.

39. $\left(1, \frac{5}{3}\right)$; Sample answer: I found the midpoint of $\overline{AC}$ and used it to find the equation for the line that contains point *B* and the midpoint of $\overline{AC}$, $y = \frac{10}{3}x - \frac{5}{3}$. I also found the midpoint of $\overline{BC}$ and the equation for the line between point *A* and the midpoint of $\overline{BC}$, $y = -\frac{1}{3}x + 2$. I solved the system of two equations for *x* and *y* to get the coordinates of the centroid, $\left(1, \frac{5}{3}\right)$.

41. $2\sqrt{13}$ **43.** Sample answer: Each median divides the triangle into two smaller triangles of equal area, so the triangle can be balanced along any one of those lines. To balance the triangle on one point, you need to find the point where these three balance lines intersect. The balancing point for a rectangle is the intersection of the segments connecting the midpoints of the opposite sides, since each segment connecting these midpoints of a pair of opposite sides divides the rectangle into two parts with equal area. **45.** 3 **47.** B **49.** 5

51.



53. Because the lines are perpendicular, the angles formed are right angles. All right angles are congruent. Therefore, ∠1 is congruent to ∠2.

Lesson 7-3

1. ∠1, ∠2 **3.** ∠4 **5.** ∠*A*, ∠*C*, ∠B; $\overline{BC}$, $\overline{AB}$, $\overline{AC}$

7. $\overline{BC}$; Sample answer: Since the angle across from segment $\overline{BC}$ is larger than the angle across from $\overline{AC}$, $\overline{BC}$ is longer.

9. ∠1, ∠2 **11.** ∠1, ∠3, ∠6, ∠7 **13.** ∠5, ∠9

17. ∠*L*, ∠*P*, ∠*M*; $\overline{PM}$, $\overline{ML}$, $\overline{PL}$ **19.** ∠*C*, ∠*D*, ∠*E*; $\overline{DE}$, $\overline{CE}$, $\overline{CD}$

21. If $m\angle X = 90$, then $m\angle Y + m\angle Z = 90$, so $m\angle Y < 90$ by the definition of inequality. So $m\angle X > m\angle Y$. According to Theorem 5.9, if $m\angle X > m\angle Y$, then the length of the side opposite ∠*X* must be greater than the length of the side opposite ∠*Y*. Since $\overline{YZ}$ is opposite ∠*X*, and $\overline{XZ}$ is opposite ∠*Y*, then $YZ > XZ$. So *YZ*, the length of the top surface of the ramp, must be greater than the length of the ramp.

23. ∠*P*, ∠*Q*, ∠*M*; $\overline{MQ}$, $\overline{PM}$, $\overline{PQ}$ **25.** ∠2 **27.** ∠3 **29.** ∠8

31. $m\angle BCF > m\angle CFB$ **33.** $m\angle DBF < m\angle BFD$

35. $RP > MP$ **37.** $RM > RQ$

39. ∠*C*, ∠*A*, ∠*B*, because $AB = \sqrt{29} \approx 5.4$, $BC = \sqrt{74} \approx 8.6$, and $AC = 9$. **41.** *AB*, *BC*, *AC*, *CD*, *BD*; In △*ABC*, $AB < BC < AC$ and in △*BCD*, $BC < CD < BD$. By the figure $AC < CD$, so $BC < AC < CD$. **43.** Sample answer: ∠*R* is an exterior angle to △*PQR*, so by the Exterior Angle Inequality, $m\angle R$ must be greater than $m\angle Q$. The markings indicate that $\angle R \cong \angle Q$, indicating that $m\angle R = m\angle Q$. This is a contradiction of the Exterior Angle Inequality Theorem, so the markings are incorrect.

45. Sample answer: 10; $m\angle C > m\angle B$, so if $AB > AC$, Theorem 5.10 is satisfied. Since $10 > 6$, $AB > AC$.

47. $m\angle 1$, $m\angle 2 = m\angle 5$, $m\angle 4$, $m\angle 6$, $m\angle 3$; Sample answer: Since the side opposite ∠5 is the smallest side in that triangle and $m\angle 2 = m\angle 5$, we know that $m\angle 4$ and $m\angle 6$ are both greater than $m\angle 2$ and $m\angle 5$. Since the side opposite ∠2 is longer than the side opposite ∠1, we know that $m\angle 1$ is less than $m\angle 2$ and $m\angle 5$. Since $m\angle 1$ is less than $m\angle 4$, we know that $m\angle 3$ is greater than $m\angle 6$.

49. D **51.** a. $t = 2.5h + 198$ **53.** 9

55. $y = -5x + 7$; The perpendicular bisector bisects the segment at the midpoint of the segment. The midpoint is $\left(\frac{1}{2}, \frac{9}{2}\right)$. The slope of the given segment is $\frac{1}{5}$, so the slope of the perpendicular bisector is -5.

57. Given: *T* is the midpoint of $\overline{SQ}$.
$\overline{SR} \cong \overline{QR}$

Prove: $\triangle SRT \cong \triangle QRT$

Proof:

Statements (Reasons)

1. *T* is the midpoint of $\overline{SQ}$. (Given)
2. $\overline{ST} \cong \overline{TQ}$ (Def. of midpoint)
3. $\overline{SR} \cong \overline{QR}$ (Given)
4. $\overline{RT} \cong \overline{RT}$ (Reflexive Prop.)
5. $\triangle SRT \cong \triangle QRT$ (SSS)

Lesson 7-4

1. $\overline{AB} \not\cong \overline{CD}$ **3.** $x \geq 6$

5. Given: $2x + 3 < 7$

Prove: $x < 2$

Indirect Proof: Step 1 Assume that $x > 2$ or $x = 2$ is true.

Step 2

x	2	3	4	5	6
2x + 3	7	9	11	13	15

When $x > 2$, $2x + 3 > 7$ and when $x = 2$, $2x + 3 = 7$.

Step 3 In both cases, the assumption leads to the contradiction of the given information that $2x + 3 < 7$. Therefore, the assumption that $x \geq 2$ must be false, so the original conclusion that $x < 2$ must be true.

7. Use a = average or $\frac{\text{number of points scored}}{\text{number of games played}}$.

Indirect Proof:

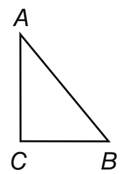
Step 1 Assume that Christina's average points per game was greater than or equal to 3, $a \geq 3$.

Step 2

CASE 1	**CASE 2**
$a = 3$	$a > 3$
$3 \stackrel{?}{=} \frac{13}{6}$	$\frac{13}{6} \stackrel{?}{>} 3$
$3 \neq 2.2$	$2.2 \not> 3$

Step 3 The conclusions are false, so the assumption must be false. Therefore, Christina's average points per game was less than 3.

9. **Given:** $\triangle ABC$ is a right triangle; $\angle C$ is a right angle.
Prove: $AB > BC$ and $AB > AC$



Indirect Proof: Step 1 Assume that the hypotenuse of a right triangle is not the longest side. That is, $AB < BC$ and $AB < AC$.

Step 2 If $AB < BC$, then $m\angle C < m\angle A$. Since $m\angle C = 90$, $m\angle A > 90$. So, $m\angle C + m\angle A > 180$. By the same reasoning, $m\angle C + m\angle B > 180$.

Step 3 Both relationships contradict the fact that the sum of the measures of the angles of a triangle equals 180. Therefore, the hypotenuse must be the longest side of a right triangle.

11. $x \leq 8$ **13.** The lines are not parallel.

15. The triangle is equiangular.

17. **Given:** $2x - 7 > -11$
Prove: $x > -2$
Indirect Proof: Step 1 Assume that $x \leq -2$ is true.
Step 2

x	−6	−5	−4	−3	−2
$2x - 7$	−19	−17	−15	−13	−11

When $x < -2$, $2x - 7 < -11$ and when $x = -2$, $2x - 7 = -11$.

Step 3 In both cases, the assumption leads to the contradiction of the given information that $2x - 7 > -11$. Therefore, the assumption that $x \leq -2$ must be false, so the original conclusion that $x > -2$ must be true.

19. **Given:** $-3x + 4 < 7$
Prove: $x > -1$
Indirect Proof: Step 1 Assume that $x \leq -1$ is true.
Step 2

x	−5	−4	−3	−2	−1
$-3x + 4$	19	16	13	10	7

When $x < -1$, $-3x + 4 > 7$ and when $x = -1$, $-3x + 4 = 7$.

Step 3 In both cases, the assumption leads to the contradiction of the given information that $-3x + 4 < 7$. Therefore, the assumption that $x \leq -1$ must be false, so the original conclusion that $x > -1$ must be true.

21. Let the cost of one game be x and the other be y.
Step 1 Given: $x + y > 80$
Prove: $x > 40$ or $y > 40$
Indirect Proof:
Assume that $x \leq 40$ *and* $y \leq 40$.
Step 2 If $x \leq 40$ and $y \leq 40$, then $x + y \leq 40 + 40$ or $x + y \leq 80$. This is a contradiction because we know that $x + y > 80$.

Step 3 Since the assumption that $x \leq 40$ and $y \leq 40$ leads to a contradiction of a known fact, the assumption must be false. Therefore, the conclusion that $x > 40$ or $y > 40$ must be true. Thus, at least one of the games had to cost more than $40.

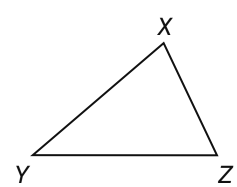
23. **Given:** xy is an odd integer.
Prove: x and y are odd integers.
Indirect Proof: Step 1 Assume that x and y are not both odd integers. That is, assume that either x or y is an even integer.
Step 2 You only need to show that the assumption that x is an even integer leads to a contradiction, since the argument for y is an even integer follows the same reasoning. So, assume that x is an even integer and y is an odd integer. This means that $x = 2k$ for some integer k and $y = 2m + 1$ for some integer m.

$xy = (2k)(2m + 1)$	Subst. of assumption
$= 4km + 2k$	Dist. Prop.
$= 2(km + k)$	Dist. Prop.

Since k and m are integers, $km + k$ is also an integer. Let p represent the integer $km + k$. So xy can be represented by $2p$, where p is an integer. This means that xy is an even integer, but this contradicts the given that xy is an odd integer.
Step 3 Since the assumption that x is an even integer and y is an odd integer leads to a contradiction of the given, the original conclusion that x and y are both odd integers must be true.

25. **Given:** x is an odd number.
Prove: x is not divisible by 4.
Indirect Proof: Step 1 Assume x is divisible by 4. In other words, 4 is a factor of x.
Step 2 Let $x = 4n$, for some integer n. $x = 2(2n)$
So, 2 is a factor of x which means x is an even number, but this contradicts the given information.
Step 3 Since the assumption that x is divisible by 4 leads to a contradiction of the given, the original conclusion x is not divisible by 4 must be true.

27. **Given:** $XZ > YZ$
Prove: $\angle X \not\cong \angle Y$

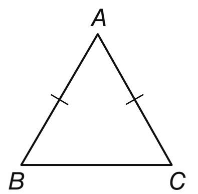


Indirect Proof: Step 1 Assume that $\angle X \cong \angle Y$.
Step 2 $\overline{XZ} \cong \overline{YZ}$ by the converse of the isosceles $\triangle$ theorem.

Step 3 This contradicts the given information that $XZ > YZ$. Therefore, the assumption $\angle X \cong \angle Y$ must be false, so the original conclusion $\angle X \ncong \angle Y$ must be true.

29. Given: $\triangle ABC$ is isosceles.

Prove: Neither of the base angles is a right angle.



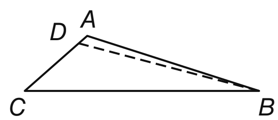
Indirect Proof: Step 1 Assume that $\angle B$ is a right angle.

Step 2 By the Isosceles $\triangle$ Theorem, $\angle C$ is also a right angle.

Step 3 This contradicts the fact that a triangle can have no more than one right angle. Therefore, the assumption that $\angle B$ is a right angle must be false, so the original conclusion neither of the base angles is a right angle must be true.

31. Given: $m\angle A > m\angle ABC$

Prove: $BC > AC$



Proof:

Assume $BC \not> AC$. By the Comparison Property, $BC = AC$ or $BC < AC$.

Case 1: If $BC = AC$, then $\angle ABC \cong \angle A$ by the Isosceles Triangle Theorem. (If two sides of a triangle are congruent, then the angles opposite those sides are congruent.) But, $\angle ABC \cong \angle A$ contradicts the given statement that $m\angle A > m\angle ABC$. So, $BC \neq AC$.

Case 2: If $BC < AC$, then there must be a point D between A and C so that $\overline{DC} \cong \overline{BC}$. Draw the auxiliary segment $\overline{BD}$. Since $DC = BC$, by the Isosceles Triangle Theorem $\angle BDC \cong \angle DBC$. Now $\angle BDC$ is an exterior angle of $\triangle BAD$ and by the Exterior Angles Inequality Theorem (the measure of an exterior angle of a triangle is greater than the measure of either corresponding remote interior angle) $m\angle BDC > m\angle A$. By the Angle Addition Postulate, $m\angle ABC = m\angle ABD + m\angle DBC$. Then by the definition of inequality, $m\angle ABC > m\angle DBC$. By Substitution and the Transitive Property of Inequality, $m\angle ABC > m\angle A$. But this contradicts the given statement that $m\angle A > m\angle ABC$. In both cases, a contradiction was found, and hence our assumption must have been false. Therefore, $BC > AC$.

33. We know that the other team scored 3 points, and Katsu thinks that they made a three-point shot. We also know that a player can score 3 points by making a basket and a foul shot.

Step 1 Assume that a player for the other team made a two-point basket and a foul shot.

Step 2 The other team's score before Katsu left was 26, so their score after a two-point basket and a foul shot would be 26 + 3 or 29.

Step 3 The score is correct when we assume that the other team made a two-point basket and a foul shot, so Katsu's assumption may not be correct. The other team could have made a three-point basket or a two-point basket and a foul shot.

35a. Indirect Proof: Step 1 50% is half, and the statement says more than half of the teens polled said that they recycle, so assume that less than 50% recycle.

Step 2 The data shows that 51% of teens said that they recycle, and 51% > 50%, so the number of teens that recycle is not less than half.

Step 3 This contradicts the data given. Therefore, the assumption is false, and the conclusion more than half of the teens polled said they recycle must be true.

35b. $400 \cdot 23\% \stackrel{?}{=} 92$

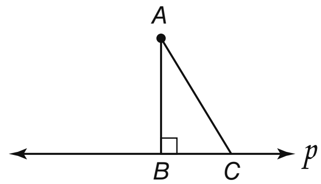
$400 \cdot 0.23 \stackrel{?}{=} 92$

$92 = 92$

37. indirect proof

Given: $\overline{AB} \perp p$

Prove: $\overline{AB}$ is the shortest segment from A to p.



Indirect Proof: Step 1 Assume $\overline{AB}$ is not the shortest segment from A to p.

Step 2 Since $\overline{AB}$ is not the shortest segment from A to p, there is a point C such that $\overline{AC}$ is the shortest distance. $\triangle ABC$ is a right triangle with hypotenuse $\overline{AC}$, the longest side of $\triangle ABC$ since it is across from the largest angle in $\triangle ABC$ by the
Angle–Side Relationships in Triangles Theorem.

Step 3 This contradicts the fact that $\overline{AC}$ is the shortest side. Therefore, the assumption is false, and the conclusion, $\overline{AB}$ is the shortest side, must be true.

39a. $n^3 + 3$

39b. Sample answer:

n	$n^3 + 3$
2	11
3	30
10	1003
11	1334
24	13,827
25	15,628
100	1,000,003
101	1,030,304
526	145,531,579
527	146,363,186

39c. Sample answer: When n 3 + 3 is even, n is odd.

39d. Indirect Proof: Step 1 Assume that n is even. Let $n = 2k$, where k some integer.

Step 2

$n^3 + 3 = (2k)^3 + 3$ Substitute assumption

$= 8k^3 + 3$ Simplify.

$= (8k^3 + 2) + 1$ Replace 3 with 2 + 1 and group the first two terms.

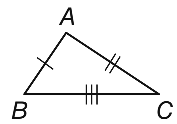
$= 2(4k^3 + 1) + 1$ Distributive Property

Since k is an integer, $4k^3 + 1$ is also an integer. Therefore, $n^3 + 3$ is odd.

Step 3 This contradicts the given information that $n^3 + 3$ is even. Therefore, the assumption is false, so the conclusion that n is odd must be true.

41. Sample answer: $\triangle ABC$ is scalene.

Given: $\triangle ABC$; $AB \neq BC$; $BC \neq AC$; $AB \neq AC$



Prove: $\triangle ABC$ is scalene.

Indirect Proof: Step 1 Assume that $\triangle ABC$ is not scalene.

Case 1: $\triangle ABC$ is isosceles.

Step 2 If $\triangle ABC$ is isosceles, then $AB = BC$, $BC = AC$, or $AB = AC$.

Step 3 This contradicts the given information, so $\triangle ABC$ is not isosceles.

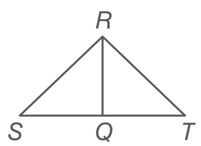
Case 2: $\triangle ABC$ is equilateral.

In order for a triangle to be equilateral, it must also be isosceles, and Case 1 proved that $\triangle ABC$ is not isosceles. Thus, $\triangle ABC$ is not equilateral. Therefore, $\triangle ABC$ is scalene.

43. Neither; sample answer: Since the hypothesis is true when the conclusion is false, the statement is false. **45.** $y = 2x - 7$ **47.** J

49. Given: $\overline{RQ}$ bisects $\angle SRT$.

Prove: $m\angle SQR > m\angle SRQ$



Proof:

Statements (Reasons)

1. $\overline{RQ}$ bisects $\angle SRT$. (Given)
2. $\angle SRQ \cong \angle QRT$ (Def. of bisector)
3. $m\angle QRS = m\angle QRT$ (Def. of $\cong$ ∡)
4. $m\angle SQR = m\angle T + m\angle QRT$ (Exterior Angle Theorem)
5. $m\angle SQR > m\angle QRT$ (Def. of Inequality)
6. $m\angle SQR > m\angle SRQ$ (Substitution)

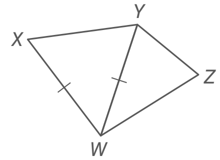
51. $\left(1\frac{2}{5}, 2\frac{3}{5}\right)$ **53.** 64 **55.** $4n^2 - 36$ **57.** $x^2 - 4y^2$ **59.** false

Lesson 7-5

1. yes; $5 + 7 > 10$, $5 + 10 > 7$, and $7 + 10 > 5$
3. yes; $6 + 14 > 10$, $6 + 10 > 14$, and $10 + 14 > 6$

5. Given: $\overline{XW} \cong \overline{YW}$

Prove: $YZ + ZW > XW$



Statements (Reasons)

1. $\overline{XW} \cong \overline{YW}$ (Given)
2. $XW = YW$ (Def. of $\cong$ segments)
3. $YZ + ZW > YW$ ($\triangle$ Inequal. Thm.)
4. $YZ + ZW > XW$ (Subst.)

7. yes; $11 + 21 > 16$, $11 + 16 > 21$, and $16 + 21 > 11$
9. no; $2.1 + 4.2 \not> 7.9$
11. yes; $1\frac{1}{5} + 4\frac{1}{2} > 3\frac{3}{4}$, $1\frac{1}{5} + 3\frac{3}{4} > 4\frac{1}{2}$, $4\frac{1}{2} + 3\frac{3}{4} > 1\frac{1}{5}$
13. $6\ m < n < 16\ m$ **15.** 5.4 in. $< n <$ 13 in.
17. $5\frac{1}{3}$ yd $< n <$ 10 yd

19. Proof:

Statements (Reasons)

1. $\overline{JL} \cong \overline{LM}$ (Given)
2. $JL = LM$ (Def. of $\cong$ segments)
3. $KJ + KL > JL$ ($\triangle$ Inequal. Thm.)
4. $KJ + KL > LM$ (Subt.)

21. $\frac{7}{5} < x < 21$

23. Proof:

Statements (Reasons)

1. Construct $\overline{CD}$ so that C is between B and D and $\overline{CD} \cong \overline{AC}$. (Ruler Post.)
2. $CD = AC$ (Def. of $\cong$)
3. $\angle CAD \cong \angle ADC$ (Isos. $\triangle$ Thm)
4. $m\angle CAD = m\angle ADC$ (Def. of $\cong$ ∡)
5. $m\angle BAC + m\angle CAD = m\angle BAD$ ($\angle$ Add. Post.)
6. $m\angle BAC + m\angle ADC = m\angle BAD$ (Subst.)
7. $m\angle ADC < m\angle BAD$ (Def. of inequality)
8. $AB < BD$ (Angle–Side Relationships in Triangles)
9. $BD = BC + CD$ (Seg. Add. Post.)
10. $AB < BC + CD$ (Subst.)
11. $AB < BC + AC$ (Subst. (Steps 2, 10))

25. $2 < x < 10$ **27.** $1 < x < 11$ **29.** $x < 0$

31. Yes; sample answer: The measurements on the drawing do not form a triangle. According to the Triangle Inequality Theorem, the sum of the lengths of any two sides of a triangle is greater than the length of the third side. The lengths in the drawing are 1 ft, $3\frac{7}{8}$ ft, and $6\frac{3}{4}$ ft. Since $1 + 3\frac{7}{8} \not> 6\frac{3}{4}$, the triangle isimpossible. They should recalculate their measurements before they cut the wood.

33. She should buy no more than 7.5 ft.

35. Yes; $\sqrt{99} \approx 9.9$ since $\sqrt{100} = 10$, $\sqrt{48} \approx 6.9$ since $\sqrt{49} = 7$, and $\sqrt{65} \approx 8.1$ since $\sqrt{64} = 8$. So, $9.9 + 6.9 > 8.1$, $6.9 + 8.1 > 9.9$, and $8.1 + 9.9 > 6.9$.

37. no; $\sqrt{122} \approx 11.1$ since $\sqrt{121} = 11$, $\sqrt{5} \approx 2.1$ since $\sqrt{4} = 2$, and $\sqrt{26} \approx 5.1$ since $\sqrt{25} = 5$. So, $2.1 + 5.1 \not> 11.1$.

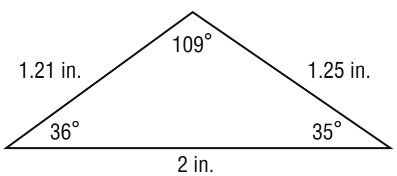
39. yes; $FG + GH > FH$, $FG + FH > GH$, and $GH + FH > FG$

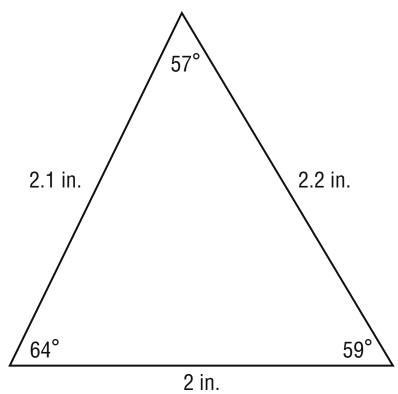
41. yes; $QR + QS > RS$, $QR + RS > QS$, and $QS + RS > QR$

43. The perimeter is greater than 36 and less than 64. Sample answer: From the diagram we know that $\overline{AC} \cong \overline{EC}$ and $\overline{DC} \cong \overline{BC}$, and $\angle ACB \cong \angle ECD$ because vertical angles are congruent, so $\triangle ACB \cong \triangle ECD$. Using the Triangle Inequality Theorem, the minimum value of AB and ED is 2 and the maximum value is 16. Therefore, the minimum value of the perimeter is greater than $2(2 + 7 + 9)$ or 36, and the maximum value of the perimeter is less than $2(16 + 7 + 9)$ or 64.

45. Sample answer: The Triangle Inequality Theorem states that the sum of the lengths of two sides of a triangle is always greater than the length of the third side of a triangle, so you set up three inequalities. For example, for a triangle with side lengths a, b, and c, you set up $a + b > c$, $a + c > b$, and $b + c > a$. Usually, one of the inequalities results in a negative number and is not necessary to find the minimum and maximum values for the unknown side. The other two inequalities give the value that the side must be greater than and the value that the side must be less than.

47.





49. B **51.** H **53.** $y > 6$ or $y < 6$ **55.** 132 mi $\leq d \leq$ 618 mi

57. 15; Alt. Ext. ∠s Thm. **59.** $x = 2$; $JK = KL = JL = 14$

61. $x = 7$; $SR = RT = 24$, $ST = 19$

Lesson 7-6

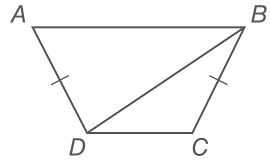
1. $m\angle ACB > m\angle GDE$ **3.** $QT < ST$ **5a.** $\overline{AB} \cong \overline{DE}$, $AC \cong \overline{DF}$

5b. $\angle D$; Sample answer: Since $EF > BC$, according to the Hinge Theorem, $m\angle D > m\angle A$.

7. $\frac{5}{3} < x < 8$

9. Given: $\overline{AD} \cong \overline{CB}$, $DC < AB$

Prove: $m\angle CBD < m\angle ADB$



Statements (Reasons)

1. $\overline{AD} \cong \overline{CB}$ (Given)
2. $\overline{DB} \cong \overline{DB}$ (Reflexive Property)
3. $DC < AB$ (Given)
4. $m\angle CBD < m\angle ADB$ (SSS Inequality)

11. $m\angle MLP < m\angle TSR$ **13.** $m\angle TUW < m\angle VUW$

15. $JK > HJ$ **17.** $2 < x < 6$ **19.** $-20 < x < 21$

21. $\overline{RS}$; sample answer: The height of the crane is the same and the length of the crane arm is fixed, so according to the Hinge Theorem, the side opposite the smaller angle is shorter. Since $29° < 52°$, $\overline{RS} < \overline{MN}$

23. Proof:

Statements (Reasons)

1. $\overline{LK} \cong \overline{JK}$, $\overline{RL} \cong \overline{RJ}$, K is the midpoint of $\overline{QS}$, $m\angle SKL > m\angle QKJ$ (Given)
2. $SK = QK$ (Def. of midpoint)
3. $SL > QJ$ (Hinge Thm.)
4. $RL = RJ$ (Def. of ≅ segs.)
5. $SL + RL > RL + RJ$ (Add. Prop.)
6. $SL + RL > QJ + RJ$ (Sub.)
7. $RS = SL + RL$, $QR = QJ + RJ$ (Seg. Add. Post.)
8. $RS > QR$ (Subst.)

25. Proof:

Statements (Reasons)

1. $\overline{XU} \cong \overline{VW}$, $\overline{XU} \parallel \overline{VW}$ (Given)
2. $\angle UXV \cong \angle XVW$, $\angle XUW \cong \angle UWV$ (Alt. Int. ∠s Thm.)
3. $\triangle XZU \cong \triangle VZW$ (ASA)
4. $\overline{XZ} \cong \overline{VZ}$ (CPCTC)
5. $\overline{WZ} \cong \overline{WZ}$ (Refl. Prop.)
6. $VW > XW$ (Given)
7. $m\angle VZW > m\angle XZW$ (Converse of Hinge Thm.)
8. $\angle VZW \cong \angle XZU$, $\angle XZW \cong \angle VZU$ (Vert. ∠s are ≅)
9. $m\angle VZW = m\angle XZU$, $m\angle XZW = m\angle VZU$ (Def. of ≅ ∠s)
10. $m\angle XZU > m\angle UZV$ (Subst.)

27a. Position 2; sample answer: If you measure the distance from her elbow to her fist for each position, it is 1.6 cm for Position 1 and 2 cm for Position 2. Therefore, the distance from her shoulder to her fist is greater in position 2.

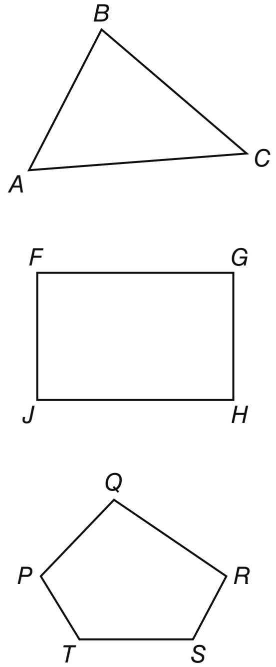
27b. Position 2; sample answer: Using the measurements in part a and the Hinge Theorem, you know that the measure of the angle opposite the larger side is larger, so the angle formed by Anica's elbow is greater in Position 2.

29. Statements (Reasons)

1. $\overline{PR} \cong \overline{PQ}$ (Given)
2. $\angle PRQ \cong \angle PQR$ (Isos. △ Thm.)
3. $m\angle PRQ = m\angle 1 + m\angle 4$, $m\angle PQR = m\angle 2 + m\angle 3$ (Angle Add. Post.)
4. $m\angle PRQ = m\angle PQR$ (Def. of ≅ ∠s)
5. $m\angle 1 + m\angle 4 = m\angle 2 + m\angle 3$ (Subst.)
6. $SQ > SR$ (Given)
7. $m\angle 4 > m\angle 3$ (Angle–Side Relationship Thm.)
8. $m\angle 4 = m\angle 3 + x$ (Def. of inequality)
9. $m\angle 1 + m\angle 4 - m\angle 4 = m\angle 2 + m\angle 3 - (m\angle 3 + x)$ (Subt. Prop.)
10. $m\angle 1 = m\angle 2 - x$ (Subst.)
11. $m\angle 1 + x = m\angle 2$ (Add. Prop.)
12. $m\angle 1 < m\angle 2$ (Def. of inequality)

31. $CB < AB$ **33.** $m\angle BGC < m\angle FBA$ **35.** $WU > YU$

37a.

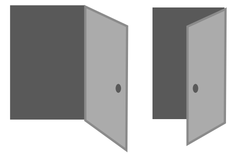


37b.

Number of sides	Angle Measures				Sum of Angles
3	$m\angle A$	59	$m\angle C$	45	180
	$m\angle B$	76			
4	$m\angle F$	90	$m\angle H$	90	360
	$m\angle G$	90	$m\angle J$	90	
5	$m\angle P$	105	$m\angle S$	116	540
	$m\angle Q$	100	$m\angle T$	123	
	$m\angle R$	96			

37c. Sample answer: The sum of the angles of the polygon is equal to 180 times two less than the number of sides of the polygon. **37d.** Inductive; sample answer: Since I used a pattern to determine the relationship, the reasoning I used was inductive.
37e. $(n - 2)180$

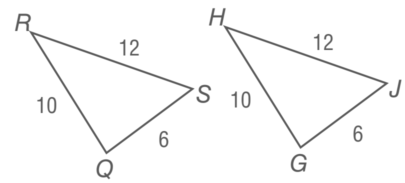
39. A door; as the door opens, the door opening increases as the angle made by the hinge increases. As the door closes, the door opening decreases as the angle made by the hinge decreases. This is similar to the side opposite the angle in a triangle, because as the side opposite an angle increases the measure of the angle also increases. As the side decrease, the angle also decreases.



41. Never; from the Converse of the Hinge Theorem, $\angle ADB < \angle BDC$. $\angle ADB < \angle BDC$ form a linear pair. So, $m\angle ADB + m\angle BDC = 180$. Since, $m\angle BDC > m\angle ADB$, $m\angle BDC$ must be greater than 90 and $m\angle ADB$ must be smaller than 90. So, by the definition of obtuse and acute angles, $m\angle BDC$ is always obtuse and $m\angle ADB$ is always acute.

43. $2.8 < x < 12$ **45.** F **47.** 1.2 cm $< n <$ 7.6 cm

51. $x = 8$



53. $x = 65$ by the Consecutive Interior Angles Theorem; $y = 73.5$ by the Supplement Theorem

55. $x = 27$ by the Consecutive Interior Angles Theorem; $y = 22\frac{2}{3}$ by the Consecutive Interior Angles Theorem

Chapter 7 Study Guide Review

1. false; orthocenter **3.** true **5.** false; median **7.** false; false **9.** false; the vertex opposite that side **11.** 5 **13.** 34 **15.** (2.3) **17.** $\angle S, \angle R, \angle T$; $\overline{RT}, \overline{TS}, \overline{SR}$ **19.** The shorter path is for Sarah to get Irene and then go to Anna's house.
21. $\triangle FGH$ is not congruent to $\triangle MNO$. **23.** $y \geq 4$
25. Let the cost of one DVD be x, and the cost of the other DVD be y.

Given: $x + y > 50$

Prove: $x > 25$ or $y > 25$

Indirect proof:

Step 1 Assume that $x \leq 25$ and $y \leq 25$.

Step 2 If $x \leq 25$ and $y \leq 25$, then $x + y \leq 25 + 25$, or $x + y \leq 50$. This is a contradiction because we know that $x + y > 50$.

Step 3 Since the assumption that $x \leq 25$ and $y \leq 25$ leads to a contradiction of a known fact, the assumption must be false. Therefore, the conclusion that $x > 25$ or $y > 25$ must be true. Thus, at least one DVD had to be over \$25. **27.** no; $3 + 4 < 8$

29. Let x be the length of the third side. 6.5 cm $< x <$ 14.5 cm
31. $m\angle ABC > m\angle DEF$ **33.** Rose

CHAPTER 8
Quadrilaterals

Chapter 8 Get Ready

1. 150 **3.** 54 **5.** 137 **7.** $x = 1$, $WX = XY = YW = 9$
9. Des Moines to Phoenix = 1153 mi, Des Moines to Atlanta = 738 mi, Phoenix to Atlanta = 1591 mi

Lesson 8-1

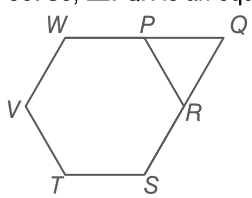
1. 1440 **3.** $m\angle X = 36$, $m\angle Y = 72$, $m\angle Z = 144$, $m\angle W = 108$ **5.** 157.5 **7.** 36 **9.** 68 **11.** 45 **13.** 3240 **15.** 5400
17. $m\angle J = 150$, $m\angle K = 62$, $m\angle L = 52$, $m\angle M = 96$
19. $m\angle U = 60$, $m\angle V = 193$, $m\angle W = 76$, $m\angle Y = 68$, $m\angle Z = 143$ **21.** 150 **23.** 144 **25a.** 720 **25b.** Yes, 120; sample answer: Since the hexagon is regular, the measures of the angles are equal. That means each angle is $720 \div 6$ or 120. **27.** 4 **29.** 15 **31.** 37 **33.** 71 **35.** 72 **37.** 24
39. 51.4, 128.6 **41.** 25.7, 154.3 **43.** Consider the sum of the measures of the exterior angles N for an n-gon. N = sum of measures of linear pairs − sum of measures of interior angles

$= 180n - 180(n - 2)$

$= 180n - 180n + 360$

$= 360$

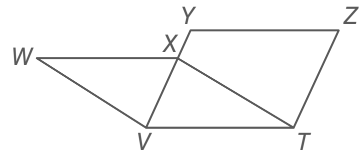
So, the sum of the exterior angle measures is 360 for any convex polygon.
45. 105, 110, 120, 130, 135, 140, 160, 170, 180, 190 **47a.** 7.5 ft
47b. 67.5; Sample answer: The measure of each angle of a regular octagon is 135, so if each side of the board makes up half of the angle, each one measures $135 \div 2$ or 67.5.
49. Liam; by the Exterior Angle Sum Theorem, the sum of the measures of any convex polygon is 360.
51. Always; by the Exterior Angle Sum Theorem, $m\angle QPR = 60$ and $m\angle QRP = 60$. Since the sum of the interior angle measures of a triangle is 180, the measure of $\angle PQR = 180 - m\angle QPR - m\angle QRP = 180 - 60 - 60 = 60$. So, $\triangle PQR$ is an equilateral triangle.



53. The Interior Angles Sum Theorem is derived from the pattern between the number of sides in a polygon and the number of triangles. The formula is the product of the sum of the measures of the angles in a triangle, 180, and the number of triangles in the polygon.
55. 72 **57.** C **59.** $ML < JM$ **61.** 3 **63.** $\angle E \cong \angle G$; $\angle EFH \cong \angle GHF$; $\angle EHF \cong \angle GFH$; $\overline{EF} \cong \overline{GH}$; $\overline{EH} \cong \overline{GF}$; $\overline{FH} \cong \overline{HF}$; $\triangle EFH \cong \triangle GHF$ **65.** $\angle 1$ and $\angle 5$, $\angle 4$ and $\angle 6$, $\angle 2$ and $\angle 8$, $\angle 3$ and $\angle 7$

Lesson 8-2

1a. 148 **1b.** 125 **1c.** 4 **3.** 15 **5.** $w = 5$, $b = 4$
7. Given: $\square ABCD$, $\angle A$ is a right angle.
Prove: $\angle B$, $\angle C$, and $\angle D$ are right angles. (Theorem 6.6)
Proof: By definition of a parallelogram, $\overline{AB} \parallel \overline{CD}$. Since $\angle A$ is a right angle, $\overline{AC} \perp \overline{AB}$. By the Perpendicular Transversal Theorem, $\overline{AC} \perp \overline{CD}$. $\angle C$ is a right angle, because perpendicular lines form a right angle. $\angle B \cong \angle C$ and $\angle A \cong \angle D$ because opposite angles in a parallelogram are congruent. $\angle C$ and $\angle D$ are right angles, since all right angles are congruent.
9. 52 **11.** 5 **13a.** 1 in. **13b.** $\frac{3}{4}$ in. **13c.** 62 **13d.** 118
15. $a = 7$, $b = 11$ **17.** $x = 5$, $y = 17$
19. $x = 58$, $y = 63.5$ **21.** (2.5, 2.5)
23. Given: $WXTV$ and $ZYVT$ are parallelograms.
Prove: $\overline{WX} \cong \overline{ZY}$



Proof:
Statements (Reasons)
1. $WXTV$ and $ZYVT$ are parallelograms. (Given)
2. $\overline{WX} \cong \overline{VT}$, $\overline{VT} \cong \overline{YZ}$ (Opp. sides of a $\square$ are $\cong$.)
3. $\overline{WX} \cong \overline{ZY}$ (Trans. Prop.)

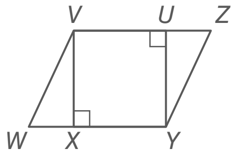
25. Proof:
Statements (Reasons):
1. $\triangle ACD \cong \triangle CAB$ (Given)
2. $\angle ACD \cong \angle CAB$ (CPCTC)
3. $\angle DPC \cong \angle BPA$ (Vert. $\angle$s are $\cong$.)
4. $\overline{AB} \cong \overline{CD}$ (CPCTC)
5. $\triangle ABP \cong \triangle CDP$ (AAS)
6. $\overline{DP} \cong \overline{PB}$ (Diag. of a $\square$ bisect each other.)

27. Proof:
Statements (Reasons)
1. $\square WXYZ$ (Given)
2. $\overline{WX} \cong \overline{ZY}$, $\overline{WZ} \cong \overline{XY}$ (Opp. sides of a $\square$ are $\cong$.)
3. $\angle ZWX \cong \angle XYZ$ (Opp. $\angle$s of a $\square$ are $\cong$.)
4. $\triangle WXZ \cong \triangle YZX$ (SAS)

29. Proof: It is given that $ACDE$ is a parallelogram. Since opposite sides of a parallelogram are congruent, $\overline{EA} \cong \overline{DC}$. By definition of a parallelogram, $\overline{EA} \parallel \overline{DC}$. $\angle AEB \cong \angle DCB$ and $\angle EAB \cong \angle CDB$ because alternate interior angles are congruent. $\triangle EBA \cong \triangle CBD$ by ASA. $\overline{EB} \cong \overline{BC}$ and $\overline{AB} \cong \overline{BD}$ by CPCTC. By the definition of segment bisector, $\overline{EC}$ bisects $\overline{AD}$ and $\overline{AD}$ bisects $\overline{EC}$.
31. 3 **33.** 131 **35.** 29 **37.** (−1, −1)

39. Given: ▱$YWVZ$, $\overline{VX} \perp \overline{WY}$, $\overline{YU} \perp \overline{VZ}$

Prove: $\triangle YUZ \cong \triangle VXW$



Proof:

Statements (Reasons)

1. ▱$YWVZ$, $\overline{VX} \perp \overline{WY}$, $\overline{YU} \perp \overline{VZ}$ (Given)
2. $\angle Z \cong \angle W$ (Opp. ∠s of a ▱ are ≅.)
3. $\overline{WV} \cong \overline{ZY}$ (Opp. sides of a ▱ are ≅.)
4. $\angle VXW$ and $\angle YUZ$ are rt. ∠s. (⊥ lines form four rt. ∠s.)
5. $\triangle VXW$ and $\triangle YUZ$ are rt. △s. (Def. of rt. △s)
6. $\triangle YUZ \cong \triangle VXW$ (HA)

41. 7

43.

45. Sample answer: In a parallelogram, the opp. sides and ∠s are ≅. Two consecutive ∠s in a ▱ are supplementary. If one angle of a ▱ is right, then all the angles are right. The diagonals of a parallelogram bisect each other.

47. 13 **49.** B **51.** 9 **53.** 18 **55.** 100 **57.** side; 3

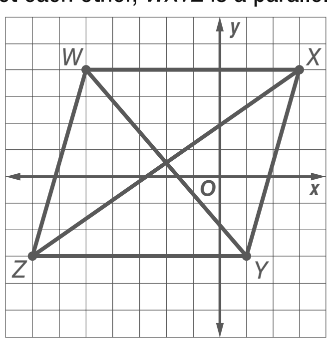
59. side; $-\frac{1}{6}$

Lesson 8-3

1. Yes; each pair of opposite angles are congruent.

3. $AP = CP$, $BP = DP$; sample answer: If the diagonals of a quadrilateral bisect each other, then the quadrilateral is a parallelogram, so if $AP = CP$ and $BP = DP$, then the string forms a parallelogram. **5.** $x = 4$, $y = 8$

7. Yes; the midpoint of $\overline{WY}$ and $\overline{XZ}$ is $\left(-2, \frac{1}{2}\right)$. Since the diagonals bisect each other, $WXYZ$ is a parallelogram.

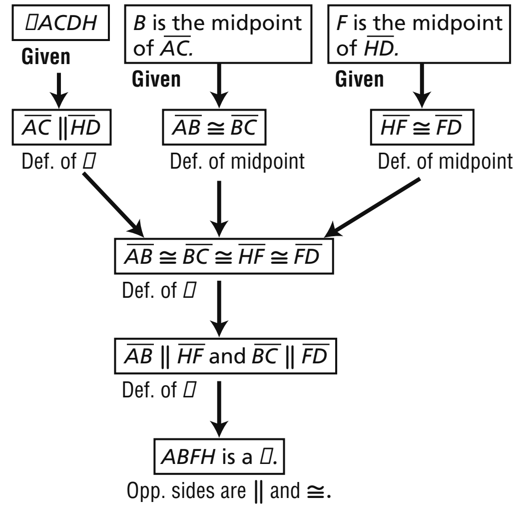


9. Yes; both pairs of opp. sides are ≅.

11. No; none of the tests for ▱ are fulfilled.

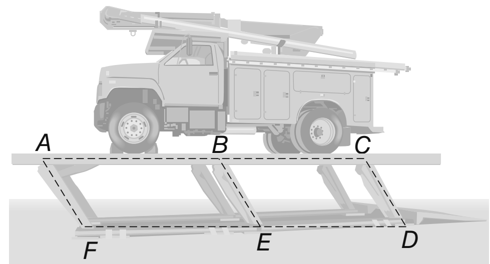
13. Yes; the diagonals bisect each other.

15.



17. Given: $ABEF$ is a parallelogram; $BCDE$ is a parallelogram.

Prove: $ACDF$ is a parallelogram.



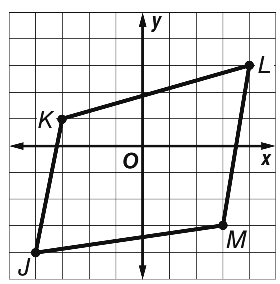
Proof:

Statements (Reasons)

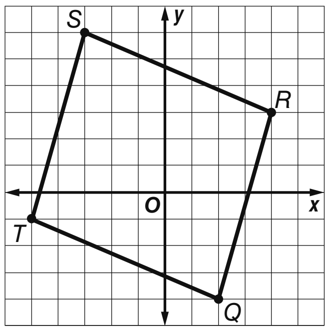
1. $ABEF$ is a parallelogram; $BCDE$ is a parallelogram. (Given)
2. $\overline{AF} \cong \overline{BE}$, $\overline{BE} \cong \overline{CD}$, $\overline{AF} \parallel \overline{BE}$, $\overline{BE} \parallel \overline{CD}$ (Def. of ▱)
3. $\overline{AF} \cong \overline{CD}$, $\overline{AF} \parallel \overline{CD}$ (Trans. Prop.)
4. $ACDF$ is a parallelogram. (If one pair of opp. sides is ≅ and ∥, then the quad. is a ▱.)

19. $x = 8$, $y = 9$ **21.** $x = 11$, $y = 7$ **23.** $x = 4$, $y = 3$

25. No; both pairs of opposite sides must be congruent. The distance between K and L is $\sqrt{53}$. The distance between L and M is $\sqrt{37}$.
The distance between M and J is $\sqrt{50}$. The distance between J and K is $\sqrt{26}$. Since, both pairs of opposite sides are not congruent, $JKLM$ is not a parallelogram.

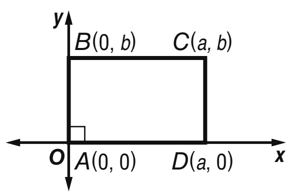


27. Yes; a pair of opposite sides must be parallel and congruent. Slope of $\overline{QR} = \frac{7}{2} =$ slope of $\overline{ST}$, so $\overline{QR} \parallel \overline{ST}$. $QR = ST = \sqrt{53}$, so $\overline{QR} \cong \overline{ST}$. So, $QRST$ is a parallelogram.



29. Given: $ABCD$ is a parallelogram. $\angle A$ is a right angle.

Prove: $\angle B$, $\angle C$, and $\angle D$ are right angles.



Proof:

slope of $\overline{BC} = \left(\frac{b-b}{a-0}\right)$ or 0 — The slope of $\overline{CD}$ is undefined.

slope of $\overline{AD} = \left(\frac{0-0}{a-0}\right)$ or 0 — The slope of $\overline{AB}$ is undefined.

Therefore, $\overline{BC} \perp \overline{CD}$, $\overline{CD} \perp \overline{AD}$, and $\overline{AB} \perp \overline{BC}$. So, $\angle B$, $\angle C$, and $\angle D$ are right angles.

31a. Given: $\overline{AC} \cong \overline{CF}$, $\overline{AB} \cong \overline{CD} \cong \overline{BE}$, and $\overline{DF} \cong \overline{DE}$

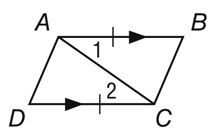
Prove: $BCDE$ is a parallelogram.

Proof: We are given that $\overline{AC} \cong \overline{CF}$, $\overline{AB} \cong \overline{CD} \cong \overline{BE}$, and $\overline{DF} \cong \overline{DE}$. $AC = CF$ by the definition of congruence. $AC = AB + BC$ and $CF = CD + DF$ by the Segment Addition Postulate and $AB + BC = CD + DF$ by substitution. Using substitution again, $AB + BC = AB + DF$, and $BC = DF$ by the Subtraction Property. $\overline{BC} \cong \overline{DF}$ by the definition of congruence, and $\overline{BC} \cong \overline{DE}$ by the Transitive Property. If both pairs of opposite sides of a quadrilateral are congruent, then the quadrilateral is a parallelogram, so $BCDE$ is a parallelogram. By the definition of a parallelogram, $\overline{BE} \parallel \overline{CD}$.

31b. about 9.2 in.

33. Given: $\overline{AB} \cong \overline{DC}$, $\overline{AB} \parallel \overline{DC}$

Prove: $ABCD$ is a parallelogram.



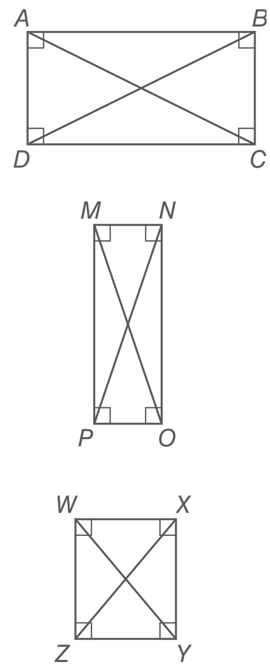
Statements (Reasons)

1. $\overline{AB} \cong \overline{DC}$, $\overline{AB} \parallel \overline{DC}$ (Given)
2. Draw $\overline{AC}$. (Two points determine a line.)
3. $\angle 1 \cong \angle 2$ (If two lines are $\parallel$, then alt. int. ∡ are $\cong$.)
4. $\overline{AC} \cong \overline{AC}$ (Refl. Prop.)
5. $\triangle ABC \cong \triangle CDA$ (SAS)
6. $\overline{AD} \cong \overline{BC}$ (CPCTC)
7. $ABCD$ is a parallelogram. (If both pairs of opp. sides are $\cong$, then the quad. is ▱.)

35. $C(a, c)$, $D(-b, c)$

37. Sample answer: Since the two vertical rails are both perpendicular to the ground, he knows that they are parallel to each other. If he measures the distance between the two rails at the top of the steps and at the bottom of the steps, and they are equal, then one pair of sides of the quadrilateral formed by the handrails is both parallel and congruent, so the quadrilateral is a parallelogram. Since the quadrilateral is a parallelogram, the two hand rails are parallel by definition.

39a. Sample answer:



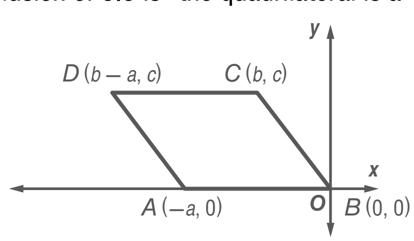
39b.

Rectangle	Side	Length
ABCD	$\overline{AC}$	3.3 cm
	$\overline{BD}$	3.3 cm
MNOP	$\overline{MO}$	2.8 cm
	$\overline{NP}$	2.8 cm
WXYZ	$\overline{WY}$	2.0 cm
	$\overline{XZ}$	2.0 cm

39c. Sample answer: The diagonals of a rectangle are congruent.

41. Sample answer: The theorems are converses of each other. The hypothesis of Theorem 6.3 is "a figure is a ▱", and the hypothesis of 6.9 is "both pairs of opp. sides of a quadrilateral are $\cong$". The conclusion of Theorem 6.3 is "opp. sides are $\cong$", and the conclusion of 6.9 is "the quadrilateral is a ▱".

43.



45. Sample answer: You can show that: both pairs of opposite sides are congruent or parallel, both pairs of opposite angles are congruent, diagonals bisect each other, or one pair of opposite sides is both congruent and parallel.

47. 4 **49.** E **51.** (4.5, 1.5) **53.** 35

55. Given: $P + W > 2$ (P is time spent in the pool; W is time spent lifting weights.)

Prove: $P > 1$ or $W > 1$

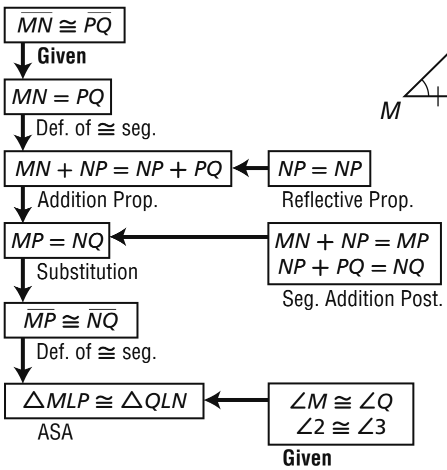
Proof:

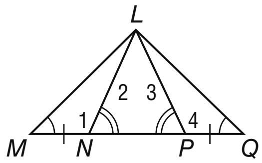
Step 1: Assume $P \leq 1$ and $W \leq 1$.

Step 2: $P + W \leq 2$

Step 3: This contradicts the given statement. Therefore he did at least one of these activities for more than an hour.

57. Proof:





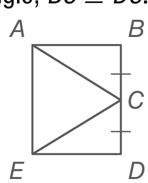
59. not perpendicular

Lesson 8-4

1. 7 ft **3.** 33.5 **5.** 11

7. Given: $ABDE$ is a rectangle; $\overline{BC} \cong \overline{DC}$.

Prove: $\overline{AC} \cong \overline{EC}$

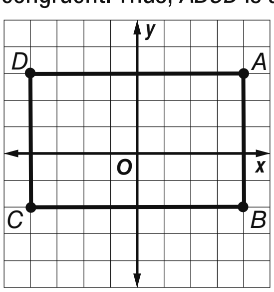


Proof:

Statements (Reasons)

1. $ABDE$ is a rectangle; $\overline{BC} \cong \overline{DC}$. (Given)
2. $ABDE$ is a parallelogram. (Def. of rectangle)
3. $\overline{AB} \cong \overline{DE}$ (Opp. sides of a ▱ are ≅.)
4. $\angle B$ and $\angle D$ are right angles. (Def. of rectangle)
5. $\angle B \cong \angle D$ (All rt ∠s are ≅.)
6. $\triangle ABC \cong \triangle EDC$ (SAS)
7. $\overline{AC} \cong \overline{EC}$ (CPCTC)

9. Yes; $AB = 5 = CD$ and $BC = 8 = AD$. So, $ABCD$ is a parallelogram. $BD = \sqrt{89} = AC$, so the diagonals are congruent. Thus, $ABCD$ is a rectangle.



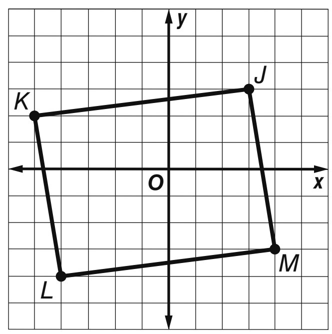
11. 6.3 ft **13.** 25 **15.** 43 **17.** 38 **19.** 46

21. Proof:

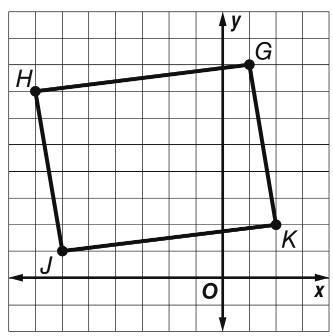
Statements (Reasons)

1. $QTVW$ is a rectangle; $\overline{QR} \cong \overline{ST}$. (Given)
2. $QTVW$ is a parallelogram. (Def. of rectangle)
3. $\overline{WQ} \cong \overline{VT}$ (Opp sides of a ▱ are ≅.)
4. $\angle Q$ and $\angle T$ are right angles. (Def. of rectangle)
5. $\angle Q \cong \angle T$ (All rt ∠s are ≅.)
6. $QR = ST$ (Def. of ≅ segs.)
7. $\overline{RS} \cong \overline{RS}$ (Refl. Prop.)
8. $RS = RS$ (Def. of ≅ segs.)
9. $QR + RS = RS + ST$ (Add. prop.)
10. $QS = QR + RS$, $RT = RS + ST$ (Seg. Add. Post.)
11. $QS = RT$ (Subst.)
12. $\overline{QS} \cong \overline{RT}$ (Def. of ≅ segs.)
13. $\triangle SWQ \cong \triangle RVT$ (SAS)

23. No; $JK = \sqrt{65} = LM$, $KL = \sqrt{37} = MJ$, so $JKLM$ is a parallelogram. $KM = \sqrt{106}$; $JL = \sqrt{98}$. $KM \neq JL$, so the diagonals are not congruent. Thus, $JKLM$ is not a rectangle.

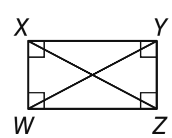


25. No; slope of $\overline{GH} = \frac{1}{8}$ = slope of $\overline{JK}$ and slope of $\overline{HJ} = -6 =$ slope of $\overline{KG} = -6$. So, $GHJK$ is a parallelogram. The product of the slopes of consecutive sides $\neq -1$, so the consecutive sides are not perpendicular. Thus, $GHJK$ is not a rectangle.



27. 40 **29.** 80 **31.** 100

33. Given: $WXYZ$ is a rectangle with diagonals $\overline{WY}$ and $\overline{XZ}$.



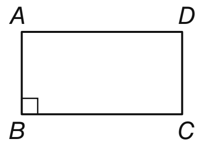
Prove: $\overline{WY} \cong \overline{XZ}$

Proof:

1. $WXYZ$ is a rectangle with diagonals $\overline{WY}$ and $\overline{XZ}$. (Given)
2. $\overline{WX} \cong \overline{ZY}$ (Opp. sides of a ▱ are ≅.)

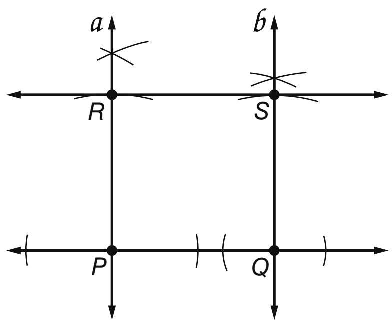
3. $\overline{WZ} \cong \overline{WZ}$ (Refl. Prop.)
4. $\angle XWZ$ and $\angle YZW$ are right angles. (Def. of rectangle)
5. $\angle XWZ \cong \angle YZW$ (All right ∠s are ≅.)
6. $\triangle XWZ \cong \triangle YZW$ (SAS)
7. $\overline{WY} \cong \overline{XZ}$ (CPCTC)

35.



ABCD is a parallelogram, and $\angle B$ is a right angle. Since *ABCD* is a parallelogram and has one right angle, then it has four right angles. So by the definition of a rectangle, *ABCD* is a rectangle.

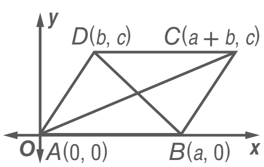
37. Sample answer: Using a protractor, $m\angle P = m\angle Q = 90$. The same compass setting was used to locate points *R* and *S* so they are the same distance from points *P* and *Q*, respectively. *RQ* and *SP* are equal so the diagonals are congruent. Thus, *PQSR* is a rectangle.



39. 5 **41.** No; sample answer: Both pairs of opposite sides are congruent, so the sign is a parallelogram, but no measure is given that can be used to prove that it is a rectangle.

43. Given: ▱*ABCD* and $\overline{AC} \cong \overline{BD}$

Prove: ▱*ABCD* is a rectangle.



Proof:

$AC = \sqrt{(a + b - 0)^2 + (c - 0)^2}$

$BD = \sqrt{(b - a)^2 + (c - 0)^2}$

But $AC = BD$ and

$\sqrt{(a + b - 0)^2 + (c - 0)^2}$

$= \sqrt{(b - a)^2 + (c - 0)^2}$.

$$(a + b - 0)^2 + (c - 0)^2 = (b - a)^2 + (c - 0)^2$$
$$(a + b)^2 + c^2 = (b - a)^2 + c^2$$
$$a^2 + 2ab + b^2 + c^2 = b^2 - 2ab + a^2 + c^2$$
$$2ab = -2ab$$
$$4ab = 0$$
$$a = 0 \text{ or } b = 0$$

Because *A* and *B* are different points, $a \neq 0$. Then $b = 0$. The slope of $\overline{AD}$ is undefined and the slope of $\overline{AB} = 0$. Thus, $\overline{AD} \perp \overline{AB}$. $\angle DAB$ is a right angle and *ABCD* is a rectangle.

45. $x = 6$, $y = -10$ **47.** 6

49. Sample answer: All rectangles are parallelograms because, by definition, both pairs of opposite sides are parallel. Parallelograms with right angles are rectangles, so some parallelograms are rectangles, but others with non-right angles are not.

51. J **53.** E **55.** $x = 8$, $y = 22$ **57.** (2.5, 0.5)

59. $\overline{AH}$ and $\overline{AJ}$ **61.** $\angle AJK$ and $\angle AKJ$ **63.** $\sqrt{101}$

Lesson 8-5

1. 32

3. Given: *ABCD* is a rhombus with diagonal $\overline{DB}$.

Prove: $AP \cong CP$

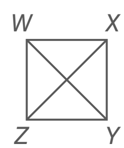
Statements (Reasons)

1. *ABCD* is a rhombus with diagonal $\overline{DB}$. (Given)
2. $\angle ABP \cong \angle CBP$ (Diag. of rhombus bisects ∠)
3. $\overline{PB} \cong \overline{PB}$ (Refl. Prop.)
4. $\overline{AB} \cong \overline{CB}$ (Def. of rhombus)
5. $\triangle APB \cong \triangle CPB$ (SAS)
6. $\overline{AP} \cong \overline{CP}$ (CPCTC)

5. Rectangle, rhombus, square; consecutive sides are ⊥, all sides are ≅. **7.** 14 **9.** 28 **11.** 95

13. Given: $\overline{WZ} \parallel \overline{XY}$, $\overline{WX} \parallel \overline{ZY}$, $\overline{WZ} \cong \overline{ZY}$

Prove: *WXYZ* is a rhombus.



Statements (Reasons)

1. $\overline{WZ} \parallel \overline{XY}$, $\overline{WX} \parallel \overline{ZY}$, $\overline{WZ} \cong \overline{ZY}$ (Given)
2. *WXYZ* is a ▱. (Both pairs of opp. sides are ||.)
3. *WXYZ* is a rhombus. (If one pair of consecutive sides of a ▱ are ≅, the ▱ is a rhombus.)

15. Proof:

Statements (Reasons)

1. *JKQP* is a square. $\overline{ML}$ bisects $\overline{JP}$ and $\overline{KQ}$. (Given)
2. *JKQP* is a parallelogram. (All squares are parallelograms.)
3. $\overline{JM} \parallel \overline{KL}$ (Def. of ▱)
4. $\overline{JP} \cong \overline{KQ}$ (Opp. Sides of ▱ are ≅.)
5. $JP = KQ$ (Def of ≅ segs.)
6. $JM = MP$, $KL = LQ$ (Def. of bisects)
7. $JP = JM + MP$, $KQ = KL + LQ$ (Seg. Add Post.)
8. $JP = 2JM$, $KQ = 2KL$ (Subst.)
9. $2JM = 2KL$ (Subst.)
10. $JM = KL$ (Division Prop.)

11. $\overline{KL} \cong \overline{JM}$ (Def. of ≅ segs.)

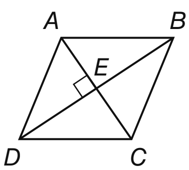
12. *JKLM* is a parallelogram. (If one pair of opp. sides is ≅ and ||, then the quad. is a ▱.)

17. Rhombus; Sample answer: The measure of angle formed between the two streets is 29, and vertical angles are congruent, so the measure of one angle of the quadrilateral is 29. Since the crosswalks are the same length, the sides of the quadrilateral are congruent. Therefore, they form a rhombus.

19. Rhombus; the diagonals are ⊥. **21.** None; the diagonals are not ≅ or ⊥. **23.** 9 **25.** 24 **27.** 6 **29.** 90

31. square **33.** rectangle

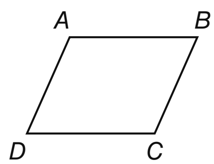
35. Given: *ABCD* is a parallelogram; $\overline{AC} \perp \overline{BD}$.



Prove: *ABCD* is a rhombus.

Proof: We are given that *ABCD* is a parallelogram. The diagonals of a parallelogram bisect each other, so $\overline{AE} \cong \overline{EC}$. $\overline{BE} \cong \overline{BE}$ because congruence of segments is reflexive. We are also given that $\overline{AC} \perp \overline{BD}$. Thus, ∠*AEB* and ∠*BEC* are right angles by the definition of perpendicular lines. Then ∠*AEB* ≅ ∠*BEC* because all right angles are congruent. Therefore, △*AEB* ≅ △*CEB* by SAS. $\overline{AB} \cong \overline{CD}$ by CPCTC. Opposite sides of parallelograms are congruent, so $\overline{AB} \cong \overline{CD}$ and $\overline{BC} \cong \overline{AD}$. Then since congruence of segments is transitive, $\overline{AB} \cong \overline{CD} \cong \overline{BC} \cong \overline{AD}$. All four sides of *ABCD* are congruent, so *ABCD* is a rhombus by definition.

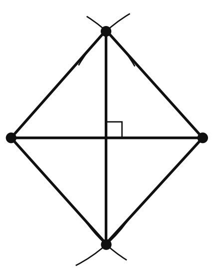
37. Given: *ABCD* is a parallelogram; $\overline{AB} \cong \overline{BC}$.



Prove: *ABCD* is a rhombus.

Proof: Opposite sides of a parallelogram are congruent, so $\overline{BC} \cong \overline{AD}$ and $\overline{AB} \cong \overline{CD}$. We are given that $\overline{AB} \cong \overline{BC}$. So, by the Transitive Property, $\overline{BC} \cong \overline{CD}$. So, $\overline{BC} \cong \overline{CD} \cong \overline{AB} \cong \overline{AD}$. Thus, *ABCD* is a rhombus by definition.

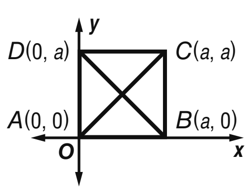
39.



Sample answer: If the diagonals of a parallelogram are perpendicular to each other, then the parallelogram is a rhombus.

41. Given: *ABCD* is a square.

Prove: $\overline{AC} \perp \overline{DB}$



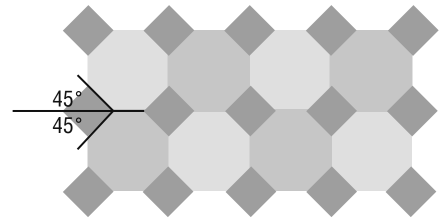
Proof:

slope of $\overline{DB} = \frac{0 - a}{a - 0}$ or –1

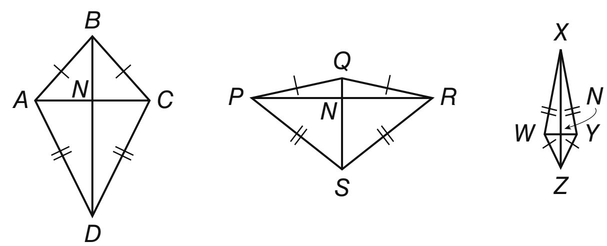
slope of $\overline{AC} = \frac{0 - a}{0 - a}$ or 1

The slope of $\overline{AC}$ is the negative reciprocal of the slope of $\overline{DB}$, so they are perpendicular.

43. Squares; sample answer: Since the octagons are regular each side is congruent, and the quadrilaterals share common sides with the octagons, so the quadrilaterals are either rhombuses or squares. The vertices of the quadrilaterals are formed by the exterior angles of the sides of the octagons adjacent to the vertices. The sum of the measures of the exterior angles of a polygon is always 360 and since a regular octagon has 8 congruent exterior angles, each one measures 45. As shown in the diagram, each angle of the quadrilaterals in the pattern measures 45 + 45 or 90. Therefore, the quadrilateral is a square.



45a. Sample answer:



45b.

Figure	Distance from *N* to Each Vertex Along Shorter Diagonal		Distance from *N* to Each Vertex Along Longer Diagonal	
ABCD	0.8 cm	0.8 cm	0.9 cm	1.5 cm
PQRS	1.2 cm	1.2 cm	0.3 cm	0.9 cm
WXYZ	0.2 cm	0.2 cm	1.1 cm	0.4 cm

47. True; sample answer: A rectangle is a quadrilateral with four right angles and a square is both a rectangle and a rhombus, so a square is always a rectangle.
Converse: If a quadrilateral is a rectangle then it is a square. False; sample answer: A rectangle is a quadrilateral with four right angles. It is not necessarily a rhombus, so it is not necessarily a square.
Inverse: If a quadrilateral is not a square, then it is not a rectangle. False; sample answer: A quadrilateral that has four right angles and two pairs of congruent sides is not a square, but it is a rectangle.
Contrapositive: If a quadrilateral is not a rectangle, then it is not a square. True; sample answer: If a quadrilateral is not a rectangle, it is also not a square by definition.

49. Sample answer: (0, 0), (6, 0), (0, 6), (6, 6); the diagonals are perpendicular, and any four points on the lines equidistant from the intersection of the lines will be the vertices of a square.

51. B **53.** H **55.** 52 **57.** 38 **59.** Yes; both pairs of opposite sides are congruent. **61.** No; the Triangle Inequality Theorem states that the sum of the lengths of any two sides of a triangle must be greater than the length of the third side. Since 22 + 23 = 45, the sides of Monifa's backyard cannot be 22 ft, 23 ft and 45 ft.

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

1. 101 **3.** $\overline{BC} \parallel \overline{AD}$, $\overline{AB} \nparallel \overline{CD}$; *ABCD* is a trapezoid.
5. 1.2 **7.** 70 **9.** 70 **11.** 15

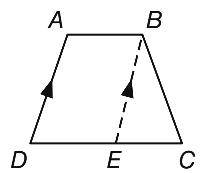
13. $\overline{JK} \parallel \overline{LM}$, $\overline{KL} \nparallel \overline{JM}$; *JKLM* is a trapezoid, but not isosceles since $KL = \sqrt{26}$ and $JM = 5$.

15. $\overline{XY} \parallel \overline{WZ}$, $\overline{WX} \nparallel \overline{YZ}$; *WXYZ* is a trapezoid, but not isosceles since $XZ = \sqrt{74}$ and $WY = \sqrt{68}$.

17. 10 **19.** 8 **21.** 17 **23.** 3.9 in. **25.** $\sqrt{20}$ **27.** 70

29. Given: *ABCD* is a trapezoid; $\angle D \cong \angle C$.

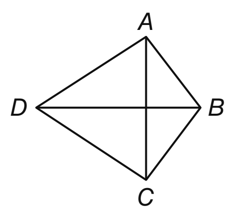
Prove: Trapezoid *ABCD* is isosceles.



Proof: By the Parallel Postulate, we can draw the auxillary line $\overline{EB} \parallel \overline{AD}$. $\angle D \cong \angle BEC$, by the Corr. ∠s Thm. We are given that $\angle D \cong \angle C$, so by the Trans. Prop, $\angle BEC \cong \angle C$. So, $\triangle EBC$ is isosceles and $\overline{EB} \cong \overline{BC}$. From the def. of a trapezoid, $\overline{AB} \parallel \overline{DE}$. Since both pairs of opposite sides are parallel, *ABED* is a parallelogram. So, $\overline{AD} \cong \overline{EB}$. By the Transitive Property, $\overline{BC} \cong \overline{AD}$. Thus, *ABCD* is an isosceles trapezoid.

31. Given: *ABCD* is a kite with $\overline{AB} \cong \overline{BC}$ and $\overline{AD} \cong \overline{DC}$.

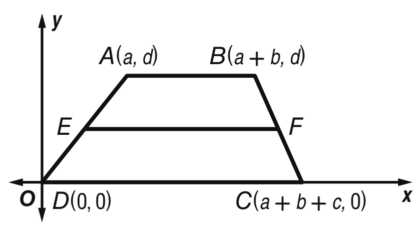
Prove: $\overline{BD} \perp \overline{AC}$



Proof: We know that $\overline{AB} \cong \overline{BC}$ and $\overline{AD} \cong \overline{DC}$. So, *B* and *D* are both equidistant from *A* and *C*. If a point is equidistant from the endpoints of a segment, then it is on the perpendicular bisector of the segment. The line that contains *B* and *D* is the perpendicular bisector of $\overline{AC}$, since only one line exists through two points. Thus, $\overline{BD} \perp \overline{AC}$.

33. Given: *ABCD* is a trapezoid with median $\overline{EF}$.

Prove: $\overline{EF} \parallel \overline{AB}$ and $\overline{EF} \parallel \overline{DC}$ and $EF = \frac{1}{2}(AB + DC)$



Proof:

By the definition of the median of a trapezoid, *E* is the midpoint of $\overline{AD}$ and *F* is the midpoint of $\overline{BC}$.

Midpoint *E* is $\left(\frac{a+0}{2}, \frac{d+0}{2}\right)$ or $\left(\frac{a}{2}, \frac{d}{2}\right)$.

Midpoint *F* is $\left(\frac{a+b+a+b+c}{2}, \frac{d+0}{2}\right)$ or $\left(\frac{2a+2b+c}{2}, \frac{d}{2}\right)$.

The slope of $\overline{AB} = 0$, the slope of $\overline{EF} = 0$, and the slope of $\overline{DC} = 0$. Thus, $\overline{EF} \parallel \overline{AB}$ and $\overline{EF} \parallel \overline{DC}$.

$AB = \sqrt{[(a+b)-a]^2 + (d-d)^2} = \sqrt{b^2}$ or b

$DC = \sqrt{[(a+b+c)-0]^2 + (0-0)^2}$

$= \sqrt{(a+b+c)^2}$ or $a + b + c$

$EF = \sqrt{\left(\frac{2a+2b+c-a}{2}\right) + \left(\frac{d}{2} - \frac{d}{2}\right)^2}$

$= \sqrt{\left(\frac{a+2b+c}{2}\right)^2}$ or $\frac{a+2b+c}{2}$

$\frac{1}{2}(AB + DC) = \frac{1}{2}[b + (a+b+c)]$

$= \frac{1}{2}(a + 2b + c)$

$= \frac{a+2b+c}{2}$

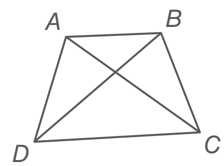
$= EF$

Thus, $\frac{1}{2}(AB + DC) = EF$.

35. 15 **37.** 28 ft **39.** 70 **41.** 2 **43.** 20 **45.** 10 in.
47. 105 **49.** 100

51. Given: *ABCD* is an isosceles trapezoid.

Prove: $\angle DAC \cong \angle CBD$

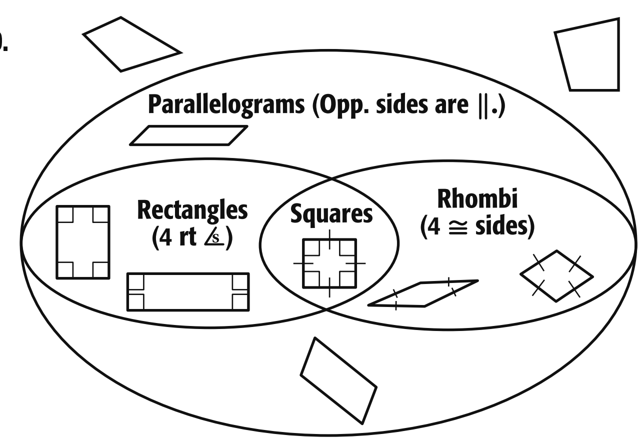


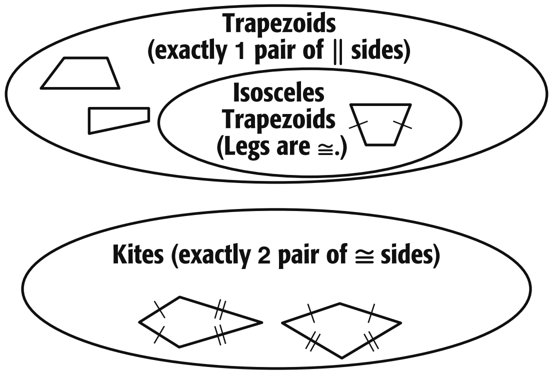
Statements (Reasons)

1. *ABCD* is an isosceles trapezoid. (Given)
2. $\overline{AD} \cong \overline{BC}$ (Def. of isos. trap.)
3. $\overline{DC} \cong \overline{DC}$ (Refl. Prop.)
4. $\overline{AC} \cong \overline{BD}$ (Diags. of isos. trap. are ≅.)
5. $\triangle ADC \cong \triangle BCD$ (SSS)
6. $\angle DAC \cong \angle CBD$ (CPCTC)

53. Sometimes; opp ∠s are supplementary in an isosceles trapezoid. **55.** Always; by def., a square is a quadrilateral with 4 rt. ∠s and 4 ≅ sides. Since by def., a rhombus is a quadrilateral with 4 ≅ sides, a square is always a rhombus. **57.** Sometimes; only if the parallelogram has 4 rt. ∠s and/or congruent diagonals, is it a rectangle.

59.

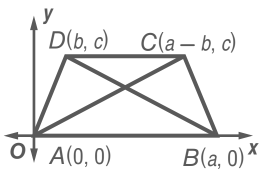




61. quadrilateral; no parallel sides

63. Given: isosceles trapezoid $ABCD$ with $\overline{AD} \cong \overline{BC}$

Prove: $\overline{BD} \cong \overline{AC}$



Proof:

$DB = \sqrt{(a-b)^2 + (0-c)^2}$

or $\sqrt{(a-b)^2 + c^2}$

$AC = \sqrt{((a-b)-0)^2 + (c-0)^2}$

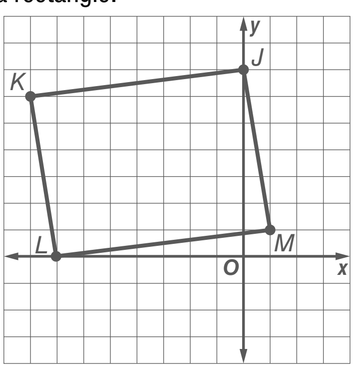
or $\sqrt{(a-b)^2 + c^2}$

$BD = AC$ and $\overline{BD} \cong \overline{AC}$

65. Belinda; $m\angle D = m\angle B$. So, $m\angle A + m\angle B + m\angle C + m\angle D = 360$ or $m\angle A + 100 + 45 + 100 = 360$. So, $m\angle A = 115$.

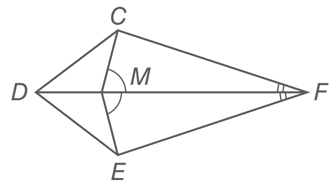
67. Never; a square has all 4 sides ≅, while a kite does not have any opposite sides congruent. 69. A quadrilateral must have exactly one pair of sides parallel to be a trapezoid. If the legs are congruent, then the trapezoid is an isosceles trapezoid. If a quadrilateral has exactly two pairs of consecutive congruent sides with the opposite sides not congruent, the quadrilateral is a kite. A trapezoid and a kite both have four sides. In a trapezoid and isosceles trapezoid, both have exactly one pair of parallel sides.

71. 76 **73.** B **75.** 18 **77.** 9 **79.** No; slope of $\overline{JK} = \frac{1}{8}$ = slope of $\overline{LM}$ and slope of $\overline{KL} = -6$ = slope of $\overline{MJ}$. So, $JKLM$ is a parallelogram. The product of the slopes of consecutive sides ≠ −1, so the consecutive sides are not perpendicular. Thus, $JKLM$ is not a rectangle.



81. Given: $\angle CMF \cong \angle EMF$,
$\angle CFM \cong \angle EFM$

Prove: $\triangle DMC \cong \triangle DME$



Proof:

Statements (Reasons)

1. $\angle CMF \cong \angle EMF$, $\angle CFM \cong \angle EFM$ (Given)
2. $\overline{MF} \cong \overline{MF}$, $\overline{DM} \cong \overline{DM}$ (Reflexive Property)
3. $\triangle CMF \cong \triangle EMF$ (ASA)
4. $\overline{CM} \cong \overline{EM}$ (CPCTC)
5. $\angle DMC$ and $\angle CMF$ are supplementary and $\angle DME$ and $\angle EMF$ are supplementary. (Supplement Th.)
6. $\angle DMC \cong \angle DME$ (∠s suppl. to ≅ ∠s are ≅.)
7. $\triangle DMC \cong \triangle DME$ (SAS)

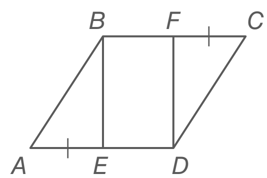
Chapter 8 Study Guide and Review

1. false, both pairs of base angles **3.** false, diagonal **5.** true
7. false, is always **9.** true **11.** 1440 **13.** 720 **15.** 26
17. 18 **19.** 115° **21.** $x = 37$, $y = 6$

23. yes, Theorem 6.11

25. Given: ▱$ABCD$, $\overline{AE} \cong \overline{CF}$

Prove: Quadrilateral $EBFD$ is a parallelogram.



1. $ABCD$ is a parallelogram, $\overline{AE} \cong \overline{CF}$ (Given)
2. $AE = CF$ (Def. of ≅ segs)
3. $\overline{BC} \cong \overline{AD}$ (Opp. sides of a ▱ are ≅)
4. $BC = AD$ (Def. of ≅ segs)
5. $BC = BF + CF$, $AD = AE + ED$ (Seg. Add. Post.)
6. $BF + CF = AE + ED$ (Subst.)
7. $BF + AE = AE + ED$ (Subst.)
8. $BF = ED$ (Subt. Prop.)
9. $\overline{BF} \cong \overline{ED}$ (Def. of ≅ segs)
10. $\overline{BF} \parallel \overline{ED}$ (Def. of ▱)
11. Quadrilateral $EBFD$ is a parallelogram. (If one pair of opposite sides is parallel and congruent then it is a parallelogram.)

27. $x = 5$, $y = 12$
29. 33 **31.** 64 **33.** 6 **35.** 55 **37.** 35
39. Rectangle, rhombus, square; all sides are ≅, consecutive are ⊥. **41.** 19.2

43a. Sample answer: The legs of the trapezoids are part of the diagonals of the square. The diagonals of a square bisect opposite angles, so each base angle of a trapezoid measures 45°. One pair of sides is parallel and the base angles are congruent.

43b. $16 + 8\sqrt{2} \approx 27.3$ in.

CHAPTER 9
Proportions and Similarity

Chapter 9 Get Ready

1. 4 or -4 **3.** -37 **5.** 64 **7.** 64.5

Lesson 9-1

1. 23:50 **3.** 30, 75, 60 **5.** 16 **7.** 8 **9.** 18 **11.** Movie A; 1 : 2 **13.** 81.9 in., 63.7 in., 45.5 in. **15.** 2.2 ft **17.** 54, 108, 18 **19.** 75, 60, 45 **21.** $\frac{15}{8}$ **23.** 3 **25.** 8 **27.** 3 **29.** about 5 **31.** 3, -3.5 **33.** 12.9, -0.2 **35.** 2541 in^2 **37.** 48, 96, 144, 72 **39a.** No; the HDTV aspect ratio is 1.77778 and the standard aspect ratio is 1.33333. Neither television set is a golden rectangle since the ratios of the lengths to the widths are not the golden ratio. **39b.** 593 pixels and 367 pixels

41. Given: $\frac{a}{b} = \frac{c}{d}$, $b \neq 0$, $d \neq 0$

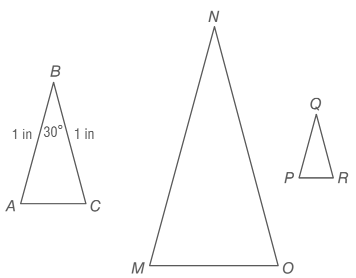
Prove: $ad = bc$

Proof:

Statement (Reasons)

1. $\frac{a}{b} = \frac{c}{d}$, $b \neq 0$, $d \neq 0$ (Given)
2. $(bd)\frac{a}{b} = (bd)\frac{c}{d}$ (Mult. Prop)
3. $da = bc$ (Subs. Prop.)
4. $ad = bc$ (Comm. Prop.)

43a.



43b.

Triangle	ABC	MNO	PQR
Leg length	1 in.	2 in.	0.5 in.
Perimeter	2.5 in.	5 in.	1.25 in.

43c. Sample answer: When the vertex angle of an isosceles triangle is held constant and the leg length is increased or decreased by a factor, the perimeter of the triangle increases or decreases by the same factor. **45.** 5:2

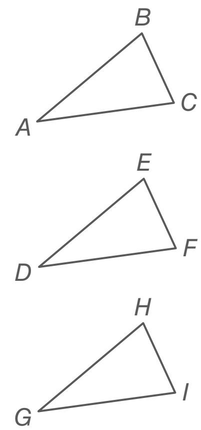
47. $\frac{2}{3} = \frac{5}{7.5}$; You need to multiply $\frac{2}{3}$ by a factor of 2.5 to get $\frac{5}{7.5}$. The factor of the other three proportions is 2.8. **49.** Both are written with fractions. A ratio compares two quantities with division, while a proportion equates two ratios. First, ratios are used to write proportions. Then the cross product is used to solve the proportion. **51.** F **53.** D **55.** 2.5

57. Since a square is a parallelogram, the diagonals bisect each other. Since a square is a rhombus, the diagonals are congruent. Therefore, the distance from first base to third base is equal to the distance between home plate and second base. Thus, the distance from home plate to the center of the infield is 127 ft $3\frac{3}{8}$ in. divided by 2 or 63 ft $7\frac{11}{16}$ in. This distance is longer than the distance from home plate to the pitcher's mound so the pitcher's mound is not located in the center of the field. It is about 3 ft closer to home.

59. $-\frac{4}{7} < x < \frac{136}{7}$ **61.** $\angle 1$, $\angle 4$, $\angle 11$ **63.** $\angle 2$, $\angle 6$, $\angle 9$, $\angle 4$

65. Given: $\triangle ABC \cong \triangle DEF$
$\triangle DEF \cong \triangle GHI$

Prove: $\triangle ABC \cong \triangle GHI$



Proof:

You are given that $\triangle ABC \cong \triangle DEF$. Because corresponding parts of congruent triangles are congruent, $\angle A \cong \angle D$, $\angle B \cong \angle E$, $\angle C \cong \angle F$, $\overline{AB} \cong \overline{DE}$, $\overline{BC} \cong \overline{EF}$, and $\overline{AC} \cong \overline{DF}$. You are also given that $\triangle DEF \cong \triangle GHI$. So $\angle D \cong \angle G$, $\angle E \cong \angle H$, $\angle F \cong \angle I$, $\overline{DE} \cong \overline{GH}$, $\overline{EF} \cong \overline{HI}$, and $\overline{DF} \cong \overline{GI}$ by CPCTC. Therefore, $\angle A \cong \angle G$, $\angle B \cong \angle H$, $\angle C \cong \angle I$, $\overline{AB} \cong \overline{GH}$, $\overline{BC} \cong \overline{HI}$, and $\overline{AC} \cong \overline{GI}$ because congruence of angles and segments is transitive. Thus, $\triangle ABC \cong \triangle GHI$ by the definition of congruent triangles.

Lesson 9-2

1. $\angle A \cong \angle Z$, $\angle B \cong \angle Y$, $\angle C \cong \angle X$; $\frac{AC}{ZX} = \frac{BC}{YX} = \frac{AB}{ZY}$

3. no; $\frac{NQ}{WZ} \neq \frac{QR}{WX}$ **5.** 6 **7.** 22 ft

9. $\angle J \cong \angle P$, $\angle F \cong \angle S$, $\angle M \cong \angle T$, $\angle H \cong \angle Q$; $\frac{PQ}{JH} = \frac{TS}{MF} = \frac{SQ}{FH} = \frac{TP}{MJ}$

11. $\angle D \cong \angle K$, $\angle F \cong \angle M$, $\angle G \cong \angle J$; $\frac{DF}{KM} = \frac{FG}{MJ} = \frac{GD}{JK}$

13. Yes; $\triangle LTK \sim \triangle MTK$ because $\triangle LTK \cong \triangle MTK$; scale factor: 1. 15. no; $\frac{AD}{WM} \neq \frac{DK}{ML}$

17. Yes; sample answer: The ratio of the longer dimensions of the screens is approximately 1.1 and the ratio of the shorter dimensions of the screens is approximately 1.1. **19.** 5 **21.** 3 **23.** 10.8 **25.** 18.9 **27.** 40 m

29. $\angle A \cong \angle V$, $\angle B \cong \angle X$, $\angle D \cong \angle Z$, $\angle F \cong \angle T$; $\frac{AB}{VX} = \frac{BD}{XZ} = \frac{DF}{ZT} = \frac{FA}{TV} = 2$

31. $\overline{AC}$, $\overline{AD}$ **33.** $\angle ABH$, $\angle ADF$ **35.** $x = 63$, $y = 32$

37. 52 in. by 37 in. **39.** no; $\frac{BC}{XY} \neq \frac{AB}{WX}$ **41** Never; sample answer: Parallelograms have both pairs of opposite sides parallel. Trapezoids have exactly one pair of parallel legs. Therefore, the two figures cannot be similar because they can never be the same type of figure. **43.** Sometimes; sample answer: If corresponding angles are congruent and corresponding sides are proportional, two isosceles triangles are similar. **45.** Always; sample answer: Equilateral triangles always have three 60° angles, so the angles of one equilateral triangle are always congruent to the angles of a second equilateral triangle. The three sides of an equilateral triangle are always congruent, so the ratio of each pair of legs of one triangle to a second triangle will always be the same. Therefore, a pair of equilateral triangles is always similar.

47. $3\frac{1}{2}$ in. by $2\frac{1}{2}$ in.

49a. $\frac{a}{3a} = \frac{b}{3b} = \frac{c}{3c} = \frac{a+b+c}{3(a+b+c)} = \frac{1}{3}$

49b. No; the sides are no longer proportional. **51.** 4

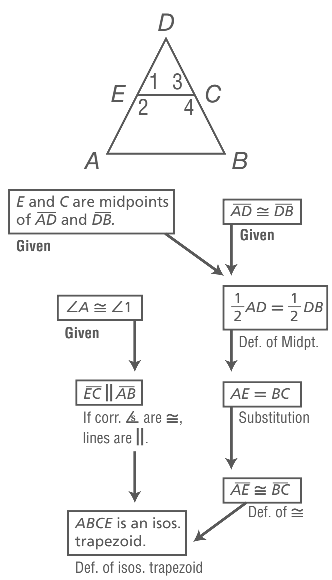
53. Sample answer:

55. Sample answer: Two figures are congruent if they are the same size and shape. In congruent figures, corresponding angles are congruent and the corresponding sides are congruent. When two figures are similar, corresponding angles are congruent and corresponding sides are proportional. Figures that are congruent are also similar, since corresponding angles are congruent and corresponding sides are proportional. Two figures that are similar are only congruent if the ratio of their corresponding side lengths is 1. If figures are equal, then they are the same figure. **57.** G **59.** E

61. Given: *E* and *C* are midpoints of $\overline{AD}$ and $\overline{AB}$, $\overline{AD} \cong \overline{DB}$, $\angle A \cong \angle 1$

Prove: *ABCE* is an isosceles trapezoid.

Proof:



63. $x \leq 4$ **65.** The angle bisector of the vertex angle of an isosceles triangle is not an altitude of the triangle. **67.** 128 **69.** 68 **71.** $x = 2$, $RT = 8$, $RS = 8$

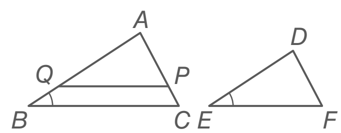
Lesson 9-3

1. Yes; $\triangle YXZ \sim \triangle VWZ$ by AA Similarity. **3.** No; corresponding sides are not proportional. **5.** C **7.** $\triangle QVS \sim \triangle RTS$; 20 **9.** Yes; $\triangle XUZ \sim \triangle WUY$ by SSS Similarity. **11.** Yes; $\triangle CBA \sim \triangle DBF$ by SAS Similarity. **13.** No; not enough information to determine. If $JH = 3$ or $WY = 24$, then $\triangle JHK \sim \triangle XWY$ by SSS Similarity.

15. Yes; sample answer:
$\overline{AB} \cong \overline{EB}$ and $\overline{CB} \cong \overline{DB}$, so
$\frac{AB}{CB} = \frac{EB}{DB}$. $\angle ABE \cong \angle CBD$
because vertical angles are congruent. Therefore, $\triangle ABE \sim \triangle CBD$ by SAS Similarity.

17. $\triangle QRS \sim \triangle QPT$; 5 **19.** $\triangle HJK \sim \triangle NQP$; 15, 10
21. $\triangle GHJ \sim \triangle GDH$; 14, 20 **23.** about 12.8 ft
25. **Given:** $\angle B \cong \angle E$, $\overline{QP} \parallel \overline{BC}$, $\overline{QP} \cong \overline{EF}$, $\frac{AB}{DE} = \frac{BC}{EF}$

Prove: $\triangle ABC \sim \triangle DEF$



Proof:

Statements (Reasons)

1. $\angle B \cong \angle E$, $\overline{QP} \parallel \overline{BC}$, $\overline{QP} \cong \overline{EF}$, $\frac{AB}{DE} = \frac{BC}{EF}$ (Given)
2. $\angle APQ \cong \angle C$, $\angle AQP \cong \angle B$ (Corr. ∡ Post.)
3. $\angle AQP \cong \angle E$ (Trans. Prop.)
4. $\triangle ABC \sim \triangle AQP$ (AA Similarity)
5. $\frac{AB}{AQ} = \frac{BC}{QP}$ (Def. of $\sim \triangle$s)
6. $AB \cdot QP = AQ \cdot BC$; $AB \cdot EF = DE \cdot BC$ (Cross products)
7. $QP = EF$ (Def. of $\cong$ segs.)
8. $AB \cdot EF = AQ \cdot BC$ (Subst.)
9. $AQ \cdot BC = DE \cdot BC$ (Subst.)
10. $AQ = DE$ (Div. Prop.)
11. $\overline{AQ} \cong \overline{DE}$ (Def. of $\cong$ segs.)
12. $\triangle AQP \cong \triangle DEF$ (SAS)
13. $\angle APQ \cong \angle F$ (CPCTC)
14. $\angle C \cong \angle F$ (Trans. Prop.)
15. $\triangle ABC \sim \triangle DEF$ (AA Similarity)

27. Proof:

Statements (Reasons)

1. $\triangle XYZ$ and $\triangle ABC$ are right triangles. (Given)
2. $\angle XYZ$ and $\angle ABC$ are right angles. (Def. of rt. $\triangle$)

3. $\angle XYZ \cong \angle ABC$ (All rt. $\angle$s are $\cong$.)

4. $\frac{XY}{AB} = \frac{YZ}{BC}$ (Given)

5. $\triangle YXZ \sim \triangle BAC$ (SAS Similarity)

29. 20 in. **31.** $\frac{3}{2}$

33. $\angle C \cong \angle C'$, since all rt. $\angle$s are $\cong$. Line ℓ is a transversal of $\parallel$ segments $\overline{BC}$ and $\overline{B'C'}$, so $\angle ABC \cong \angle A'B'C'$ since corresponding $\angle$s of $\parallel$ lines are $\cong$. Therefore, by AA Similarity, $\triangle ABC \sim \triangle A'B'C'$. So $\frac{BC}{AC}$, the slope of line ℓ through points A and B, is equal to $\frac{B'C'}{A'C'}$, the slope of line ℓ through points A' and B'. **35.** 31.5 cm **37.** Sample answer: The AA Similarity Postulate, SSS Similarity Theorem, and SAS Similarity Theorem are all tests that can be used to determine whether two triangles are similar. The AA Similarity Postulate is used when two pairs of congruent angles on two triangles are given. The SSS Similarity Theorem is used when the corresponding side lengths of two triangles are given. The SAS Similarity Theorem is used when two proportional side lengths and the included angle on two triangles are given. **39.** 6 **41.** Sample answer: Choose a side of the original triangle and measure it. Draw a segment that is twice as long as the one you measured. Measure the angles between the side that you measured on the original triangle and the other two sides. Construct angles congruent to the two angles on the original triangle from your segment. Extend the two new segments until they meet. The new triangle will be similar to the first triangle and twice as large.

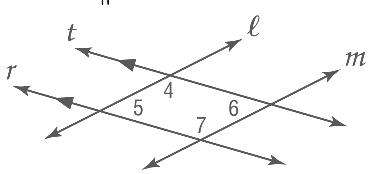
43a. $\frac{6}{x-2} = \frac{4}{5}$ **43b.** 9.5, 7.5 **45.** B

47. $\angle X \cong \angle R$, $\angle W \cong \angle Q$, $\angle Y \cong \angle S$, $\angle Z \cong \angle T$; $\frac{WX}{QR} = \frac{ZY}{TS} = \frac{WZ}{QT} = \frac{XY}{RS}$

49. 12 **51.** 52.3 **53** Sample answer: If one pair of opposite sides are congruent and parallel, the quadrilateral is a parallelogram. **55.** not possible

57. Given: $r \parallel t$; $\angle 5 \cong \angle 6$

Prove: $\ell \parallel m$



Proof:

Statements (Reasons)

1. $r \parallel t$; $\angle 5 \cong \angle 6$ (Given)
2. $\angle 4$ and $\angle 5$ are supplementary. (Consecutive Interior Angle Theorem)
3. $m\angle 4 + m\angle 5 = 180$ (Definition of supplementary angles)
4. $m\angle 5 = m\angle 6$ (Definition of congruent angles)
5. $m\angle 4 + m\angle 6 = 180$ (Substitution)
6. $\angle 4$ and $\angle 6$ are supplementary. (Definition of supplementary)
7. $\ell \parallel m$ (If cons. int. $\angle$s are suppl., then lines are $\parallel$)

Lesson 9-4

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.** 15 **13.** 10

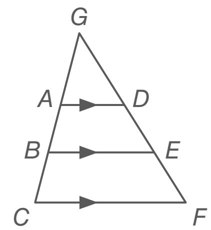
15. yes; $\frac{ZV}{VX} = \frac{WY}{YX} = \frac{11}{5}$ 17. no; $\frac{ZV}{VX} \neq \frac{WY}{YX}$

19. 60 **21.** 1.35 **23.** 1.2 in. **25.** $x = 18$; $y = 3$

27. $x = 48$; $y = 72$

29. Given: $\overleftrightarrow{AD} \parallel \overleftrightarrow{BE} \parallel \overleftrightarrow{CF}$, $\overline{AB} \cong \overline{BC}$

Prove: $\overline{DE} \cong \overline{EF}$



Proof:

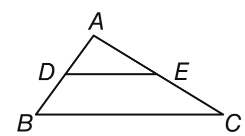
From Corollary 7.1, $\frac{AB}{BC} = \frac{DE}{EF}$.

Since $\overline{AB} \cong \overline{BC}$, $AB = BC$ by definition of congruence.

Therefore, $\frac{AB}{BC} = 1$. By substitution, $1 = \frac{DE}{EF}$ Thus, $DE = EF$. By definition of congruence, $\overline{DE} \cong \overline{EF}$.

31. Given: $\frac{DB}{AD} = \frac{EC}{AE}$

Prove: $\overline{DE} \parallel \overline{BC}$



Proof:

Statements (Reasons)

1. $\frac{DB}{AD} = \frac{EC}{AE}$ (Given)
2. $\frac{AD}{AD} + \frac{DB}{AD} = \frac{AE}{AE} + \frac{EC}{AE}$ (Add. Prop.)
3. $\frac{AD + DB}{AD} = \frac{AE + EC}{AE}$ (Subst.)
4. $AB = AD + DB$, $AC = AE + EC$ (Seg. Add. Post.)
5. $\frac{AB}{AD} = \frac{AC}{AE}$ (Subst.)
6. $\angle A \cong \angle A$ (Refl. Prop.)
7. $\triangle ADE \cong \triangle ABC$ (SAS Similarity)
8. $\angle ADE \cong \angle ABC$ (Def. of $\sim$ polygons)
9. $\overline{DE} \parallel \overline{BC}$ (If corr. $\angle$s are $\cong$, then the lines are $\parallel$.)

33. 9 **35.** 3, 1 **37.** 8, 7.5

39. $\triangle ABC \sim \triangle ADE$ — **SAS** Similarity

$\frac{AD}{AB} = \frac{DE}{BC}$ — Def. of $\sim \triangle$s

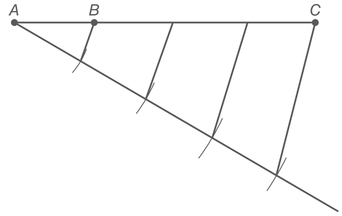
$\frac{40}{100} = \frac{DE}{BC}$ — Substitution

$\frac{2}{5} = \frac{DE}{BC}$ — Simplify.

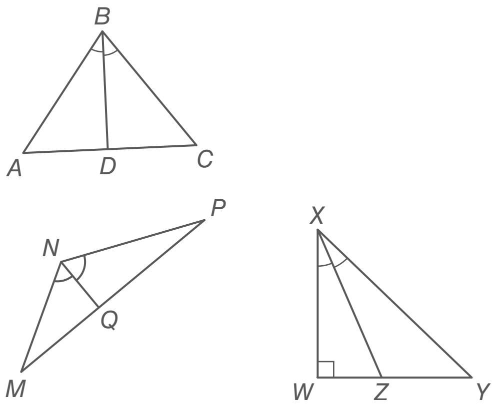
$\frac{2}{5}BC = DE$ — Multiply.

41. 6 **43.** 8.75 in., 17.5 in., 26.25 in.

45. Sample answer:



47a. Sample answer:



47b.

Triangle	Length		Ratio	
ABC	*AD*	1.1 cm	$\frac{AD}{CD}$	1.0
	CD	1.1 cm		
	AB	2.0 cm	$\frac{AB}{CB}$	1.0
	CB	2.0 cm		
MNP	*MQ*	1.4 cm	$\frac{MQ}{PQ}$	0.8
	PQ	1.7 cm		
	MN	1.6 cm	$\frac{MN}{PN}$	0.8
	PN	2.0 cm		
WXY	*WZ*	0.8 cm	$\frac{WZ}{YZ}$	0.7
	YZ	1.2 cm		
	WX	2.0 cm	$\frac{WX}{YX}$	0.7
	YX	2.9 cm		

47c. Sample answer: The proportion of the segments created by the angle bisector of a triangle is equal to the proportion of their respective consecutive sides.

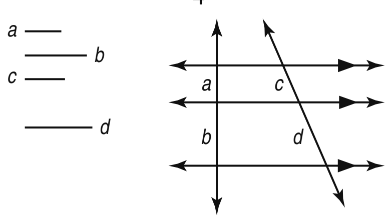
49. Always; sample answer: *FH* is a midsegment. Let $BC = x$, then

$FH = \frac{1}{2}x$. *FHCB* is a trapezoid,

so $DE = \frac{1}{2}(BC + FH) = \frac{1}{2}\left(x + \frac{1}{2}x\right) = \frac{1}{2}x + \frac{1}{4}x = \frac{3}{4}x$.

Therefore, $DE = \frac{3}{4}BC$.

51.



By Corollary 7.1, $\frac{a}{b} = \frac{c}{d}$.

53. 8 **55.** G **57.** $\triangle ABE \sim \triangle CDE$ by AA Similarity; 6.25

59. $\triangle WZT \sim \triangle WXY$ by AA Similarity; 7.5 **61.** $\overline{QR} \parallel \overline{TS}$, $\overline{QT} \nparallel \overline{RS}$; *QRST* is an isosceles trapezoid since $RS = \sqrt{26} = QT$.

63. 6 **65.** 56 **67.** $\frac{2}{3}$ **69.** 2.1 **71.** 8.7

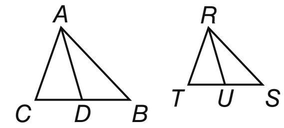
Lesson 9-5

1. 8 **3.** 35.7 ft **5.** 20 **7.** 8.5 **9.** 18 **11.** 18 **13.** 15 **15.** 5 **17.** 4

19. Given: $\triangle ABC \sim \triangle RST$

$\overline{AD}$ is a median of $\triangle ABC$.

$\overline{RU}$ is a median of $\triangle RST$.



Prove: $\frac{AD}{RU} = \frac{AB}{RS}$

Proof:

Statements (Reasons)

1. $\triangle ABC \sim \triangle RST$; $\overline{AD}$ is a median of $\triangle ABC$; $\overline{RU}$ is a median of $\triangle RST$. (Given)
2. $CD = DB$; $TU = US$ (Def. of median)
3. $\frac{AB}{RS} = \frac{CB}{TS}$ (Def. of ~ △s)
4. $CB = CD + DB$; $TS = TU + US$ (Seg. Add. Post.)
5. $\frac{AB}{RS} = \frac{CD + DB}{TU + US}$ (Subst.)
6. $\frac{AB}{RS} = \frac{DB + DB}{US + US}$ or $\frac{2(DB)}{2(US)}$ (Subst.)
7. $\frac{AB}{RS} = \frac{DB}{US}$ (Subst.)
8. $\angle B \cong \angle S$ (Def. of ~ △s)
9. $\triangle ABD \sim \triangle RSU$ (SAS Similarity)
10. $\frac{AD}{RU} = \frac{AB}{RS}$ (Def. of ~ △s)

21. 3 **23.** 70

25. Proof:

Statements (Reasons)

1. $\overline{CD}$ bisects $\angle ACB$; By construction, $\overline{AE} \parallel \overline{CD}$. (Given)
2. $\frac{AD}{DB} = \frac{EC}{BC}$ (△ Prop. Thm.)
3. $\angle 1 \cong \angle 2$ (Def. of ∠ Bisector)
4. $\angle 3 \cong \angle 1$ (Alt. Int. ∠ Thm.)
5. $\angle 2 \cong \angle E$ (Corr. ∠ Post.)
6. $\angle 3 \cong \angle E$ (Trans. Prop.)
7. $\overline{EC} \cong \overline{AC}$ (Conv. of Isos. △ Thm.)
8. $EC = AC$ (Def. of ≅ segs.)
9. $\frac{AD}{DB} = \frac{AC}{BC}$ (Subst.)

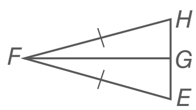
27. Proof:

Statements (Reasons)

1. $\triangle STQ \sim \triangle ZWX$, $\overline{TR}$ and $\overline{WY}$ are angle bisectors. (Given)
2. $\angle STQ \cong \angle ZWX$, $\angle Q \cong \angle X$ (Def of ~ △s)
3. $\angle STR \cong \angle QTR$, $\angle ZWY \cong \angle XWY$ (Def. ∠ bisector)
4. $m\angle STQ = m\angle STR + m\angle QTR$, $m\angle ZWX = m\angle ZWY \cong m\angle XWY$ (∠ Add. Post.)

5. $m\angle STQ = 2m\angle QTR$, $m\angle ZWX = 2m\angle XWY$ (Subst.)
6. $2m\angle QTR = 2m\angle XWY$ (Subst.)
7. $m\angle QTR = m\angle XWY$ (Div.)
8. $\triangle QTR \sim \triangle XWY$ (AA Similarity)
9. $\frac{TR}{WY} = \frac{QT}{XW}$ (Def of $\sim \triangle$s)

29. Craig **31.** Chun; by the Angle Bisector Theorem, the correct proportion is $\frac{5}{8} = \frac{15}{x}$. **33.** $PS = 18.4$, $RS = 24$ **35.** Both theorems have a segment that bisects an angle and have proportionate ratios. The Triangle Angle Bisector Theorem pertains to one triangle, while Theorem 7.9 pertains to similar triangles. Unlike the Triangle Angle Bisector Theorem, which separates the opposite side into segments that have the same ratio as the other two sides, Theorem 7.9 relates the angle bisector to the measures of the sides. **37.** 2.2 **39.** C **41.** $x = 2$; $y = 3$
43. $KP = 5$, $KM = 15$,
$MR = 13\frac{1}{3}$, $ML = 20$,
$MN = 12$, $PR = 16\frac{2}{3}$
45. Given: $\overline{EF} \cong \overline{HF}$
G is the midpoint of $\overline{EH}$.
Prove: $\triangle EFG \cong \triangle HFG$



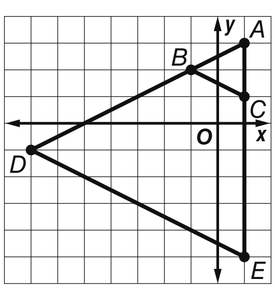
Proof:
Statements (Reasons)
1. $\overline{EF} \cong \overline{HF}$; *G* is the midpoint of $\overline{EH}$ (Given)
2. $\overline{EG} \cong \overline{GH}$ (Def. of midpoint)
3. $\overline{FG} \cong \overline{FG}$ (Reflexive Prop.)
4. $\triangle EFG \cong \triangle HFG$ (SSS)

47. 5 **49.** $\sqrt{137} \approx 11.7$ **51.** $\sqrt{340} \approx 18.4$

Lesson 9-6

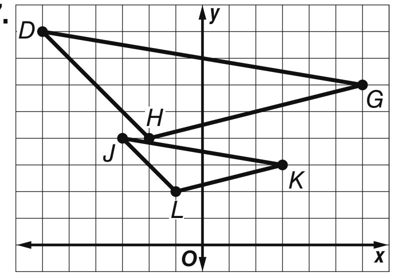
1. enlargement; 2 **3.** No; sample answer: Since $\frac{152.5}{27} \neq \frac{274}{78}$, a table tennis table is not a dilation of a tennis court.
5. $\frac{RJ}{KJ} = \frac{SJ}{LJ} = \frac{RS}{KL} = \frac{1}{2}$, so $\triangle RSJ \sim \triangle KLJ$ by SSS Similarity.
7. reduction; $\frac{1}{2}$ **9.** enlargement; 2 **11.** reduction
13. No; sample answer: Since $\frac{1.2}{2.5} \neq \frac{1.25}{3}$, the design and the actual tattoo are not proportional. Therefore, the tattoo is not a dilation of the design.

15.



$\angle A \cong \angle A$ and $\frac{AB}{AD} = \frac{AC}{AE} = \frac{1}{4}$, so $\triangle ABC \sim \triangle ADE$ by SAS Similarity.

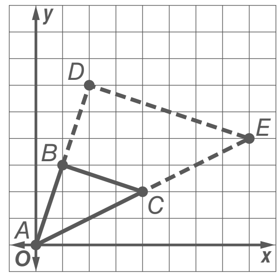
17.



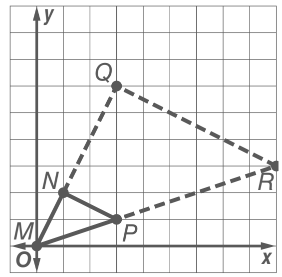
$\frac{JK}{DG} = \frac{KL}{GH} = \frac{JL}{DH} = \frac{1}{2}$, so $\triangle JKL \sim \triangle DGH$ by SSS Similarity.

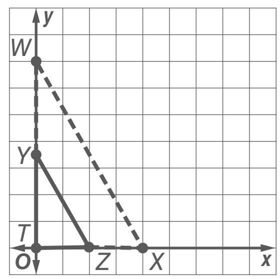
19. (0, −2)

21a.



21b.



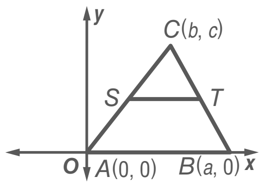


21c.

Coordinates											
$\triangle ABC$		$\triangle ADE$		$\triangle MNP$		$\triangle MQR$		$\triangle TWX$		$\triangle TYZ$	
A	(0, 0)	A	(0, 0)	M	(0, 0)	M	(0, 0)	T	(0, 0)	T	(0, 0)
B	(1, 3)	D	(2, 6)	N	(1, 2)	Q	(3, 6)	W	(0, 7)	Y	(0, 3.5)
C	(4, 2)	E	(8, 4)	P	(3, 1)	R	(9, 3)	X	(4, 0)	Z	(2, 0)

21d. Sample answer: Multiply the coordinates of the given triangle by the scale factor to get the coordinates of the dilated triangle. **23.** No; sample answer: Since the *x*-coordinates are multiplied by 3 and the *y*-coordinates are multiplied by 2, $\triangle XYZ$ is 3 times as wide and only 2 times as tall as $\triangle PQR$. Therefore, the transformation is not a dilation. **25.** Sample answer: Architectural plans are reductions. **27.** Sample answer: If a transformation is an enlargement, the lengths of the transformed object will be greater than the original object, so the scale factor will be greater than 1. If a transformation is a reduction, the lengths of the transformed object will be less than the original object, so the scale factor will be less than 1, but greater than 0. If the transformation is a congruence transformation, the scale factor is 1, because the lengths of the transformed object are equal to the lengths of the original object.

29. $\frac{1}{2}$ **31.** E **33.** yes; $\frac{AC}{BD} = \frac{DE}{CE} = \frac{4}{3}$ **35.** no; $\frac{AB}{CD} \neq \frac{AE}{CE}$
37. 117
39.



Given: $\triangle ABC$
S is the midpoint of $\overline{AC}$.
T is the midpoint of $\overline{BC}$.
Prove: $\overline{ST} \parallel \overline{AB}$
Proof:
Midpoint S is $\left(\frac{b+0}{2}, \frac{c+0}{2}\right)$ or $\left(\frac{b}{2}, \frac{c}{2}\right)$.
Midpoint T is $\left(\frac{a+b}{2}, \frac{0+c}{2}\right)$ or $\left(\frac{a+b}{2}, \frac{c}{2}\right)$.
Slope of $\overline{ST} = \dfrac{\frac{c}{2} - \frac{c}{2}}{\frac{a+b}{2} - \frac{b}{2}} = \dfrac{0}{\frac{a}{2}}$ or 0.
Slope of $\overline{AB} = \frac{0-0}{a-0} = \frac{0}{a}$ or 0.
$\overline{ST}$ and $\overline{AB}$ have the same slope so $\overline{ST} \parallel \overline{AB}$.

41. 8 **43.** 0.003 **45.** 0.17

Lesson 9-7

1. about 117 mi **3a.** 6 in.: 50 ft **3b.** $\frac{1}{100}$ **5.** 380 km
7. 173 km **9a.** 1 in.:1 ft **9b.** $\frac{1}{12}$ times
11. Sample answer: 1 in. = 12 ft

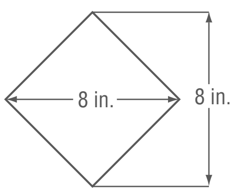


Figure not shown actual size.

13. about 2.7 h or 2 h and 42 min **15.** 1.61 km **17a.** 84 ft **17b.** 0.5 in. **19.** 329 ft **21.** Felix; sample answer: The ratio of the actual high school to the replica is $\frac{75}{1.5}$ or 50:1. **23.** The first drawing will be larger. The second drawing will be $\frac{1}{6}$ the size of the first drawing, so the scale factor is 1:6. **25.** Both can be written as ratios comparing lengths. A scale factor must have the same unit of measure for both measurements. **27.** D **29.** C
31. 12 **33.** 17.5 **35.** 29.3 **37.** 3.5 **39.** 10.5 **41.** 8
43. $JK = \sqrt{10}$, $KL = \sqrt{10}$,
$JL = \sqrt{20}$, $XY = \sqrt{10}$,
$YZ = \sqrt{10}$, and $XZ = \sqrt{20}$. Each pair of corresponding sides has the same measure so they are congruent.
$\triangle JKL \cong \triangle XYZ$ by SSS.
45. 8 **47.** 48 **49.** $3\sqrt{77}$

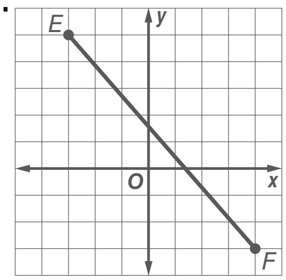
Chapter 9 Study Guide and Review

1. j **3.** g **5.** d **7.** b **9.** 49 **11.** 10 or −10 **13.** 120 in.
15. No, the polygons are not similar because the corresponding sides are not proportional. **17.** 16.5 **19.** Yes, $\triangle ABE \sim \triangle ADC$ by the SAS ~ Thm. **21.** No, the triangles are not similar because not all corresponding angles are congruent. **23.** 34.2 ft
25. 22.5 **27.** 6 **29.** 633 mi **31.** enlargement; 2 **33.** 10.5 in.
35. 95.8 mi

CHAPTER 10
Right Triangles and Trigonometry

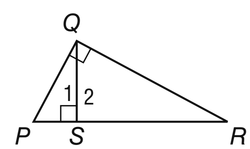
Chapter 10 Get Ready

1. $4\sqrt{7}$ **3.** $10\sqrt{3}$ **5.** $\frac{3}{4}$ **7.** 10 **9.** $x = 17.2$ in.,68.8 in. of trim
11.



Lesson 10-1

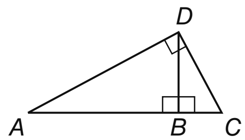
1. 10 **3.** $10\sqrt{6}$ or 24.5 **5.** $x = 6$; $y = 3\sqrt{5} \approx 6.7$; $z = 6\sqrt{5} \approx 13.4$ **7.** 18 ft 11 in. **9.** 20 **11.** $12\sqrt{6} \approx 29.4$
13. $3\sqrt{3} \approx 5.2$ **15.** $\triangle WXY \sim \triangle XZY \sim \triangle WZX$
17. $\triangle HGF \sim \triangle HIG \sim \triangle GIF$
19. $x = 5\sqrt{13} \approx 18.0$; $y = 54\frac{1}{6} \approx 54.2$; $z \approx 51.1$
21. $x \approx 4.7$; $y \approx 1.8$; $z \approx 13.1$
23. $x = 24\sqrt{2} \approx 33.9$; $y = 8\sqrt{2} \approx 11.3$; $z = 32$ **25.** 161.8 ft
27. $\frac{\sqrt{30}}{7}$ or 0.8 **29.** $x = \frac{3\sqrt{3}}{2} \approx 2.6$; $y = \frac{3}{2}$; $z = 3$
31. 11 **33.** 3.5 ft **35.** 5 **37.** 4
39. Given: $\angle PQR$ is a right angle.
$\overline{QS}$ is an altitude of $\triangle PQR$.



Prove: $\triangle PSQ \sim \triangle PQR$
$\triangle PQR \sim \triangle QSR$
$\triangle PSQ \sim \triangle QSR$
Proof:
Statements (Reasons)
1. $\angle PQR$ is a right angle. $\overline{QS}$ is an altitude of $\triangle PQR$. (Given)
2. $\overline{QS} \perp \overline{RP}$ (Definition of altitude)
3. $\angle 1$ and $\angle 2$ are right ∠s. (Definition of ⊥ lines)
4. $\angle 1 \cong \angle PQR$; $\angle 2 \cong \angle PQR$ (All right ∠s are ≅.)
5. $\angle P \cong \angle P$; $\angle R \cong \angle R$ (Congruence of angles is reflexive.)
6. $\triangle PSQ \sim \triangle PQR$; $\triangle PQR \sim \triangle QSR$ (AA Similarity Statements 4 and 5)
7. $\triangle PSQ \sim \triangle QSR$ (Similarity of triangles is transitive.)

41. Given: $\angle ADC$ is a right angle.
$\overline{DB}$ is an altitude of $\triangle ADC$.

Prove: $\frac{AB}{AD} = \frac{AD}{AC}; \frac{BC}{DC} = \frac{DC}{AC}$



Proof:

Statements (Reasons)

1. $\angle ADC$ is a right angle. $\overline{DB}$ is an altitude of $\triangle ADC$ (Given)
2. $\triangle ADC$ is a right triangle. (Definition of right triangle)
3. $\triangle ABD \sim \triangle ADC; \triangle DBC \sim \triangle ADC$ (If the altitude is drawn from the vertex of the rt. $\angle$ to the hypotenuse of a rt. $\triangle$, then the 2 $\triangle$s formed are similar to the given $\triangle$ and to each other.)
4. $\frac{AB}{AD} = \frac{AD}{AC}; \frac{BC}{DC} = \frac{DC}{AC}$ (Definition of similar triangles)

43. about 9%

45. Never; sample answer: The geometric mean of two consecutive integers is $\sqrt{x(x+1)}$, and the average of two consecutive integers is $\frac{x + (x+1)}{2}$. If you set the two expressions equal to each other, the equation has no solution.

47. Sometimes; sample answer: When the product of the two integers is a perfect square, the geometric mean will be a positive integer. **49.** Neither; sample answer: On the similar triangles created by the altitude, the leg that is x units long on the smaller triangle corresponds with the leg that is 8 units long on the larger triangle, so the correct proportion is $\frac{4}{x} = \frac{x}{8}$ and x is about 5.7

51. Sample answer: 9 and 4, 8 and 8; In order for two whole numbers to result in a wholenumber geometric mean, their product must be a perfect square.

53. Sample answer: Both the arithmetic and the geometric mean calculate a value between two given numbers. The arithmetic mean of

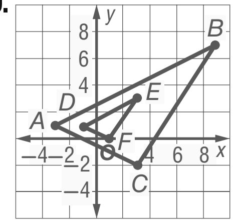
two numbers a and b is $\frac{a+b}{2}$, and the geometric mean of two numbers a and b is $\sqrt{ab}$. The two means will be equal when $a = b$.

Justification:

$$\frac{a+b}{2} = \sqrt{ab}$$
$$\left(\frac{a+b}{2}\right)^2 = ab$$
$$\frac{(a+b)^2}{4} = ab$$
$$(a+b)^2 = 4ab$$
$$a^2 + 2ab + b^2 = 4ab$$
$$a^2 - 2ab + b^2 = 0$$
$$(a-b)^2 = 0$$
$$a - b = 0$$
$$a = b$$

55. 10 **57.** c

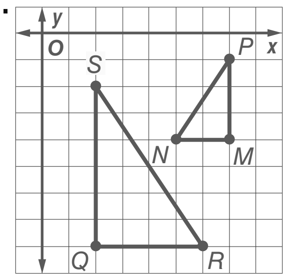
59.



$\frac{AB}{DE} = \frac{BC}{EF} = \frac{AC}{DF} = 3$, so

$\triangle ABC \sim \triangle DEF$ by SSS Similarity.

61.



$\angle M \cong \angle Q$ and $\frac{PM}{SQ} = \frac{MN}{QR} = \frac{1}{2}$,

so $\triangle MNP \sim \triangle QRS$ by SAS Similarity.

63. octagon **65.** $x = 34$, $y = \pm 5$ **67.** $\sqrt{2}$ **69.** $\frac{\sqrt{6}}{2}$

71. $7\sqrt{3}$

Lesson 10-2

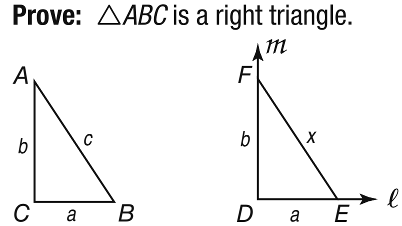
1. 12 **3.** $4\sqrt{5} \approx 15.5$ **5.** D **7.** yes; obtuse $26^2 \stackrel{?}{=} 16^2 + 18^2$ $676 > 256 + 324$ **9.** 20 **11.** $\sqrt{21} \approx 4.6$ **13.** $\frac{\sqrt{10}}{5} \approx 0.6$ **15.** 34 **17.** 70 **19.** about 3 ft **21.** yes; obtuse $21^2 \stackrel{?}{=} 7^2 + 15^2$ $441 > 49 + 225$ **23.** yes; right $20.5^2 \stackrel{?}{=} 4.5^2 + 20^2$ $420.25 = 20.25 + 400$ **25.** yes; acute $7.6^2 \stackrel{?}{=} 4.2^2 + 6.4^2$ $57.76 < 17.64 + 40.96$ **27.** 15 **29.** $4\sqrt{6} \approx 9.8$

31. acute; $XY = \sqrt{29}$,
$YZ = \sqrt{20}$, $XZ = \sqrt{13}$;
$(\sqrt{29})^2 < (\sqrt{20})^2 + (\sqrt{13})^2$

33. right; $XY = 6$, $YZ = 10$, $XZ = 8$; $6^2 + 8^2 = 10^2$

35. Given: $\triangle ABC$ with sides of measure a, b, and c, where $c^2 = a^2 + b^2$

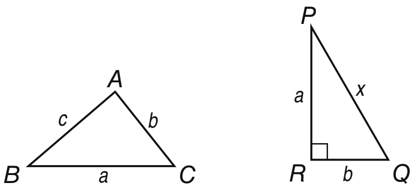
Prove: $\triangle ABC$ is a right triangle.



Proof: Draw $\overline{DE}$ on line ℓ with measure equal to a. At D, draw line $m \perp \overline{DE}$. Locate point F on m so that $DF = b$. Draw $\overline{FE}$ and call its measure x. Because $\triangle FED$ is a right triangle, $a^2 + b^2 = x^2$. But $a^2 + b^2 = c^2$, so $x^2 = c^2$ or $x = c$. Thus, $\triangle ABC \cong \triangle FED$ by SSS. This means $\angle C \cong \angle D$. Therefore, $\angle C$ must be a right angle, making $\triangle ABC$ a right triangle.

37. Given: In $\triangle ABC$, $c^2 > a^2 + b^2$, where c is the length of the longest side.

Prove: $\triangle ABC$ is an obtuse triangle.



Proof:

Statements (Reasons)

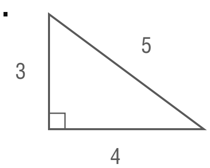
1. In $\triangle ABC$, $c^2 > a^2 + b^2$, where c is the length of the longest side. In $\triangle PQR$, $\angle R$ is a right angle. (Given)
2. $a^2 + b^2 = x^2$ (Pythagorean Theorem)
3. $c^2 > x^2$ (Substitution Property)
4. $c > x$ (A property of square roots)
5. $m\angle R = 90°$ (Definition of a right angle)
6. $m\angle C > m\angle R$ (Converse of the Hinge Theorem)
7. $m\angle C > 90°$ (Substitution Property of Equality)
8. $\angle C$ is an obtuse angle. (Definition of an obtuse angle)
9. $\triangle ABC$ is an obtuse triangle. (Definition of an obtuse triangle

39. $P = 36$ units; $A = 60$ units^2 **41.** 15

43. 47 in. **45.** 10

47. $\frac{1}{2}$ **49.** 5.4

51.



Right; sample answer: If you double or halve the side lengths, all three sides of the new triangles are proportional to the sides of the original triangle. Using the Side-Side-Side Similarity Theorem, you know that both of the new triangles are similar to the original triangle, so they are both right.

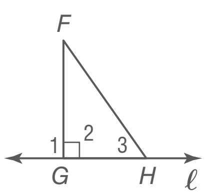
53. D **55.** 250 units **57.** 6 **59.** $6\sqrt{5} \approx 13.4$

61. 1 in. = 2 ft; 6 in. × 4 in. **63.** yes; AA

65. Given: $\overline{FG} \perp \ell$

$\overline{FH}$ is any nonperpendicular segment from F to ℓ.

Prove: $FH > FG$



Proof:

Statements (Reasons)

1. $\overline{FG} \perp \ell$ (Given)
2. $\angle 1$ and $\angle 2$ are right angles. ($\perp$ lines form right angles.)
3. $\angle 1 \cong \angle 2$ (All right angles are congruent.)
4. $m\angle 1 = m\angle 2$ (Definition of congruent angles)
5. $m\angle 1 > m\angle 3$ (Exterior Angle Inequality Theorem)
6. $m\angle 2 > m\angle 3$ (Substitution Property)
7. $FH > FG$ (If an angle of a triangle is greater than a second angle, then the side opposite the greater angle is longer than the side opposite the lesser angle.)

67. 50 **69.** 40 **71.** $6\sqrt{2}$ **73.** $\frac{\sqrt{3}}{2}$

Lesson 10-3

1. $5\sqrt{2}$ **3.** 22 **5.** $x = 14$; $y = 7\sqrt{3}$

7. Yes; sample answer: The height of the triangle is about $3\frac{1}{2}$ in., so since the diameter of the roll of art is less than the diameter of the opening, it will fit.

9. $\frac{15\sqrt{2}}{2}$ or $7.5\sqrt{2}$ **11.** $18\sqrt{6}$ **13.** $20\sqrt{2}$ **15.** $\frac{11\sqrt{2}}{2}$

17. $8\sqrt{2}$ or 11.3 cm **19.** $x = 10$; $y = 20$

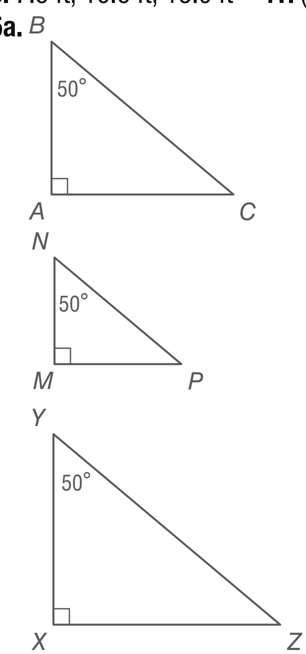
21. $x = \frac{17\sqrt{3}}{2}$; $y = \frac{17}{2}$

23. $x = \frac{14\sqrt{3}}{3}$; $y = \frac{28\sqrt{3}}{3}$ **25.** $16\sqrt{3}$ or 27.7 ft **27.** 22.6 ft

29. $x = 3\sqrt{2}$; $y = 6\sqrt{2}$ **31.** $x = 5$; $y = 10$ **33.** $x = 45$; $y = 12\sqrt{2}$ **35.** 50 ft **37.** $x = 9\sqrt{2}$; $y = 6\sqrt{3}$; $z = 12\sqrt{3}$

39. 7.5 ft; 10.6 ft; 13.0 ft **41.** (6, 9) **43.** (4, −2)

45a.

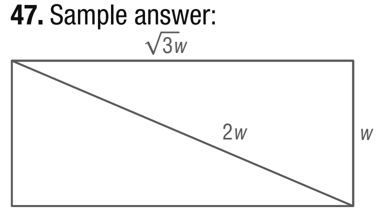


45b.

Triangle	Length				Ratio	
ABC	*AC*	2.4 cm	*BC*	3.2 cm	$\frac{AC}{BC}$	1.3
MNP	*MP*	1.7 cm	*NP*	2.2 cm	$\frac{MP}{NP}$	1.3
XYZ	*XZ*	3.0 cm	*YZ*	3.9 cm	$\frac{XZ}{YZ}$	1.3

45c. The ratios will always be the same.

47. Sample answer:



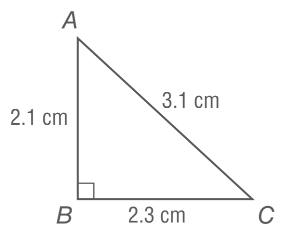
Let ℓ represent the length. $\ell^2 + w^2 = (2w)^2$; $\ell^2 = 3w^2$; $\ell = w\sqrt{3}$.

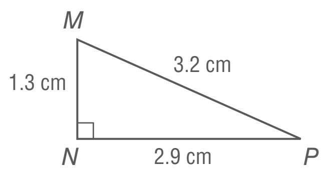
Selected Answers and Solutions

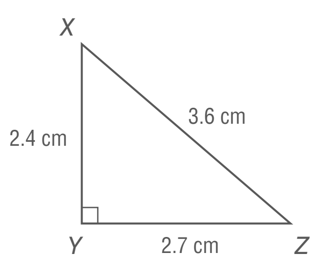
49. 37.9 **51.** B **53.** $(-13, -3)$ **55.** 15 ft 57. $x = 16.9$, $y = 22.6$, $z = 25.4$ **59.** 36, 90, 54 **61.** 45, 63, 72 **63.** $\angle 1$, $\angle 4$, $\angle 11$ **65.** $\angle 2$, $\angle 6$, $\angle 9$, $\angle 8$, $\angle 7$ **67.** 12.0

Lesson 10-4

1. $\frac{16}{20} = 0.80$ **3.** $\frac{12}{20} = 0.60$ **5.** $\frac{16}{20} = 0.80$ **7.** $\frac{\sqrt{3}}{2} \approx 0.87$
9. 27.44 **11.** about 1.2 ft **13.** 44.4
15. $RS \approx 6.7$; $m\angle R \approx 42$; $m\angle T \approx 48$
17. $\frac{56}{65} \approx 0.86$; $\frac{33}{65} \approx 0.51$;
$\frac{56}{33} \approx 1.70$; $\frac{33}{65} \approx 0.51$;
$\frac{56}{65} \approx 0.86$; $\frac{33}{56} \approx 0.59$
19. $\frac{84}{85} \approx 0.99$; $\frac{13}{85} \approx 0.15$;
$\frac{84}{13} \approx 6.46$; $\frac{13}{85} \approx 0.15$;
$\frac{84}{85} \approx 0.99$; $\frac{13}{84} \approx 0.15$
21. $\frac{\sqrt{3}}{2} \approx 0.87$; $\frac{2\sqrt{2}}{4\sqrt{2}} = 0.50$;
$\frac{2\sqrt{6}}{2\sqrt{2}} = \sqrt{3} \approx 1.73$; $\frac{2\sqrt{2}}{4\sqrt{2}} = 0.50$;
$\frac{\sqrt{3}}{2} \approx 0.87$; $\frac{\sqrt{3}}{3} \approx 0.58$
23. $\frac{\sqrt{3}}{2} \approx 0.87$ **25.** $\frac{1}{2}$ or 0.5 **27.** $\frac{1}{2}$ or 0.5 **29.** 28.7
31. 57.2 **33.** 17.4 **35.** 80 ft **37.** 61.4 **39.** 28.5 **41.** 21.8
43. $WX = 15.1$; $XZ = 9.8$; $m\angle W = 33$
45. $ST = 30.6$; $m\angle R = 58$; $m\angle T = 32$
47. 54.5 **49.** 51.3 **51.** 13.83 in.; 7.50 in^2 **53.** 8.74 ft; 3.41 ft^2
55. 0.92 **57.** $x = 18.8$; $y = 25.9$ **59.** $x = 9.2$; $y = 11.7$
61a. Sample Answer:







61b.

Triangle	Trigonometric Ratios				Sum of Ratios Squared	
ABC	cos *A*	0.677	sin *A*	0.742	$(\cos A)^2 + (\sin A)^2 =$	1
	cos *C*	0.742	sin *C*	0.677	$(\cos C)^2 + (\sin C)^2 =$	1
MNP	cos *M*	0.406	sin *M*	0.906	$(\cos M)^2 + (\sin M)^2 =$	1
	cos *P*	0.906	sin *P*	0.406	$(\cos P)^2 + (\sin P)^2 =$	1
XYZ	cos *X*	0.667	sin *X*	0.75	$(\cos X)^2 + (\sin X)^2 =$	1
	cos *Z*	0.75	sin *Z*	0.667	$(\cos Z)^2 + (\sin Z)^2 =$	1

61c. Sample answer: The sum of the cosine squared and the sine squared of an acute angle of a right triangle is 1.
61d. $(\sin X)^2 + (\cos X)^2 = 1$
61e. Sample answer:
$(\sin A)^2 + (\cos A)^2 \stackrel{?}{=} 1$ (Conjecture)
$\left(\frac{y}{r}\right)^2 + \left(\frac{x}{r}\right)^2 \stackrel{?}{=} 1$ $\left(\sin A = \frac{y}{r}, \cos A = \frac{x}{r}\right)$
$\frac{y^2}{r^2} + \frac{x^2}{r^2} \stackrel{?}{=} 1$ (Simplify.)
$\frac{y^2 + x^2}{r^2} \stackrel{?}{=} 1$ (Combine fractions with like denominators.)
$\frac{r^2}{r^2} \stackrel{?}{=} 1$ (Pythagorean Theorem)
$1 = 1$ (Simplify.)
63. Sample answer: Yes; since the values of sine and cosine are both calculated by dividing one of the legs of a right triangle by the hypotenuse, and the hypotenuse is always the longest side of a right triangle, the values will always be less than 1. You will always be dividing the smaller number by the larger number.
65. Sample answer: To find the measure of an acute angle of a right triangle, you can find the ratio of the leg opposite the angle to the hypotenuse and use a calculator to find the inverse sine of the ratio, you can find the ratio of the leg adjacent to the angle to the hypotenuse and use a calculator to find the inverse cosine of the ratio, or you can find the ratio of the leg opposite the angle to the leg adjacent to the angle and use a calculator to find the inverse tangent of the ratio.
67. H **69.** E **71.** $x = 7\sqrt{2}$; $y = 14$
73. yes; right
$17^2 \stackrel{?}{=} 8^2 + 15^2$
$289 = 64 + 225$
75. yes; obtuse
$35^2 \stackrel{?}{=} 30^2 + 13^2$
$1225 > 900 + 169$
77. no; $8.6 > 3.2 + 5.3$ **79.** $5\frac{7}{15}$ hours or 5 hours 28 min
81. $x = 1$, $y = \frac{3}{2}$ **83.** 260 **85.** 18.9 **87.** 157.1

Lesson 10-5

1. 27.5 ft **3.** 14.2 ft **5.** 66° **7.** 14.8° **9.** 9.3 ft
11. about 1309 ft **13.** 16.6° **15.** 240.2 ft **17.** 154.9 ft
19a. ≈64.6° **19b.** ≈110.1 m **21.** José throws at an angle of depression of 2.02°. Kelsey throws at an angle of elevation of 4.71°. **23.** Rodrigo; sample answer: Since your horizontal line of sight is parallel to the other person's horizontal line of sight, the angles of elevation and depression are congruent according to the Alternate Interior Angles Theorem. **25.** True; sample answer: As a person moves closer to an object, the horizontal distance

decreases, but the height of the object is constant. The tangent ratio will increase, and therefore the measure of the angle also increases. **27.** Sample answer: If you sight something with a 45° angle of elevation, you don't have to use trigonometry to determine the height of the object. Since the legs of a 45°-45°-90° are congruent, the height of the object will be the same as your horizontal distance from the object.

29. 6500 ft **31.** B **33.** $\frac{20}{15} = 1.33$

35. $\frac{15}{20} = 0.75$ **37.** $\frac{20}{25} = 0.80$

39. Proof:

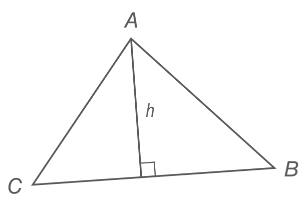
Statements (Reasons)

1. $\overline{CD}$ bisects $\angle ACB$. By construction, $\overline{AE} \parallel \overline{CD}$. (Given)
2. $\frac{AD}{DB} = \frac{EC}{BC}$ (Triangle Proportionality Thm.)
3. $\angle 1 \cong \angle 2$ (Def. of $\angle$ Bisector)
4. $\angle 3 \cong \angle 1$ (Alt. Int. $\angle$ Thm.)
5. $\angle 2 \cong \angle E$ (Corres. $\angle$ Post.)
6. $\angle 3 \cong \angle E$ (Transitive Prop.)
7. $\overline{EC} \cong \overline{AC}$ (Isosceles $\triangle$ Thm.)
8. $EC = AC$ (Def. of $\cong$ segments)
9. $\frac{AD}{DB} = \frac{AC}{BC}$ (Substitution)

41a. (7, 4) **43.** (−5, 6) **45.** 2 **47.** 2.1

Lesson 10-6

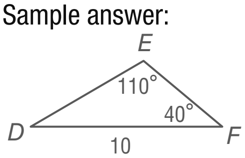
1. 6.1 **3.** 69.8 **5.** 8.3 **7.** 47.1 ft
9. $m\angle B = 77$, $AB \approx 7.8$, $BC \approx 4.4$
11. $m\angle D \approx 73$, $m\angle E \approx 62$, $m\angle F \approx 45$ **13.** 4.1 **15.** 22.8
17. 15.1 **19.** 2.0 **21.** 2.8 in. **23.** 3.8 **25.** 98 **27.** 112
29. 126.2 ft **31.** $m\angle B = 34$, $AB \approx 9.5$, $CA \approx 6.7$
33. $m\angle J \approx 65$, $m\angle K \approx 66$, $m\angle L \approx 49$
35. $m\angle G = 75$, $GH \approx 19.9$, $GJ \approx 11.8$
37. $m\angle P \approx 35$, $m\angle R \approx 75$, $RP \approx 14.6$
39. $m\angle C \approx 23$, $m\angle D \approx 67$, $m\angle E \approx 90$
41. $m\angle A = 35$, $AB \approx 7.5$, $BC \approx 9.8$ **43.** ≈96.2 ft
45a. Def. of sine **45b.** Mult. Prop. **45c.** Subs.
45d. Div. Prop. **47.** 24.3 **49.** 275.1 **51.** 8.4 in.
53a.



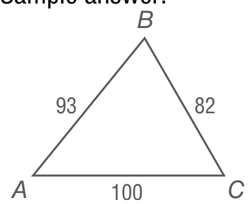
53b. $h = AB \sin B$ **53c.** $A = \frac{1}{2}(BC)(AB \sin B)$ **53d.** 57.2 units^2

53e. $A = \frac{1}{2}(BC)(CA \sin C)$ **55.** 5.6

57a. Sample answer:



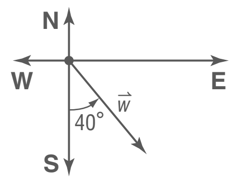
57b. Sample answer:



59. A **61.** 325.6 **63.** 269.6 ft **65.** 45
67. Never; sample answer: Since an equilateral triangle has three congruent sides and a scalene triangle has three non-congruent sides, the ratios of the three pairs of sides can never be equal. Therefore, an equilateral triangle and a scalene triangle can never be similar. **69.** $Q(a, a)P(a, 0)$ **71.** $\sqrt{80} \approx 8.9$ **73.** $\sqrt{72} \approx 8.5$

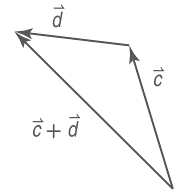
Lesson 10-7

1.

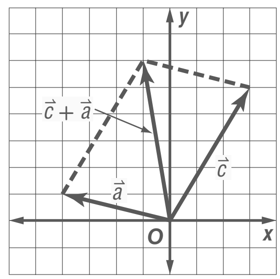


1 in. : 60 mi/h

3.

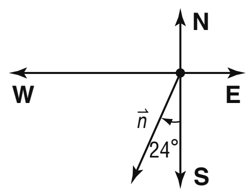


5. ⟨5, 5⟩ **7.** $\sqrt{20}$; ≈ 296.6°
9. ⟨−1, 6⟩



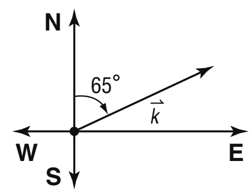
11. ≈ 354.3 mi/h at angle of 8.9° east of north

13.



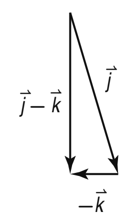
1 in. : 5 m

15.

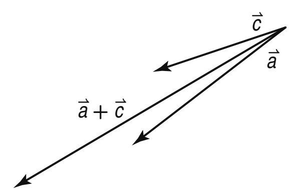


1 in. : 50 km/h

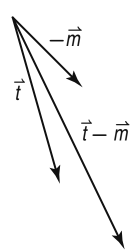
17.



19.

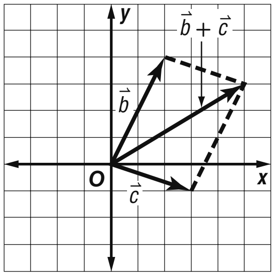


21.

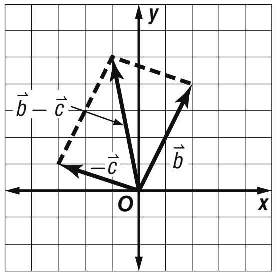


23. ⟨5, 0⟩ 25. ⟨−6, −3⟩
27. ⟨−3, −6⟩
29. $\sqrt{34}$; ≈ 31.0°
31. $\sqrt{50}$; ≈ 171.9°
33. $\sqrt{45}$; ≈ 243.4°

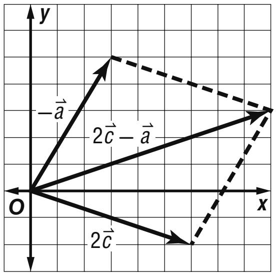
35. $\langle 5, 3\rangle$



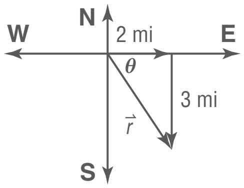
37. $\langle -1, 5\rangle$



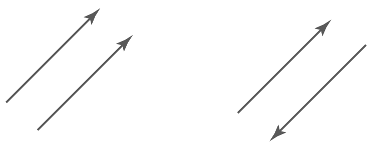
39. $\langle 9, 3\rangle$



41a.



41b. 3.6 mi at an angle of 33.7° east of south **43.** $\langle 4, -4\rangle$
45. $\langle 26, 5\rangle$ **47.** 2.3 ft/s
49. Sometimes; sample answer: Parallel vectors can either have the same or opposite direction.



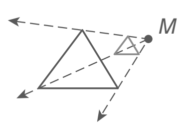
51.

$$k(\vec{a} + \vec{b}) = k(\langle x_1, y_1\rangle + \langle x_2, y_2\rangle)$$
$$= k\langle x_1 + x_2, y_1 + y_2\rangle$$
$$= \langle k(x_1 + x_2), k(y_1 + y_2)\rangle$$
$$= \langle kx_1 + kx_2, ky_1 + ky_2\rangle$$
$$= \langle kx_1, ky_1\rangle + \langle kx_2, ky_2\rangle$$
$$= k\langle x_1, y_1\rangle + k\langle x_2, y_2\rangle$$
$$= k\vec{a} + k\vec{b}$$

53. The initial point of the resultant starts at the initial point of the first vector in both methods. However, in the parallelogram method, both vectors start at the same initial point, whereas, in the triangle method, the resultant connects the initial point of the first vector and the terminal point of the second. The resultant is the diagonal of the parallelogram formed using the parallelogram method. **55.** B **57.** D **59.** 72.0 **61.** 376.4 **63.** 30 **65.** 30 **67.** 60 **69.** △s 1–4, △s 5–12, △s 13—20

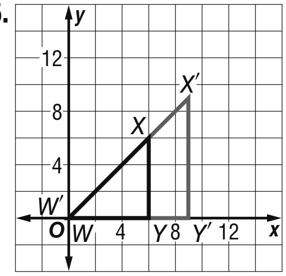
Lesson 10-8

1.

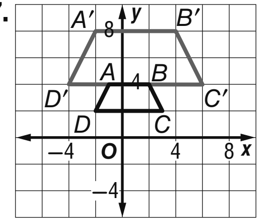


3. enlargement; $\frac{4}{3}$; 2

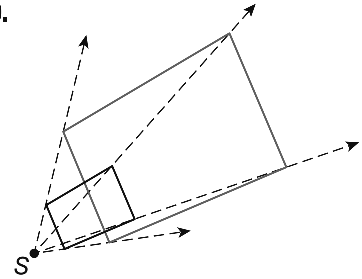
5.



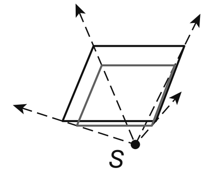
7.



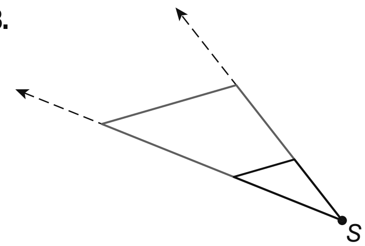
9.



11.



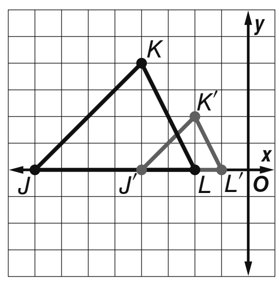
13.



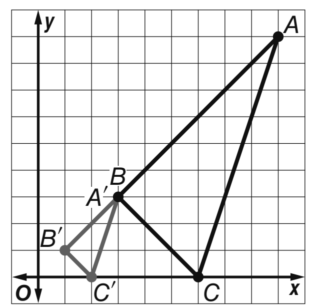
15. enlargement; 2; 4.5 **17.** reduction; $\frac{3}{4}$; 3.5

19. 15×; The insect's image length in millimeters is 3.75 • 10 or 37.5 mm. The scale factor of the dilation is $\frac{37.5}{2.5}$ or 15.

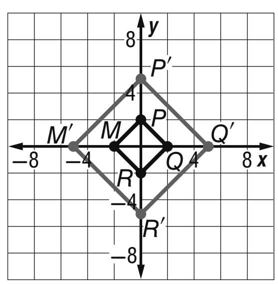
21.



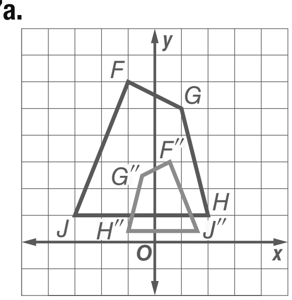
23.



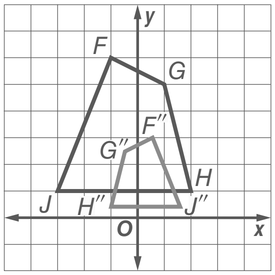
25.



27a.

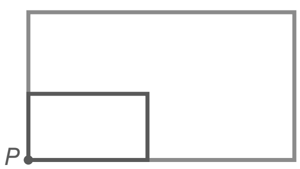


27b.



27c. no

27d. Sometimes; sample answer: For the order of a composition of a dilation centered at the origin and a reflection to be unimportant, the line of reflection must contain the origin, or must be of the form $y = mx$. **29.** No; sample answer: The measures of the sides of the rectangles are not proportional, so they are not similar and cannot be a dilation. **31a.** surface area: 88 cm^2; volume: 48 cm^3
31b. surface area: 352 cm^2; volume: 384 cm^3
31c. surface area: 22 cm^2; volume: 6 cm^3
31d. surface area: 4 times greater after dilation with scale factor 2; $\frac{1}{4}$ as great after dilation with scale factor $\frac{1}{2}$. Volume: 8 times greater after dilation with scale factor 2; $\frac{1}{8}$ as great after dilation with scale factor $\frac{1}{2}$.
31e. The surface area of the preimage would be multiplied by r^2. The volume of the preimage would be multiplied by r^3.
33a. $1\frac{1}{3}$ **33b.** 1.77 mm^2; 3.14 mm^2
35.



$\frac{11}{5}$

37. $y = 4x - 3$ **39a.** Always; sample answer: Since a dilation of 1 maps an image onto itself, all four vertices will remain invariant under the dilation. **39b.** Always; sample answer: Since the rotation is centered at B, point B will always remain invariant under the rotation. **39c.** Sometimes: sample answer: If one of the vertices is on the x-axis, then that point will remain invariant under reflection. If two vertices are on the x-axis, then the two vertices located on the x-axis will remain invariant under reflection. **39d.** Never; when a figure is translated, all points move an equal distance. Therefore, no points can remain invariant under translation. **39e.** Sometimes; sample answer: If one of the vertices of the triangle is located at the origin, then that vertex would remain invariant under the dilation. If none of the vertices are located at the origin, then no points will remain invariant under the dilation. **41.** Sample answer: Translations, reflections, and rotations produce congruent figures because the sides and angles of the preimage are congruent to the corresponding sides and angles of the image. Dilations produce similar figures, because the angles of the preimage and the image are congruent and the sides of the preimage are proportional to the corresponding sides of the image. A dilation with a scale factor of 1 produces an equal figure because the image is mapped onto its corresponding parts in the preimage.

Chapter 10 Study Guide and Review

1. false, geometric **3.** false, sum **5.** true **7.** true
9. false, Law of Cosines **11.** 6 **13.** $\frac{8}{3}$ **15.** 50 ft
17. $9\sqrt{3} \approx 15.6$ **19.** yes; acute $16^2 \stackrel{?}{=} 13^2 + 15^2$ $256 < 169 + 225$ **21.** 18.4 m **23.** $x = 4\sqrt{2}$, $y = 45°$ **25.** $\frac{5}{13}$, 0.38
27. $\frac{12}{13}$, 0.92 **29.** $\frac{5}{12}$, 0.42 **31.** 32.2 **33.** 63.4° and 26.6°
35. 86.6 ft **37.** 15.2 **39.** $\langle -6, -5 \rangle$ **41.** $\langle -8, 1 \rangle$
43. reduction; 8.25, 0.45

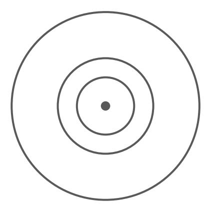
CHAPTER 11
Circles

Chapter 11 Get Ready

1. 130 **3.** 15.58 **5.** 82.8 **7.** \$5.85 **9.** 8.5 ft **11.** −3, 4

Lesson 11-1

1. $\odot N$ **3.** 8 cm **5.** 14 in. **7.** 22 ft; 138.23 ft **9.** $4\pi\sqrt{13}$ cm
11. $\overline{SU}$ **13.** 8.1 cm **15.** 28 in. **17.** 3.7 cm **19.** 14.6
21. 30.6 **23.** 13 in.; 81.68 in. **25.** 39.47 ft; 19.74 ft
27. 830.23 m; 415.12 m **29.** 12π ft **31.** 10π in. **33.** 14π yd
35a. 31.42 ft **35b.** 4 ft **37.** 22.80 ft; 71.63 ft **39.** $0.25x$; $0.79x$ **41.** neither **43.** 471.2 ft
45a. Sample answer:

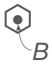


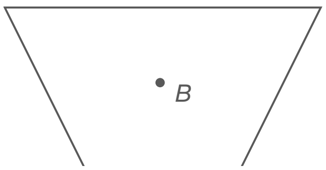
45b. Sample answer:

Circle Radius (cm)	Circumference (cm)
0.5	3.14
1	6.28
2	12.57

45c. They all have the same shape—circular.
45d. The ratio of their circumferences is also 2.
45e. $(C_B) = \frac{b}{a}(C_A)$ **45f.** 4 in. **47a.** 157.1 mi **47b.** ≈31.4 mi
49a. $8r$ and $6r$; Twice the radius of the circle, $2r$ is the side length of the square, so the perimeter of the square is $4(2r)$ or $8r$. The regular hexagon is made up of six equilateral triangles with side length r, so the perimeter of the hexagon is $6(r)$ or $6r$.
49b. less; greater; $6r < C < 8r$ **49c.** $3d < C < 4d$; The circumference of the circle is between 3 and 4 times its diameter.
49d. These limits will approach a value of πd, implying that $C = \pi d$. **51.** Always; a radius is a segment drawn between the center of the circle and a point on the circle. A segment drawn from the center to a point inside the circle will always have a length less than the radius of the circle.

53. $\frac{8\pi}{\sqrt{3}}$ or $\frac{8\pi\sqrt{3}}{3}$ in **55.** 40.8 **57.** J

59. 

61. 

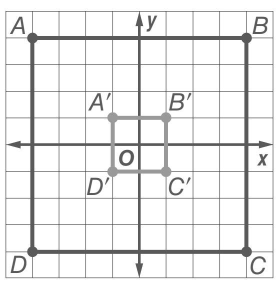
63. Sample answer: If each pair of opposite sides is parallel, the quadrilateral is a parallelogram. **65.** 60 **67.** 45

Lesson 11-2

1. 170 **3.** major arc; 270 **5.** semicircle; 180 **7.** 147 **9.** 123 **11.** 13.74 cm **13.** 225 **15.** 40 **17.** minor arc; 125 **19.** major arc; 305 **21.** semicircle; 180 **23.** major arc; 270 **25a.** 280.8; 36 **25b.** major arc; minor arc **25c.** No; no categories share the same percentage of the circle. **27.** 60 **29.** 300 **31.** 180 **33.** 220 **35.** 120 **37.** 8.80 cm **39.** 17.02 in. **41.** 12.04 m **43.** The length of the arc would double. **45.** 40.83 in. **47.** 9.50 ft **49.** 142 **51a.** 136 **51b.** 147.17 ft **53a.** 67.4 **53b.** 22.6 **53c.** 44.8 **53d.** 15.29 units **53e.** 10.16 units **55.** Selena; the circles are not congruent because they do not have congruent radii. So, the arcs are not congruent. **57.** Never; obtuse angles intersect arcs that measure between 90° and 180°.

59. $m\widehat{LM} = 150$, $m\widehat{MN} = 90$, $m\widehat{NL} = 120$ **61.** 175 **63.** B

65. H **67.** *J* **69.** 6.2

71. 

73. $x = \frac{50}{3}$; $y = 10$; $z = \frac{40}{3}$ **75.** 10, −10 **77.** 46.1, −46.1

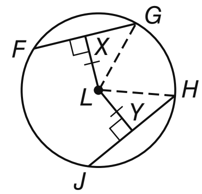
Lesson 11-3

1. 93 **3.** 3 **5.** 3.32 **7.** 21 **9.** 127 **11.** 7 **13.** 27 **15.** 122.5° **17.** 5.34 **19.** 6.71 **21.** 98.3 ft **23.** 4

25. Proof:
Because all radii are congruent, $\overline{QP} \cong \overline{PR} \cong \overline{SP} \cong \overline{PT}$. You are given that $\overline{QR} \cong \overline{ST}$, so $\triangle PQR \cong \triangle PST$ by SSS. Thus, $\angle QPR \cong \angle SPT$ by CPCTC. Since the central angles have the same measure, their intercepted arcs have the same measure and are therefore congruent. Thus, $\widehat{QR} \cong \widehat{ST}$.

27. Each arc is 90° and each chord is 2.12 ft.

29. Given: $\odot L$, $\overline{LX} \perp \overline{FG}$, $\overline{LY} \perp \overline{JH}$, $\overline{LX} \cong \overline{LY}$
Prove: $\overline{FG} \cong \overline{JH}$

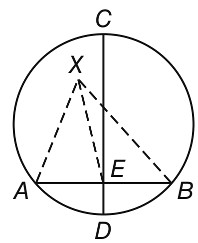


Proof:
Statements (Reasons):
1. $\overline{LG} \cong \overline{LH}$ (All radii of a $\odot$ are $\cong$.)
2. $\overline{LX} \perp \overline{FG}$, $\overline{LY} \perp \overline{JH}$, $\overline{LX} \cong \overline{LY}$ (Given)
3. $\angle LXG$ and $\angle LYH$ are right ∠s. (Definition of $\perp$ lines)
4. $\triangle XGL \cong \triangle YHL$ (HL)
5. $\overline{XG} \cong \overline{YH}$ (CPCTC)
6. $XG = YH$ (Definition of $\cong$ segments)
7. $2(XG) = 2(YH)$ (Multiplication Property)
8. $\overline{LX}$ bisects $\overline{FG}$; $\overline{LY}$ bisects $\overline{JH}$. (A radius $\perp$ to a chord bisects the chord.)
9. $FG = 2(XG)$, $JH = 2(YH)$ (Definition of segment bisector)
10. $FG = JH$ (Substitution)
11. $\overline{FG} \cong \overline{JH}$ (Definition of $\cong$ segments)

31. 2 **33.** 5

35. About 17.3; *P* and *Q* are equidistant from the endpoints of $\overline{AB}$ so they both lie on the perpendicular bisector of $\overline{AB}$, so $\overline{PQ}$ is the perpendicular bisector of $\overline{AB}$. Let *S* be the point of intersection of $\overline{AB}$ and $\overline{PQ}$. Hence, $PS = QS = 5$. Since $\overline{PS}$ is perpendicular to chord $\overline{AB}$, $\angle PSA$ is a right angle. So, $\triangle PSA$ is a right triangle. By the Pythagorean Theorem, $PS = \sqrt{(PA)^2 - (AS)^2}$. By substitution, $PS = \sqrt{11^2 - 5^2}$ or $\sqrt{96}$. Similarly, $\triangle ASQ$ is a right triangle with $SQ = \sqrt{(AQ)^2 - (AS)^2} = \sqrt{9^2 - 5^2}$ or $\sqrt{56}$. Since $PQ = PS + SQ$, $PQ = \sqrt{96} + \sqrt{56}$ or about 17.3.

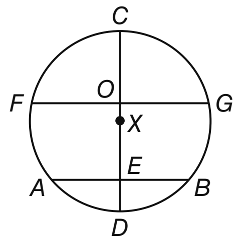
37a. Given: $\overline{CD}$ is the perpendicular bisector of chord $\overline{AB}$ in $\odot X$.
Prove: $\overline{CD}$ contains point *X*.



Proof:
Suppose *X* is not on $\overline{CD}$. Draw $\overline{XE}$ and radii $\overline{XA}$ and $\overline{XB}$. Since $\overline{CD}$ is the perpendicular bisector of $\overline{AB}$, *E* is the midpoint of $\overline{AB}$ and $\overline{AE} \cong \overline{EB}$. Also, $\overline{XA} \cong \overline{XB}$, since all radii of a $\odot$ are $\cong$. $\overline{XE} \cong \overline{XE}$ by the Reflexive Property. So, $\triangle AXE \cong \triangle BXE$ by *SSS*. By CPCTC, $\angle XEA \cong \angle XEB$. Since they also form a linear pair, $\angle XEA$ and $\angle XEB$ are right angles. So $\overline{XE} \perp \overline{AB}$. Then $\overline{XE}$ is the perpendicular bisector of $\overline{AB}$. But $\overline{CD}$ is also the perpendicular bisector of $\overline{AB}$. This contradicts the uniqueness of a perpendicular bisector of a segment. Thus, the assumption is false, and center *X* must be on $\overline{CD}$.

37b. Given: In $\odot X$, X is on $\overline{CD}$ and $\overline{FG}$ bisects $\overline{CD}$ at O.

Prove: Point O is point X.



Proof:

Since point X is on $\overline{CD}$ and C and D are on $\odot X$, $\overline{CD}$ is a diameter of $\odot X$. Since $\overline{FG}$ bisects $\overline{CD}$ at O, O is the midpoint of $\overline{CD}$. Since the midpoint of a diameter is the center of a circle, O, is the center of the circle. Therefore, point O is point X.29.

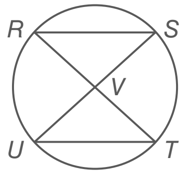
39. No; sample answer: In a circle with a radius of 12, an arc with a measure of 60 determines a chord of length 12. (The triangle related to a central angle of 60 is equilateral.) If the measure of the arc is tripled to 180, then the chord determined by the arc is a diameter and has a length of 2(12) or 24, which is not three times as long as the original chord.

41. F **43.** E **45.** 170 **47.** 275 in.
49. yes; obtuse $31^2 \stackrel{?}{=} 20^2 + 21^2$ $961 > 400 + 441$ **51.** ± 11

Lesson 11-4

1. 30 **3.** 66 **5.** 54

7. Given: $\overline{RT}$ bisects $\overline{SU}$.
Prove: $\triangle RVS \cong \triangle UVT$



Proof:

Statements (Reasons)

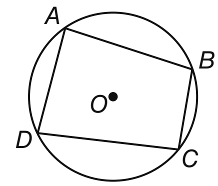
1. $\overline{RT}$ bisects $\overline{SU}$. (Given)
2. $\overline{SV} \cong \overline{VU}$ (Def. of segment bisector)
3. $\angle SRT$ intercepts $\widehat{ST}$. $\angle SUT$ intercepts $\widehat{ST}$. (Def. of intercepted arc)
4. $\angle SRT \cong \angle SUT$ (Inscribed ∠s of same arc are ≅.)
5. $\angle RVS \cong \angle UVT$ (Vertical ∠s are ≅.)
6. $\triangle RVS \cong \triangle UVT$ (AAS)

9. 25 **11.** 162 **13.** 70 **15.** 140 **17.** 32 **19.** 20

21. Proof: Given $m\angle T = \frac{1}{2}m\angle S$ means that $m\angle S = 2m\angle T$. Since $m\angle S = \frac{1}{2}m\widehat{TUR}$ and $m\angle T = \frac{1}{2}m\widehat{URS}$, the equation becomes $\frac{1}{2}m\widehat{TUR} = 2\left(\frac{1}{2}m\widehat{URS}\right)$. Multiplying each side of the equation by 2 results in $m\widehat{TUR} = 2m\widehat{URS}$.

23. 30 **25.** 12.75 **27.** 135 **29.** 106

31. Given: Quadrilateral $ABCD$ is inscribed in $\odot O$.
Prove: $\angle A$ and $\angle C$ are supplementary.
$\angle B$ and $\angle D$ are supplementary.



Proof: By arc addition and the definitions of arc measure and the sum of central angles, $m\widehat{DCB} + m\widehat{DAB} = 360$.
Since by Theorem 10.6, $m\angle C = \frac{1}{2}m\widehat{DAB}$ and $m\angle A = \frac{1}{2}m\widehat{DCB}$, $m\angle C + m\angle A = \frac{1}{2}(m\widehat{DCB} + m\widehat{DAB})$, but $m\widehat{DCB} + m\widehat{DAB} = 360$, so $m\angle C + m\angle A = \frac{1}{2}(360)$ or 180. This makes $\angle C$ and $\angle A$ supplementary. Because the sum of the measures of the interior angles of a quadrilateral is 360, $m\angle A + m\angle C + m\angle B + m\angle D = 360$. But $m\angle A + m\angle C = 180$, so $m\angle B + m\angle D = 180$, making them supplementary also.

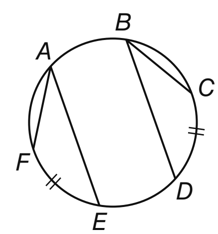
33. 22.5 **35.** 135

37. Proof:

Statements (Reasons)

1. $m\angle ABC = m\angle ABD + m\angle DBC$ (∠ Addition Postulate)
2. $m\angle ABD = \frac{1}{2}m\widehat{AD}$
   $m\angle DBC = \frac{1}{2}m\widehat{DC}$
   (The measure of an inscribed ∠ whose side is a diameter is half the measure of the intercepted arc (Case 1)).
3. $m\angle ABC = \frac{1}{2}m\widehat{AD} + \frac{1}{2}m\widehat{DC}$ (Substitution)
4. $m\angle ABC = \frac{1}{2}[m\widehat{AD} + m\widehat{DC}]$ (Factor)
5. $m\widehat{AD} + m\widehat{DC} = m\widehat{AC}$ (Arc Addition Postulate)
6. $m\angle ABC = \frac{1}{2}m\widehat{AC}$ (Substitution)

39. Given: $\angle FAE$ and $\angle CBD$ are inscribed; $\widehat{EF} \cong \widehat{DC}$
Prove: $\angle FAE \cong \angle CBD$

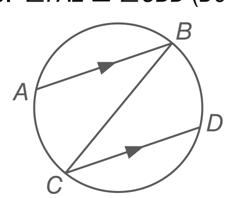


Proof:

Statements (Reasons)

1. $\angle FAE$ and $\angle CBD$ are inscribed; $\widehat{EF} \cong \widehat{DC}$ (Given)
2. $m\angle FAE = \frac{1}{2}m\widehat{EF}$; $m\angle CBD = \frac{1}{2}m\widehat{DC}$ (Measure of an inscribed ∠ = half measure of intercepted arc.)
3. $m\widehat{EF} = m\widehat{DC}$ (Def. of ≅ arcs)
4. $\frac{1}{2}m\widehat{EF} = \frac{1}{2}m\widehat{DC}$ (Mult. Prop.)
5. $m\angle FAE = m\angle CBD$ (Substitution)
6. $\angle FAE \cong \angle CBD$ (Def. of ≅ ∠s)

41a.



41b. Sample answer: $m\angle A = 30$, $m\angle D = 30$; $m\widehat{AC} = 60$, $m\widehat{BD} = 60$; The arcs are congruent because they have equal measures.

41c. Sample answer: In a circle, two parallel chords cut congruent arcs. See students' work. **41d.** 70; 70 **43.** Always; rectangles have right angles at each vertex, therefore each pair of opposite angles will be supplementary and inscribed in a circle.

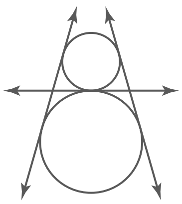
45. Sometimes; a rhombus can be inscribed in a cirlce as long as it is a square. Since the opposite angles of rhombi that are not squares are not supplementary, they can not be inscribed in a circle. **47.** $\frac{\pi}{2}$ **49.** See students' work **51.** A **53.** $d = 17$ in., $r = 8.5$ in., $C = 17\pi$ or about 53.4 in. **55.** 48 **57.** 24 **59.** 107 **61.** 144 **63.** 54

65. $\frac{1}{2}$

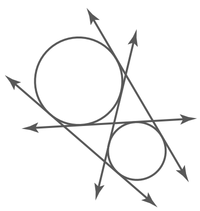
Lesson 11-5

1. no common tangent **3.** yes; $1521 = 1521$ **5.** 16
7. $x = 250$; $y = 275$

9.



11.



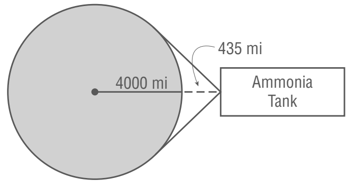
13. yes; $625 = 625$ **15.** no; $89 \neq 64$ **17.** 26 **19.** 9 **21.** 4

23a. 37.95 in. **23b.** 37.95 in. **25.** 8; 52 cm **27.** 8.06

29. **Statements (Reasons)**

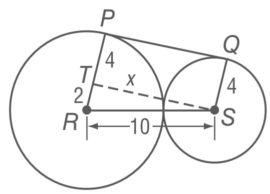
1. Quadrilateral *ABCD* is circumscribed about $\odot P$. (Given)
2. Sides $\overline{AB}$, $\overline{BC}$, $\overline{CD}$, and $\overline{DA}$ are tangent to $\odot P$ at points *H*, *G*, *F*, and *E*, respectively. (Def. of circumscribed)
3. $\overline{EA} \cong \overline{AH}$; $\overline{HB} \cong \overline{BG}$; $\overline{GC} \cong \overline{CF}$; $\overline{FD} \cong \overline{DE}$ (Two segments tangent to a circle from the same exterior point are $\cong$.)
4. $AB = AH + HB$, $BC = BG + GC$, $CD = CF + FD$, $DA = DE + EA$ (Segment Addition)
5. $AB + CD = AH + HB + CF + FD$; $DA + BC = DE + EA + BG + GC$ (Substitution)
6. $AB + CD = AH + BG + GC + FD$; $DA + BC = FD + AH + BG + GC$ (Substitution)
7. $AB + CD = FD + AH + BG + GC$ (Comm. Prop. of Add.)
8. $AB + CD = DA + BC$ (Substitution)

31. 1916 mi;



33. Proof: Assume that ℓ is not tangent to $\odot S$. Since ℓ intersects $\odot S$ at *T*, it must intersect the circle in another place. Call this point *Q*. Then $ST = SQ$. $\triangle STQ$ is isosceles, so $\angle T \cong \angle Q$. Since $ST \perp \ell$, $\angle T$ and $\angle Q$ are right angles. This contradicts that a triangle can only have one right angle. Therefore, ℓ is tangent to $\odot S$.

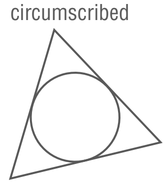
35 Sample answer:



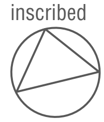
Using the Pythagorean Theorem, $2^2 + x^2 = 10^2$, so $x \approx 9.8$. Since *PQST* is a rectangle, $PQ = x = 9.8$.

37. Sample answer:

circumscribed



inscribed



39. From a point outside the circle, two tangents can be drawn. From a point on the circle, one tangent can be drawn. From a point inside the circle, no tangents can be drawn because a line would intersect the circle in two points. **41.** $6\sqrt{2}$ or about 8.5 in. **43.** D **45.** 61 **47.** 71 **49.** 109 **51.** Yes; $\triangle AEC \sim \triangle BDC$ by AA Similarity **53.** 110 **55.** 58

Lesson 11-6

1. 110 **3.** 73 **5.** 248 **7.** 15 **9.** 71.5 **11.** 28 **13.** 144 **15.** 125 **17a.** 100 **17b.** 20 **19.** 74 **21.** 185 **23.** 22 **25.** 168 **27.** 20 **29a.** 145 **29b.** 30

31. Statements (Reasons)

1. $\overrightarrow{FM}$ is a tangent to the circle and $\overrightarrow{FL}$ is a secant to the circle. (Given)
2. $m\angle FLH = \frac{1}{2} m\widehat{HG}$, $m\angle LHM = \frac{1}{2} m\widehat{LH}$ (The meas. of an inscribed $\angle = \frac{1}{2}$ the measure of its intercepted arc.)
3. $m\angle LHM = m\angle FLH + m\angle F$ (Exterior $\angle$s Theorem)
4. $\frac{1}{2} m\widehat{LH} = \frac{1}{2} m\widehat{HG} + m\angle F$ (Substitution)
5. $\frac{1}{2} m\widehat{LH} - \frac{1}{2} m\widehat{HG} = m\angle F$ (Subtraction Prop.)
6. $\frac{1}{2} (m\widehat{LH} - m\widehat{HG}) = m\angle F$ (Distributive Prop.)

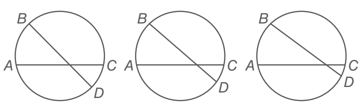
33a. Proof:

By Theorem 10.10, $\overline{OA} \perp \overline{AB}$. So, $\angle FAE$ is a right $\angle$ with measure 90 and $\widehat{FCA}$ is a semicircle with measure of 180. Since $\angle CAE$ is acute, C is in the interior of $\angle FAE$, so by the Angle and Arc Addition Postulates, $m\angle FAE = m\angle FAC + m\angle CAE$ and $m\widehat{FCA} = m\widehat{FC} + m\widehat{CA}$. By substitution, $90 = m\angle FAC + m\angle CAE$ and $180 = m\widehat{FC} + m\widehat{CA}$. So, $90 = \frac{1}{2} m\widehat{FC} + \frac{1}{2} m\widehat{CA}$ by Division Prop., and $m\angle FAC + m\angle CAE = \frac{1}{2} m\widehat{FC} + \frac{1}{2} m\widehat{CA}$ by substitution. $m\angle FAC = \frac{1}{2} m\widehat{FC}$ since $\angle FAC$ is inscribed, so substitution yields $\frac{1}{2} m\widehat{FC} + m\angle CAE = \frac{1}{2} m\widehat{FC} + \frac{1}{2} m\widehat{CA}$. By Subtraction Prop., $m\angle CAE = \frac{1}{2} m\widehat{CA}$.

33b. Proof:

Using the Angle and Arc Addition Postulates, $m\angle CAB = m\angle CAF + m\angle FAB$ and $m\widehat{CDA} = m\widehat{CF} + m\widehat{FDA}$. Since $\overline{OA} \perp \overline{AB}$ and $\overline{FA}$ is a diameter, $\angle FAB$ is a right angle with a measure of 90 and $\widehat{FDA}$ is a semicircle with a measure of 180. By substitution, $m\angle CAB = m\angle CAF + 90$ and $m\widehat{CDA} = m\widehat{CF} + 180$. Since $\angle CAF$ is inscribed, $m\angle CAF = \frac{1}{2} m\widehat{CF}$ and by substitution, $m\angle CAB = \frac{1}{2} m\widehat{CF} + 90$. Using the Division and Subtraction Properties on the Arc Addition equation yields $\frac{1}{2} m\widehat{CDA} - \frac{1}{2} mCF = 90$. By substituting for 90, $m\angle CAB = \frac{1}{2} m\widehat{CF} + \frac{1}{2} m\widehat{CDA} - \frac{1}{2} m\widehat{CF}$. By subtraction, $m\angle CAB = \frac{1}{2} m\widehat{CDA}$.

35a.



35b.

	Circle 1	Circle 2	Circle 3
$\widehat{CD}$	25	15	5
$\widehat{AB}$	50	50	50
x	37.5	32.5	27.5

35c. As the measure of $\widehat{CD}$ gets closer to 0, the measure of x approaches half of $m\widehat{AB}$; $\angle AEB$ becomes an inscribed angle.

35d. $x = \frac{1}{2}(m\widehat{AB} + m\widehat{CD})$; $x = \frac{1}{2}(m\widehat{AB} + 0)$; $x = \frac{1}{2}mAB$

37. 15 **39a.** $m\angle G \le 90$; $m\angle G < 90$ for all values except when $\overrightarrow{JG} \perp \overrightarrow{GH}$ at G, then $m\angle G = 90$.

39b. $m\widehat{KH} = 56$; $m\widehat{HJ} = 124$; Because a diameter is involved the intercepted arcs measure $(180 - x)$ and x degrees. Hence solving $\frac{180 - x - x}{2} = 34$ leads to the answer.

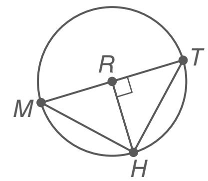
41. Sample answer: Using Theorem 10.14, $60° = \frac{1}{2}[(360 - x) - x]$ or 120°; repeat for 50° to get 130°. The third arc can be found by adding 50° and 60° and subtracting from 360 to get 110°.

43. J **45.** B **47.** 8

49. Given: $\widehat{MHT}$ is a semicircle.

$\overline{RH} \perp \overline{TM}$.

Prove: $\frac{TR}{RH} = \frac{TH}{HM}$



Proof:

Statements (Reasons)

1. $\widehat{MHT}$ is a semicircle; $\overline{RH} \perp \overline{TM}$. (Given)
2. $\angle THM$ is a right angle. (If an inscribed $\angle$ intercepts a semicircle, the $\angle$ is a rt. $\angle$.)
3. $\angle TRH$ is a right angle (Def. of $\perp$ lines)
4. $\angle THM \cong \angle TRH$ (All rt. angles are $\cong$.)
5. $\angle T \cong \angle T$ (Reflexive Prop.)
6. $\triangle TRH \sim \triangle THM$ (AA Sim.)
7. $\frac{TR}{RH} = \frac{TH}{HM}$ (Def. of $\sim \triangle s$)

51. 51.3 **53.** 3 **55.** −7, 4 **57.** $\frac{5}{2}$

Lesson 11-7

1. 2 **3.** 5 **5.** 71.21 cm **7.** 5 **9.** 14 **11.** 3.1 **13.** 7.4
15. 13 in. **17.** 7.1 **19.** $a = 15$; $b \approx 11.3$
21. $c \approx 22.8$; $d \approx 16.9$

23. Proof:

Statements (Reasons)

1. $\overline{AC}$ and $\overline{DE}$ intersect at B. (Given)
2. $\angle A \cong \angle D$, $\angle E \cong \angle C$ (Inscribed $\measuredangle$s that intercept the same arc are $\cong$.)
3. $\triangle ABE \sim \triangle DBC$ (AA Similarity)
4. $\frac{AB}{BD} = \frac{EB}{BC}$ (Definition of similar $\triangle$s)
5. $AB \cdot BC = EB \cdot BD$ (Cross products)

25. Proof:

Statements (Reasons)

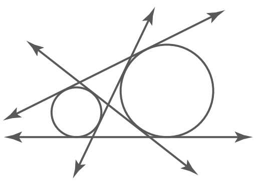
1. tangent $\overline{JK}$ and secant $\overline{JM}$ (Given)
2. $m\angle KML = \frac{1}{2}m\widehat{KL}$ (The measure of an inscribed $\angle$ equals half the measure of its intercept arc.)
3. $m\angle JKL = \frac{1}{2}m\widehat{KL}$ (The measure of an $\angle$ formed by a secant and a tangent = half the measure of its intercepted arc.)
4. $m\angle KML = m\angle JKL$ (Substitution)
5. $\angle KML \cong \angle JKL$ (Definition of $\cong \measuredangle$s)
6. $\angle J \cong \angle J$ (Reflexive Property)
7. $\triangle JMK \sim \triangle JKL$ (AA Similarity)

8. $\frac{JK}{JL} = \frac{JM}{JK}$ (Definition of ~ △s)

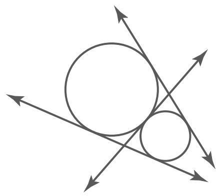
9. $JK^2 = JL \cdot JM$ (Cross products)

27. Sample answer: When two secants intersect in the exterior of a circle, the product of the measures of one secant segment and its external segment is equal to the product of the measures of the other secant segment and its external segment. When a secant and a tangent intersect at an exterior point, the product of the measures of the secant segment and its external segment equals the square of the measure of the tangent segment, because for the tangent the measures of the external segment and the whole segment are the same. **29.** Sometimes; they are equal when the chords are perpendicular. **31.** Sample answer: The product of the parts on one interse chord equals the product of the parts of the other chord. **33.** G **35.** E

37.



39.



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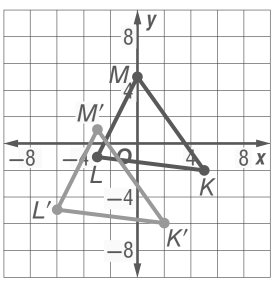
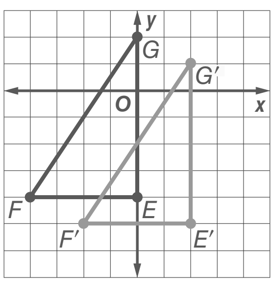


43.



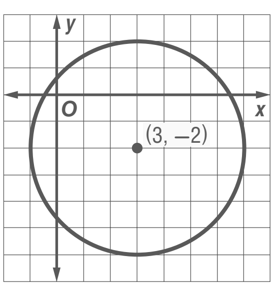
45. $y = 2x + 8$ **47.** $y = \frac{2}{9}x + \frac{1}{3}$ **49.** $y = \frac{1}{12}x + 1$

Lesson 11-8

1. $(x - 9)^2 + y^2 = 25$ **3.** $x^2 + y^2 = 8$

5. $(x - 2)^2 + (y - 1)^2 = 4$

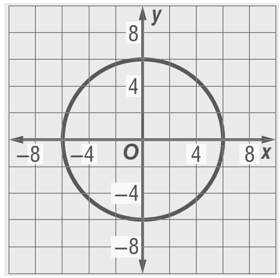
7. (3, − 2); 4



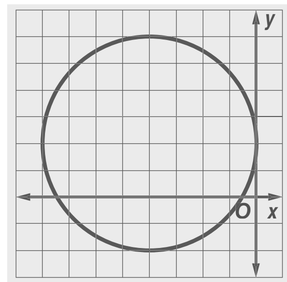
9. (2, −1); $(x - 2)^2 + (y + 1)\ 2 = 40$ **11.** (1, 2), (−1, 0)
13. $x^2 + y^2 = 16$ **15.** $(x + 2)^2 + y^2 = 64$
17. $(x + 3)^2 + (y - 6)^2 = 9$ **19.** $(x + 5)^2 + (y + 1)^2 = 9$

21. $x^2 + y^2 = 2025$

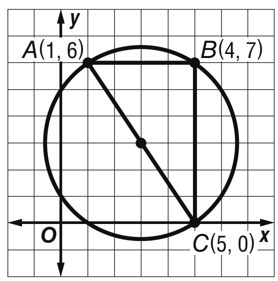
23. (0, 0); 6



25. (−4, 2); 4



27. $(x - 3)^2 + (y - 3)^2 = 13$

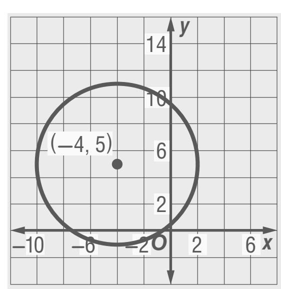


29. (−2, −1), (2, 1) **31.** (−2, −4), (2, 0)

33. $\left(\frac{\sqrt{2}}{2}, \frac{3\sqrt{2}}{2}\right), \left(-\frac{\sqrt{2}}{2}, \frac{3\sqrt{2}}{2}\right)$ **35.** $(x - 3)^2 + y^2 = 25$

37a. $x^2 + y\ 2 = 810{,}000$ **37b.** 3000 ft

39a. $(x + 4)^2 + (y - 5)^2 = 36$;



39b. All homes within the circle get free delivery. Consuela's home at (0, 0) is located outside the circle, so she cannot get free delivery. **41.** **43.** $(x + 5)^2 + (y - 2)^2 = 36$ **45.** $(x - 8)^2 + (y - 2)^2 = 16$; the first circle has its center at (5, −7). If the circle is shifted 3 units right and 9 units up, the new center is at (8, 2), so the new equation becomes $(x - 8)^2 + (y - 2)^2 = 16$.

47. Method 1: Draw a circle of radius 200 centered on each station. Method 2: Use the Pythagorean theorem to identify stations that are more than 200 miles apart. Using Method 2, plot the points representing the stations on a graph. Stations that are more than 4 units apart on the graph will be more than 200 miles apart and will thus be able to use the same frequency. Assign station A to the first frequency. Station B is within 4 units of station A, so it must be assigned the second frequency. Station C is within 4 units of both stations A and B, so it must be assigned a third frequency. Station D is also within 4 units of stations A, B, and C, so it must be assigned a fourth frequency, Station is E is $\sqrt{29}$ or about 5.4 units away from station A, so it can share the first frequency. Station F is $\sqrt{29}$ or about 5.4 units away from station B, so it can share the second frequency. Station G is $\sqrt{32}$ or about 5.7 units away from station C, so it can share the third frequency. Therefore, the least number of frequencies that can be assigned is 4

49. (−6.4, 4.8)
51. A
53. Step 1
55. 3
57. 5.6
59. 53
61. 28.3 ft
63. 32 cm; 64 cm^2

Lesson 11-9

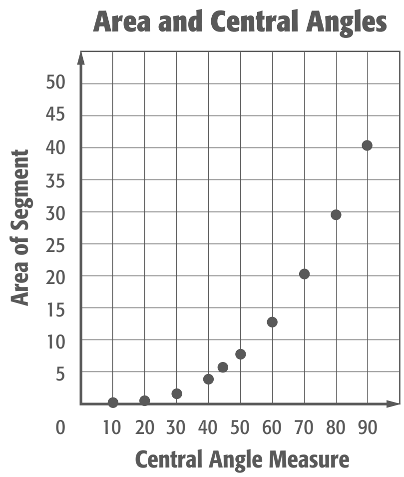
1. 1385.4 yd^2 **3.** 9.7 mm **5.** 4.5 in^2 **7a.** 10.6 in^2 **7b.** $48s
9. 78.5 yd^2 **11.** 14.2 in^2 **13.** 78.5 ft^2 **15.** 10.9 mm
17. 8.1 ft **19.** 40.2 cm^2 **21.** 322 m^2 **23.** 284 in^2
25a. 1.7 cm^2 **25b.** about 319.4 mg **27.** 13 **29.** 9.8
31a. 0.8 ft **31b.** 3.6 yr **33.** 53.5 m^2 **35.** 10.7 cm^2
37. 7.9 in^2 **39.** 30 mm^2 **41.** 50.3 in^2

43a. $A = \frac{x\pi r^2}{360} - r^2\left[\sin\left(\frac{x}{2}\right)\cos\left(\frac{x}{2}\right)\right]$

43b.

x	A
10	0.1
20	0.5
30	1.7
40	4.0
45	5.6
50	7.7
60	13.0
70	20.3
80	29.6
90	41.1

43c.

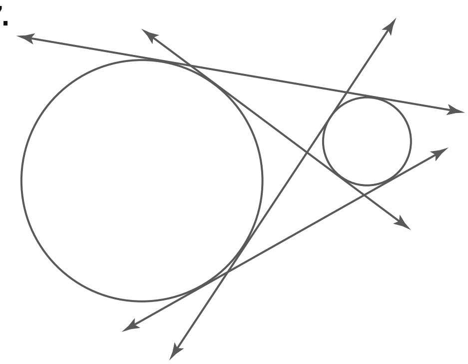


43d. Sample answer: From the graph, it looks like the area would be about 15.5 when x is 63°. Using the formula, the area is 15.0 when x is 63°. The values are very close because I used the formula to create the graph. **45.** 449.0 cm^2 **47.** Sample answer: You can find the shaded area of the circle by subtracting x from 360° and using the resulting measure in the formula for the area of a sector. You could also find the shaded area by finding the area of the entire circle, finding the area of the unshaded sector using the formula for the area of a sector, and subtracting the area of the unshaded sector from the area of the entire circle. The method in which you find the ratio of the area of a sector to the area of the whole circle is more efficient. It requires less steps, is faster, and there is a lower probability for error. **49.** Sample answer: If the radius of the circle doubles, the area will not double. If the radius of the circle doubles, the area will be four times as great. Since the radius is squared, if you multiply the radius by 2, you multiply the area by 2^2, or 4. If the arc length of a sector is doubled, the area of the sector is doubled. Since the arc length is not raised to a power, if the arc length is doubled, the area would also be twice as large. **51.** $x = 56$; $m\angle MTQ = 117$; $m\angle PTM = 63$ **53.** E **55.** about 118.2 yd **57.** 38

Chapter 11 Study Guide and Review

1. false; chord **3.** true **5.** true **7.** false; two
9. false; congruent **11.** $\overline{DM}$ or $\overline{DP}$ **13.** 13.69 cm; 6.84 cm
15. 34.54 ft; 17.27 ft **17.** 163 **19a.** 100.8 **19b.** 18
19c. minor arc **21.** 131 **23.** 50.4 **25.** 56

27.



29. 97 **31.** 214 **33.** 4 **35.** $(x + 2)^2 + (y - 4)^2 = 25$
37. $x^2 + y^2 = 1156$ **39.** 175.8 In^2 **41a.** 50.27 in^2
41b. 33.51 in^2 **41c.** 117.29 in^2

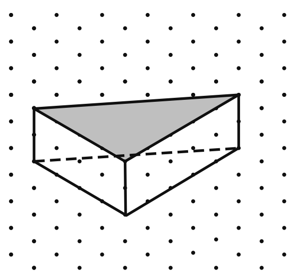
Extending Surface Area and Volume

Chapter 12 Get Ready

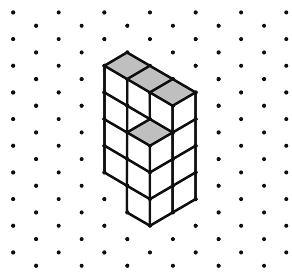
1. true **3.** true **5.** true **7.** 96 ft^2
9. 176 in^2 **11.** ± 15

Lesson 12-1

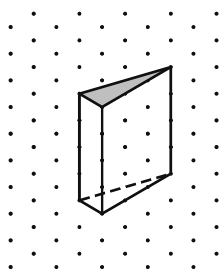
1. Sample answer:



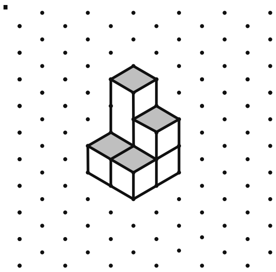
3. Sample answer:



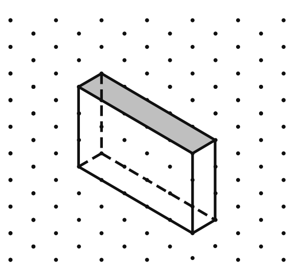
5a. slice vertically **5b.** slice horizontally
5c. slice at an angle
7. triangle
9. Sample answer:



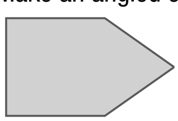
11.



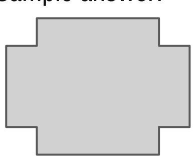
13.



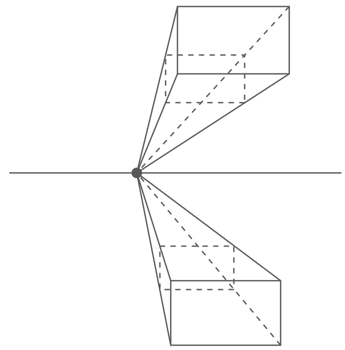
15a. rectangle **15b.** Cut off a corner of the clay.
17. hexagon19. trapezoid **21.** Make a vertical cut.
23. Make an angled cut. **25.** Sample answer:



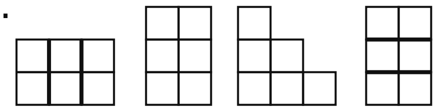
27. Sample answer:



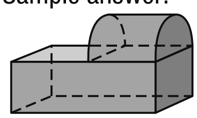
29a–b. Sample answer:



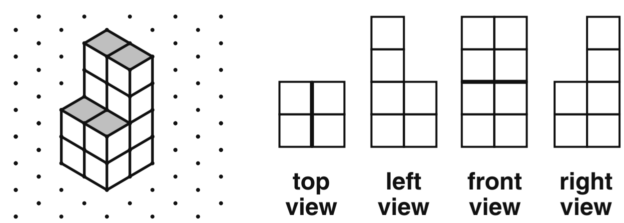
29c. Sample answer: The first drawing shows a view of the object from the bottom. The second drawing shows a view of the object from the top.
31.



33a. Sample answer:



33b. Make a horizontal cut through the bottom part of the figure or make a vertical cut through the left side of the figure.
33c. The front view of the solid is the cross section when a vertical cut is made lengthwise. The right view of the solid is the cross section when a vertical cut is made through the right side of the figure.
35. Sample answer: A cone is sliced at an angle through its lateral side and base.
37. Sample answer:

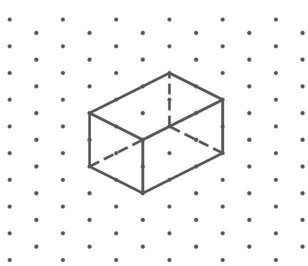


39. The cross section is a triangle. There are six different ways to slice the pyramid so that two equal parts are formed because the figure has six planes of symmetry. In each case, the cross section is an isosceles triangle. Only the side lengths of the triangles change.
41a. inner side of deck = circumference 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 **41b.** area of deck = $(2 \times 3 \times 32) + (2 \times 3 \times 26) = 348$ square feet
43. E **45.** $x = 8\sqrt{3}$; $y = 16$ **47.** sometimes **49.** always
51. sometimes **53.** 28.9 in.; 66.5 in^2

Lesson 12-2

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. $L = 24$ ft^2; $S = 36$ ft^2 **11.** $L = 64$ in^2; $S = 88$ in^2

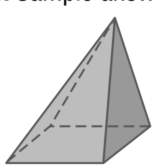
13. $L = 11.2\ m^2$; $S = 13.6\ m^2$
15. $L = 1032\ cm^2$; $S = 1932\ cm^2$ (18×25 base); $L = 1332\ cm^2$; $S = 1932\ cm^2$ (25×12 base); $L = 1500\ cm^2$; $S = 1932\ cm^2$ (18×12 base)
17. $L = 1484.8\ cm^2$; $S = 1745.2\ cm^2$
19. $L \approx 282.7\ mm^2$; $S \approx 339.3\ mm^2$
21. $L \approx 155.8\ in^2$; $S \approx 256.4\ in^2$ **23.** $42.5\ m^2$ **25.** $r = 9.2$ cm
27. 16 mm **29.** $283.7\ in^2$ **31.** $1392.0\ cm^2$; $2032\ cm^2$
33. about $299.1\ cm^2$ **35.** $2824.8\ cm^2$ **37.** $1059.3\ cm^2$
39. Derek; sample answer: $S = 2\pi r^2 + 2\pi rh$, so the surface area of the cylinder is $2\pi(6)^2 + 2\pi(6)(5)$ or 132π cm2.
41. To find the surface area of any solid figure, find the area of the base (or bases) and add to the area of the lateral faces of the figure. The lateral faces and bases of a rectangular prism are rectangles. Since the bases of a cylinder are circles, the lateral face of a cylinder is a rectangle.
43. $\frac{\sqrt{3}}{2}\ell^2 + 3\ell h$; the area of an equilateral triangle of side ℓ is $\frac{\sqrt{3}}{4}\ell^2$ and the perimeter of the triangle is 3ℓ. So, the total surface area is $\frac{\sqrt{3}}{2}\ell^2 + 3\ell h$.
45. A **47.** H
49.



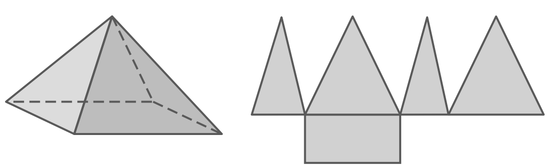
51. 9.5 in. **53.** 8.1 **55.** 42.3

Lesson 12-3

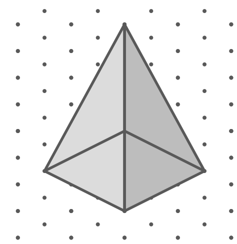
1. $L = 384\ cm^2$; $S = 640\ cm^2$ **3.** $L \approx 207.8\ m^2$; $S \approx 332.6\ m^2$
5. $L \approx 188.5\ m^2$; $S \approx 267.0\ m^2$ **7.** $L = 20\ m^2$; $S = 24\ m^2$
9. $L \approx 178.2\ cm^2$; $S \approx 302.9\ cm^2$
11. $L \approx 966.0\ in^2$; $S \approx 1686.0\ in^2$ **13.** $139{,}440\ ft^2$
15. $L \approx 357.6\ cm^2$; $S \approx 470.7\ cm^2$
17. $L \approx 241.1\ ft^2$; $S \approx 446.1\ ft^2$ **19.** $28{,}013.6\ yd^2$
21. 34 **23.** 5 mm **25.** 16 cm **27.** $266\pi\ ft^2$
29a. nonregular pyramid with a square bas
29b. Sample answer:



31. Sample answer:



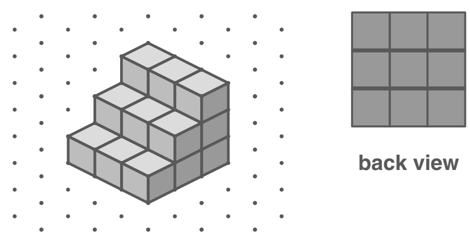
33. $\approx 333.5\ mm^2$; $\approx 510.2\ mm^2$
35a. Sample answer:



35b.

Slant Height (units)	Lateral Area ($units^2$)
1	6
3	18
9	54

37. Always; if the heights and radii are the same, the surface area of the cylinder will be greater since it has two circular bases and additional lateral area **39.** Sample answer: a square pyramid with a base edge of 5 units and a slant height of 7.5 units
41. Use the apothem, the height, and the Pythagorean Theorem to find the slant height ℓ of the pyramid. Then use the central angle of the n-gon and the apothem to find the length of one side of the n-gon. Then find the perimeter. Finally, use $S = \frac{1}{2}P\ell + B$ to find the surface area. The area of the base B is $\frac{1}{2}Pa$.
43. $3299\ mm^2$ **45.** D
47.



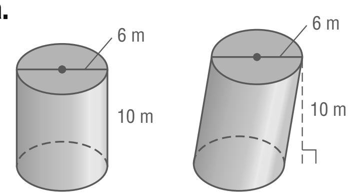
back view

corner view

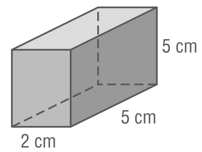
49. semicircle; 180 **51.** major arc; 270 **53.** 73 mm, $180.5\ mm^2$

Lesson 12-4

1. $108\ cm^3$ **3.** $26.95\ m^3$ **5.** $206.4\ ft^3$ **7.** $1025.4\ cm^3$ **9.** D
11. $539\ m^3$ **13.** $58.14\ ft^3$ **15.** $1534.25\ in^3$ **17.** $407.2\ cm^3$
19. $2686.1\ mm^3$ **21.** $521.5\ cm^3$ **23.** $3934.9\ cm^3$
25. 35.1 cm **27a.** $0.0019\ lb/in^3$
27b. The plant should grow well in this soil since the bulk density of $0.019\ lb/in^3$ is close to the desired bulk density of $0.0018\ lb/in^3$.
29. $120\ m^3$ **31.** $304.1\ cm^3$ **33.** $678.6\ in^3$
35. $3{,}190{,}680.0\ cm^3$ **37.** $11\frac{1}{4}$ in.
39. $1100\ cm^3$; Each triangular prism has a base area of $\frac{1}{2}(8)(5.5)$ or $22\ cm^2$ and a height of 10 cm.
41a.



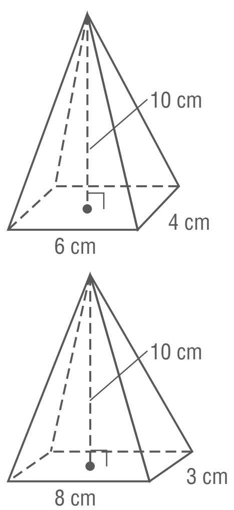
41b. Greater than; a square with a side length of 6 m has an area of 36 m^2. A circle with a diameter of 6 m has an area of 9π or 28.3 m^2. Since the heights are the same, the volume of the square prism is greater. **41c.** Multiplying the radius by x; since the volume is represented by $\pi r^2 h$, multiplying the height by x makes the volume x times greater. Multiplying the radius by x makes the volume x^2 times greater.
43a. base 3 in. by 5 in., height 4π in.
43b. base 5 in. per side, height $\frac{12}{5}\pi$ in.
43c. base with legs measuring 3 in. and 4 in., height 10π in.
45. Sample answer:



47. 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.
49. F **51.** C **53.** 126 cm^2; 175 cm^2 **55.** 205 in^2
57. 11.4 cm **59.** 9.3 in. **61.** 378 m^2

Lesson 12-5

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.** 105.8 mm^3 **13.** 233.8 cm^3 **15.** 35.6 cm^3
17. 235.6 in^3 **19.** 1473.1 cm^3 **21.** 1072.3 in^3 **23.** 234.6 cm^3
25. 32.2 ft^3 **27.** 3190.6 m^3 **29.** about 13,333 BTUs
31a. The volume is doubled.
31b. The volume is multiplied by 2^2 or 4.
31c. The volume is multiplied by 2^3 or 8. **33.** 14 in.
35a. Sample answer:

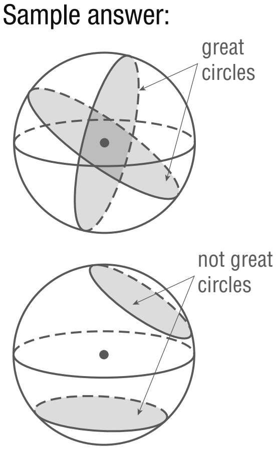


35b. The volumes are the same. The volume of a pyramid equals one third times the base area times the height. So, if the base areas of two pyramids are equal and their heights are equal, then their volumes are equal.
35c. If the base area is multiplied by 5, the volume is multiplied by 5. If the height is multiplied by 5, the volume is multiplied by 5. If both the base area and the height are multiplied by 5, the volume is multiplied by 5 • 5 or 25.

37. Cornelio; Alexandra incorrectly used the slant height.
39. Sample answer: A square pyramid with a base area of 16 and a height of 12, a prism with a square base area of 16 and a height of 4; if a pyramid and prism have the same base, then in order to have the same volume, the height of the pyramid must be 3 times as great as the height of the prism. **41.** A **43.** F
45. 1008.0 in^3 **47.** 426,437.6 m^3 **49.** 30.4 cm^2 **51.** 26.6 ft^2

Lesson 12-6

1. 1017.9 m^2 **3.** 452.4 yd^2 **5.** 4188.8 ft^3 **7.** 3619.1 m^3
9. 277.0 in^2 **11.** 113.1 cm^2 **13.** 680.9 in^2 **15.** 128 ft^2
17. 530.1 mm^2 **19.** 4.2 cm^3 **21.** 2712.3 cm^3 **23.** 179.8 in^3
25. 77.9 m^3 **27.** 860,289.5 ft^3 **29.** 276.5 in^2; 385.4 in^3
31a. 594.6 cm^2; 1282.8 cm^3 **31b.** 148.7 cm^2; 160.4 cm^3
33. $\overline{DC}$ **35.** $\overline{AB}$ **37.** $\odot S$
39a. $\sqrt{r^2 - x^2}$ **39b.** $\pi\left(\sqrt{r^2 - x^2}\right)2 \cdot y$ or $\pi y r^2 - \pi y x^2$
39c. The volume of the disc from the cylinder is $\pi r^2 y$ or $\pi y r^2$. The volume of the disc from the two cones is $\pi x^2 y$ or $\pi y x^2$. Subtract the volumes of the discs from the cylinder and cone to get $\pi y r^2 - \pi y x^2$, which is the expression for the volume of the disc from the sphere at height x. **39d.** Cavalieri's Principle
39e. The volume of the cylinder is πr^2 (2r) or $2\pi r^3$. The volume of one cone is $\frac{1}{3}\pi r^2$ (r) or $\frac{1}{3}\pi r^3$, so the volume of the double napped cone is $2 \cdot \frac{1}{3}\pi r^3$ or $\frac{2}{3}\pi r^3$. Therefore, the volume of the hollowed out cylinder, and thus the sphere, is $2\pi r^3 - \frac{2}{3}\pi r^3$ or $\frac{4}{3}\pi r^3$. **41.** There are infinitely many planes that produce reflection symmetry as long as they are vertical planes. Only rotation about the vertical axis will produce rotation symmetry through infinitely many angles. **43.** The surface area is divided by 3^2 or 9. The volume is divided by 3^3 or 27. **45.** 587.7 in^3
47. Sample answer:

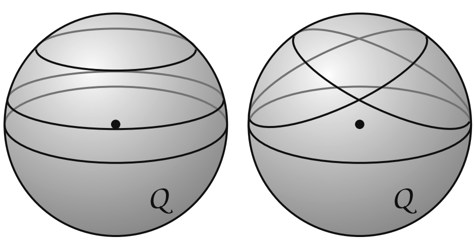


49. 68.6 **51.** H **53.** 58.9 ft^3 **55.** 232.4 m^3 **57.** 75 **59.** 110
61. D, B, and G
63. $\overleftrightarrow{EF}$ and $\overleftrightarrow{AB}$ do not intersect. $\overleftrightarrow{AB}$ lies in plane $\mathcal{P}$, but only E lies in $\mathcal{P}$.

Lesson 12-7

1. $\overleftrightarrow{DH}$, $\overleftrightarrow{FJ}$ **3.** $\triangle JKQ$, $\triangle LMP$ **5.** no **7.** The points on any great circle or arc of a great circle can be put into one-to-one correspondence with real numbers.
9. Sample answers: $\overleftrightarrow{WZ}$ and $\overleftrightarrow{XY}$, $\overline{RY}$ or $\overline{TZ}$, $\triangle RST$ or $\triangle MPL$
11a. $\overleftrightarrow{AD}$ and $\overleftrightarrow{FC}$ **11b.** Sample answers: $\overline{BG}$ and $\overline{AH}$

11c. Sample answers: $\triangle BCD$ and $\triangle ABF$ **11d.** $\overline{QD}$ and $\overline{BL}$
11e. $\overleftrightarrow{MJ}$ **11f.** $\overleftrightarrow{MB}$ and $\overleftrightarrow{KF}$
13. no **15.** No; a great circle is finite and returns to its original starting point. **17.** Yes; if three points are collinear, any one of the three points is between the other two.
19. 14.0 in.; since 100 degrees is $\frac{5}{18}$ of 360 degrees, $\frac{5}{18} \times$ circumference of great circle ≈ 14.0
21a. about 913 mi; the cities are 13.2° apart on the same great circle, so $\frac{13.2}{360} \times 2\pi \times 3963$ gives the distance between them.
21b. Yes; sample answer: Since the cities lie on a great circle, the distance between the cities can be expressed as the major arc or the minor arc. The sum of the two values is the circumference of Earth. **21c.** No; sample answer: Since lines of latitude do not go through opposite poles of the sphere, they are not great circles. Therefore, the distance cannot be calculated in the same way.
21d. Sample answer: Infinite locations. If Phoenix were a point on the sphere, then there are infinite points that are equidistant from that point. **23a.** No; if $\overline{CD}$ was perpendicular to $\overline{DA}$, then $\overline{DA}$ would be parallel to $\overline{CB}$. This is not possible, because there are no parallel lines in spherical geometry. **23b.** $DA < CB$ **23c.** No; the sides are not parallel.
25. Sample answer: In plane geometry, the sum of the measures of the angles of a triangle is 180. In spherical geometry, the sum of the measures of the angles of a triangle is greater than 180. In hyperbolic geometry, the sum of the measures of the angles of a triangle is less than 180.
27. Sometimes; sample answer: Since small circles cannot go through opposite poles, it is possible for them to be parallel, such as lines of latitude. It is also possible for them to intersect when two small circles can be drawn through three points, where they have one point in common and two points that occur on one small circle and not the other.



29. False; sample answer: Spherical geometry is non-Euclidean, so it cannot be a subset of Euclidean geometry.
31. C **33.** Sample answer: $\overleftrightarrow{BC}$ **35.** 735.4 m^3 **37.** 1074.5 cm^3
39. 78.5 m^3 **41.** 0.1 m^3 **43.** 2.7 cm^2 **45** 322.3 m^2 1282.8 cm^3

Lesson 12-8

1. similar; 4:3 **3.** 4:25 **5.** 220,893.2 cm^3 **7.** neither
9. similar; 6:5 **11.** 343:125 **13.** 5:1 **15.** 10:13 **17.** 156 : 7 **19.** 4.1 in. **21.** 2439.6 cm^3 **23.** about 5.08 to 1
25. 89.8 ft^3 **27.** Laura; because she compared corresponding parts of the similar figures. Paloma incorrectly compared the diameter of *X* to the radius of *Y*. **29.** Since the scale factor is 15:9 or 5:3, the ratio of the surface areas is 25:9 and the ratio of the volumes is 125:27. So, the surface area of the larger prism is $\frac{25}{9}$ or about 2.8 times the surface area of the smaller prism. The volume of the larger prism is $\frac{125}{27}$ or about 4.6 times the volume of the smaller prism.
31. 14 **cm** **33.** B **35.** $\sqrt{85} \approx 9.2$ km **37.** yes **39.** yes
41. 5 **43.** 6 **45.** 0.31 **47.** 0.93

Chapter 12 Study Guide and Review

1. false, Spherical geometry **3.** false, right cone **5.** true
7. true **9.** true **11.** triangle **13.** rectangle
15. Sample answer: 160 ft^2; 202 ft^2 **17.** 113.1 cm^2; 169.6 cm^2
19. 354.4 cm^2; 432.9 cm^2 **21.** 972 cm^3 **23.** 3.6 cm^3
25. 91,636,272 ft^3 **27.** 1017.9 m^2 **29.** 1708.6 in^3
31. $\overleftrightarrow{FG}$, $\overleftrightarrow{DJ}$ **33.** $\triangle CBD$ **35.** $\overline{KC}$
37. no **39.** congruent **41.** neither

CHAPTER 13
Probability and Measurement

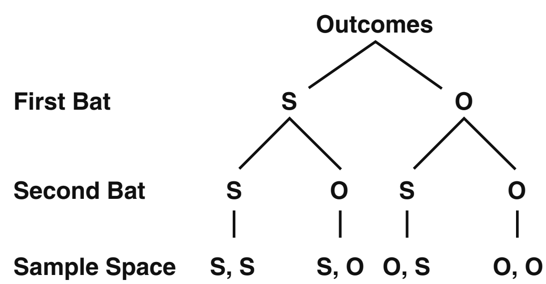
Chapter 13 Get Ready

1. $\frac{7}{8}$ **3.** $1\frac{11}{40}$ **5.** $\frac{3}{8}$ **7.** 144 **9.** $\frac{1}{2}$ or 50% **11** $\frac{1}{3}$ or 33%
13 $\frac{1}{5}$ or 20% **15.** $\frac{11}{20}$ or 55%

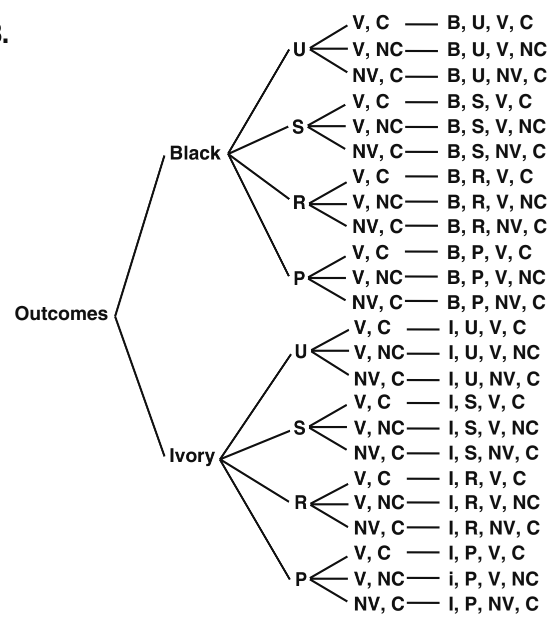
Lesson 13-1

1. S, S 0, 0
S, 0 0, S

Outcomes	Safe	Out
Safe	S, S	S, 0
Out	0, S	0, 0



3.

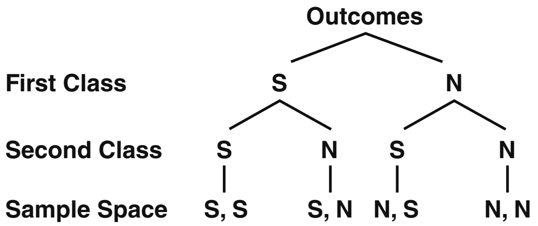


5. 20,736

7. S, S   N, N

S, N   N, S

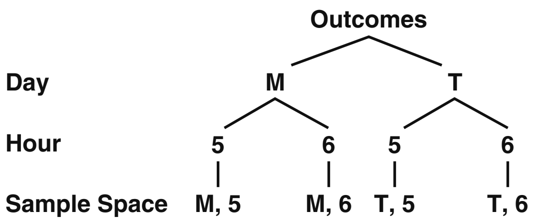
Outcomes	Smithsonian	Natural
Smithsonian	S, S	S, N
Natural	N, S	N, N



9. M, 5   T, 5

M, 6   T, 6

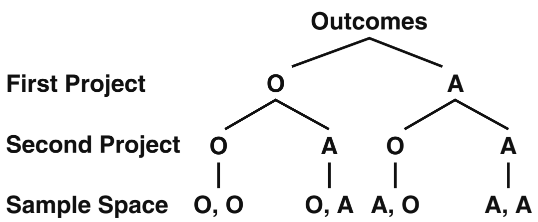
Outcomes	5	6
Monday	M, 5	M, 6
Thursday	T, 5	T, 6



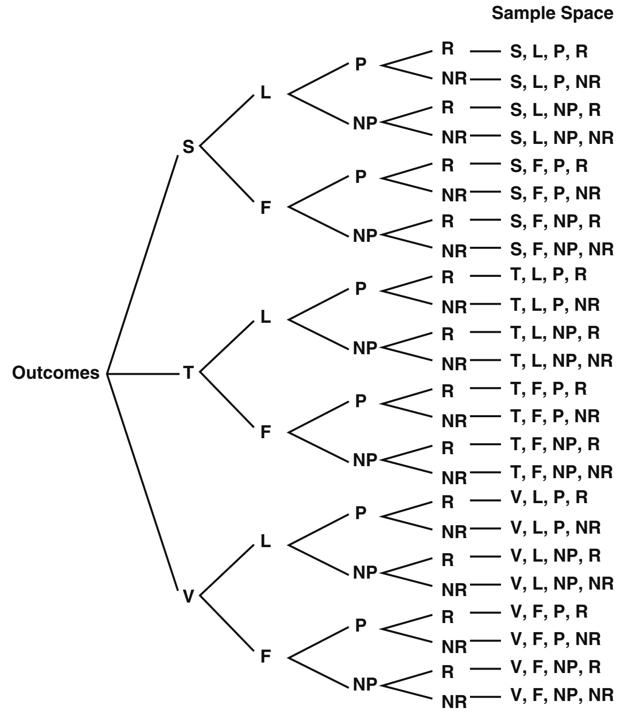
11. O, O   A, A

O, A   A, O

Outcomes	Oil	Acrylic
Oil	O, O	O, A
Acrylic	A, O	A, A

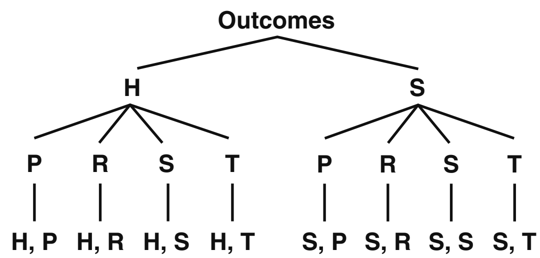


13. S = sedan, T = truck, V = van, L = leather, F = fabric, P = CD player, NP = no CD player, R = sunroof, NR = no sunroof



15. 120 **17.** 240 **19.** H = rhombus, P = parallelogram, R = rectangle, S = square, T = trapezoid; H, P; H, R; H, S; H, T; S, P; S, R; S, S; S, T; H, H; S, H

Outcomes	rhombus	square
parallelogram	H, P	S, P
rectangle	H, R	S, R
square	H, S	S, S
trapezoid	H, T	S, T
rhombus	H, H	S, H



21. 6 different ways

$4(x + 6) + 2(3) + 2(x + 4);$

$2(x + 11) + 2(x + 8) + 2(x);$

$2(x + 4) + 2(x + 9) + 2(x + 6);$

$2(x) + 2(3) + 4(x + 8);$

$2(x) + 2(x + 8) + 2(3) + 2(x + 8);$

$2(x) + 2(3) + 2(4) + 2(x + 6) + 2(x + 6)$

23a. 5 **23b.** 18 **25.** $n^3 - 3n^2 + 2n$; Sample answer: There are n objects in the box when you remove the first object, so after you remove one object, there are $n - 1$ possible outcomes. After you remove the second object, there are $n - 2$ possible outcomes. The number of possible outcomes is the product of the number of outcomes of each experiment or $n(n - 1)(n - 2)$.

27. Sample answer: You can list the possible outcomes for one stage of an experiment in the columns and the possible outcomes for the other stage of the experiment in the rows. Since a table is two dimensional, it would be impossible to list the possible outcomes for three or more stages of an experiment. Therefore, tables can only be used to represent the sample space for a two-stage experiment.
29. $P = n^k$; Sample answer: The total number of possible outcomes is the product of the number of outcomes for each of the stages 1 through k. Since there are k stages, you are multiplying n by itself k times which is n^k.
31. B **33.** G
35. 130 m high, 245 m wide, and 465 m long
37. $\overline{FC}$ **39.** 1429.4 ft^{2}1737.3 ft2 **41.** 1710.6 m^{2}3421.2 m2
43. 12.5 **45.** 12 **47.** 32

Lesson 13-2

1. $\frac{1}{20}$ **3.** $\frac{1}{420}$ **5.** $\frac{1}{124{,}750}$ **7.** $\frac{1}{2450}$ **9.** $\frac{1}{15{,}120}$
11. $\frac{1}{453{,}600}$ **13.** $\frac{1}{7}$ **15.** $\frac{1}{10{,}626}$
17a. $\frac{1}{56}$ **17b.** $\frac{1}{40{,}320}$ **17c.** $\frac{1}{140}$ **17d** $\frac{2}{7}$
19a. 720 **19b.** 5040 **21.** 600 **23.** $\frac{13}{261}$
25. Sample answer: A bag contains seven marbles that are red, orange, yellow, green, blue, purple, and black. The probability that the orange, blue, and black marbles will be chosen if three marbles are drawn at random can be calculated using a combination.
27.

$$C(n, n-r) \stackrel{?}{=} C(n, r)$$
$$\frac{n!}{[n-(n-r)]!(n-r)!} \stackrel{?}{=} \frac{n!}{(n-r)!r!}$$
$$\frac{n!}{r!(n-r)!} \stackrel{?}{=} \frac{n!}{(n-r)!r!}$$
$$\frac{n!}{(n-r)!r!} = \frac{n!}{(n-r)!r!} \checkmark$$

29. C **31.** J **33.** 16 **35.** 2 **37.** 4.5 **39.** 10 **41** 6 **43** 6

Lesson 13-3

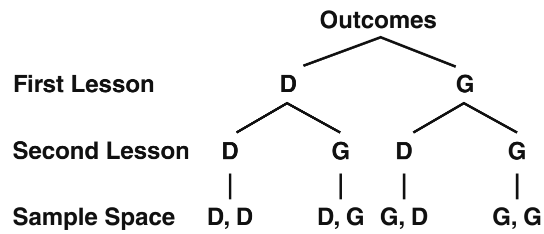
1. $\frac{1}{2}$, 0.5, or 50% **3.** $\frac{13}{33}$, 0.39, or about 39%
5. $\frac{1}{8}$, 0.125, or 12.5% **7.** $\frac{13}{18}$, 0.72, or 72% **9.** $\frac{1}{9}$, 0.11, or 11%
11. $\frac{1}{6}$, 0.17, or about 17% **13.** $\frac{1}{2}$, 0.5,or 50% **15.** 12.2%
17. 69.4% **19.** 62.2% **21.** Sample answer: a point between 10 and 20 **23.** $\frac{1}{2}$, 0.5,or 50% **25.** 53.5%
27. Sample answer: The probability that a randomly chosen point will lie in the shaded region is the ratio of the area of the sector to the area of the circle.

$$P(\text{point lies in sector}) = \frac{\text{area of sector}}{\text{area of circle}}$$
$$P(\text{point lies in sector}) = \frac{\frac{x}{360} \cdot \pi r^2}{\pi r^2}$$
$$P(\text{point lies in sector}) = \frac{x}{360}$$

29. 0.24 or 24% **31.** 0.33 or 33% **33.** 0.31 or 31% **35.** 14.3%
37. Sample answer: Athletic events should not be considered random because there are factors involved, such as pressure and ability that have an impact on the success of the event.

39. Sample answer: The probability of a randomly chosen point lying in the shaded region of the square on the left is found by subtracting the area of the unshaded square from the area of the larger square and finding the ratio of the difference of the areas to the area of the larger square. The probability is $\frac{1^2 - 0.75^2}{1^2}$ or 43.75%. The probability of a randomly chosen point lying in the shaded region of the square on the left is the ratio of the area of the shaded square to the area of the larger square, which is $\frac{0.4375}{1}$ or 43.75%. Therefore, the probability of a randomly chosen point lying in the shaded area of either square is the same.
41. F **43.** C
45. D, D G, G
D, G G, D

Outcomes	Drums	Guitar
Drums	D, D	D, G
Guitar	G, D	G, G

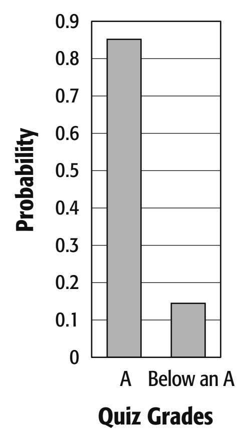


47. 45 **49.** Square; each angle intercepts a semicircle, making them 90° angles. Each side is a chord of congruent arcs, so the chords are congruent. **51.** 57.1 m^2 **53** 66.3 cm^2

Lesson 13-4

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. B **7.** 1.3 **9.** C **11.** A **13.** D

15a. $\frac{13}{30}$ or 43.3% **15b.** 0.8; 1.1

17. Yes; sample answer: If the spinner were going to be divided equally into three outcomes, each sector would measure 120. Since you only want to know the probability of outcome C, you can record spins that end in the pink area as a success, or the occurrence of outcome C, and spins that end in the blue area as a failure, or an outcome of A or B.

19a. Sample answer: Use the random number generator on your calculator to generate 20 sets of 5 values that are either 0 or 1. Let 0 be heads and 1 be tails. You would count the trials with exactly three 1s to calculate the experimental probability of getting exactly three tails. **19b.** Sample answer: Yes; you would just count the number of trials with three or more 1s to calculate the experimental probability of getting more than three tails.

21. Sample answer: Rolling a die has an expected value that is not a possible outcome. Each of the six faces of the die is equally likely to occur, so the probability of each is $\frac{1}{6}$. The expected value is $\frac{1}{6} \cdot 1 + \frac{1}{6} \cdot 2 + \frac{1}{6} \cdot 3 + \frac{1}{6} \cdot 4 + \frac{1}{6} \cdot 5 + \frac{1}{6} \cdot 6$ or 3.5. Since 3.5 is not a possible outcome, the expected value is not a possible outcome.

23. D **25.** $\frac{27}{50}$ **27.** $\frac{9}{14}$, 0.64, or 64% **29.** $\frac{1}{120}$ **31.** 21.2 cm^2

33a. 117 **33b.** sports or shopping **33c.** 56

Lesson 13-5

1. The outcome of Jeremy taking the SAT in no way changes the probability of the outcome of his ACT test. Therefore, these two events are independent.

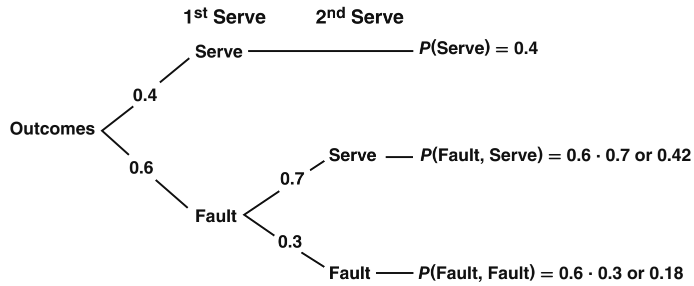
3. $\frac{1}{2704}$ or 3.7 × 10-4 **5.** $\frac{1}{5}$ or 0.20 **7.** dependent; $\frac{1}{221}$ or 0.5%

9. independent; $\frac{1}{36}$ or about 3% **11.** $\frac{1}{306}$ or about 0.3%

13. $\frac{20}{161}$ or about 12% **15.** $\frac{1}{4}$ or 25% **17.** $\frac{1}{6}$ or 17%

19. 0.65

21a.



21b. 0.18 or 18%

21c. Sample answer: I would use a random number generator to generate integers 1 through 50. The integers 1–9 will represent a double fault, and the integers 10–50 will represent the other possible outcomes. The simulation will consist of 50 trials.

23. Allison; sample answer: Since the events are independent, $P(A \text{ and } B) = P(A) \cdot P(B)$. Substituting for $P(A \text{ and } B)$ in the formula $P(A|B) = \frac{P(A \text{ and } B)}{P(B)}$, $P(A|B) = \frac{P(A) \cdot P(B)}{P(B)}$ or $P(A)$.

25. A and B are independent events.

27. Sample answer: A probability tree shows all of the possible outcomes of a compound event that occur in the sample space. The probability of each outcome is the proportion of the outcome to the whole sample space. The whole sample space is represented by 1, so the sum of the probabilities of all of the outcomes must equal 1

29a. J **31.** B **33.** 0.25 **35.** 0.07 **37.** neither

39a. 5026.5 ft **39b.** 500–600 ft **39c.** 3142 ft; 3770 ft

41. 12 **43.** 216

Lesson 13-6

1. not mutually exclusive; A jack of clubs is both a jack and a club.

3. $\frac{2}{3}$ or about 67%

5. The probability of missing the spare is $\frac{8}{10}$ or 80%.

7. 17.3% **9.** not mutually exclusive; $\frac{10}{36}$ or 27.8%

11. mutually exclusive; 100%

13. mutually exclusive; $\frac{2}{9}$ or about 22.2%

15. $\frac{7}{16}$ or about 43.8%

17. $\frac{3}{4}$ or about 75% **19.** $\frac{7}{8}$ or 87.5% **21.** 42%

23. $\frac{1}{13}$ or 7.7% **25.** $\frac{3}{13}$ or 23.1%

27a. 71.3% **27b.** 11.3% **27c.** 36.2% **27d.** 3.8%

29. 0.74; Sample answer: Consider an outcome to be an event in which at least two of the dice show a 4 or less. There are three outcomes in which the values of two or more of the dice are less than or equal to 4 and one outcome where the values of all three of the dice are less than or equal to 4. You have to find the probability of each of the four scenarios and add them together.

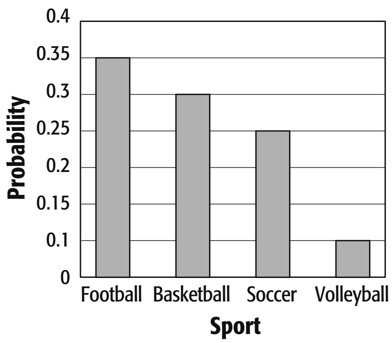
31. Not mutually exclusive; sample answer: If a triangle is equilateral, it is also equiangular. The two can never be mutually exclusive.

33. Sample answer: If you pull a card from a deck, it can be either a 3 or a 5. The two events are mutually exclusive. If you pull a card from a deck, it can be a 3 and it can be red. The two events are not mutually exclusive.

35. D **37.** J **39.** dependent; $\frac{1}{221}$ or 0.5%

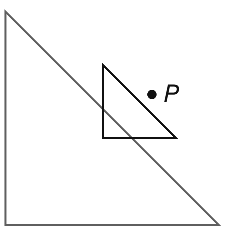
41. Sample answer: Use a random number generator to generate integers 1 through 20 in which 1–7 represent football, 8–13 represent basketball, 14–17 represent soccer, and 18–20 represent volleyball. Do 20 trials, and record the results in a frequency table.

Outcome	Frequency
football	7
basketball	6
soccer	5
volleyball	2
Total	20



The probability that an athlete plays only football is 0.35, only basketball is 0.30, only soccer is 0.25, and only volleyball is 0.1.

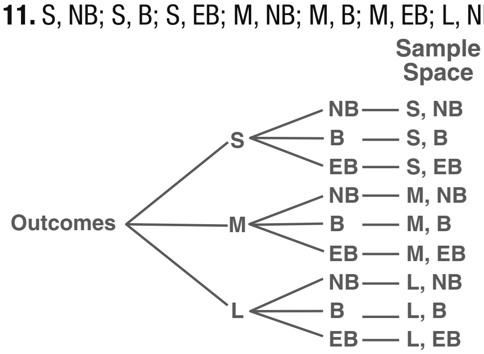
43.



Chapter 13 Study Guide and Review

1. true **3.** true **5.** true **7.** true **9.** false, simulation

11. S, NB; S, B; S, EB; M, NB; M, B; M, EB; L, NB; L, LB; L, EB



Outcomes	No Butter	Butter	Extra Butter
Small	S, NB	S, B	S, EB
Medium	M, NB	M, B	M, EB
Large	L, NB	L, B	L, EB

13. 4 **15.** 35,960 **17a.** $\frac{2}{9}$ **17b.** $\frac{7}{9}$

19. Sample answer: Use a spinner that is divided into 4 sectors, 108°, 79.2°, 82.8°, and 90°. Perform 50 trials and record the results in a frequency table. The results can be used to determine the probability of when a particular book will be purchased.

21. $\frac{6}{35}$ **23.** 37% **25.** $\frac{4}{13}$