CHAPTER 1

Lesson 1.1

Think & Discuss (p. 1)

1. Answers may vary

Sample answer:

A consistent runway naming scheme could prevent accidents due to confusion of which runway to use.

2. The missing runway numbers are $50 \div 10$, or 5, and $230 \div 10$, or 23.

Skill Review (p. 2)

1. $17 - 9 = 8$ **2.** $9 - 17 = -8$

3. $5 - (-3) = 5 + 3 = 8$ **4.** $3 - (-5) = 3 + 5 = 8$

5. $-7 - 2 = -7 + (-2) = -9$

6. $-7 - (-2) = -7 + 2 = -5$

7. $-6 - (-5) = -6 + 5 = -1$

8. $-5 - (-6) = -5 + 6 = 1$

9. $2^2 + 4^2 = 4 + 16 = 20$

10. $5^2 + (-2)^2 = 25 + 4 = 29$

11. $(-1)^2 + 1^2 = 1 + 1 = 2$

12. $(-5)^2 + 0^2 = 25 + 0 = 25$

13. $\sqrt{36 + 4} = \sqrt{40} \approx 6.32$

14. $\sqrt{1 + 49} = \sqrt{50} \approx 7.07$

15. $\sqrt{225 + 100} = \sqrt{325} \approx 18.03$

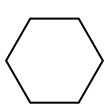
16. $\sqrt{9 + 9} = \sqrt{18} \approx 4.24$

1.1 Guided Practice (p. 6)

1. A *conjecture* is an unproven statement that is based on observations.

2. A conjecture can be proven false by finding a counterexample.

3.



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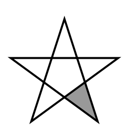


5. Each number is 3 times the previous number. The next number is 54×3 or 162.

6. The numbers are consecutive perfect squares. The next number is 4^2 or 16.

7. Each number is $\frac{1}{4}$ the previous number. The next number is $4 \div 4$ or 1.

8. Every other number is zero. The other numbers alternate between 3 and -3. The next number is -3.

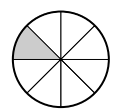
9. Each number is 0.5 greater than the previous number. The next number is $8.5 + 0.5$ or 9.0.

10. Each number is 6 less than the previous number. The next number is $-5 - 6$ or -11.

11. The sum of any three consecutive positive integers is 3 times the middle integer.

1.1 Practice and Applications (pp. 6–9)

12.



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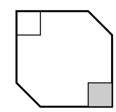
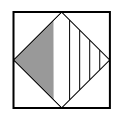


14.



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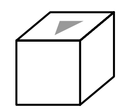


16. Each number is 3 more than the previous number. The next number is $10 + 3$ or 13.

17. Each number is half the previous number. The next number is $1.25 \div 2$ or 0.625.

18. Each number is 11 times the previous number. The next number is 1331×11 or 14,641.

19. Each number is 5 less than the previous number. The next number is $-10 - 5$ or -15.

20. Numbers after the first are found by adding consecutive even integers. The sixth number is 10 more than the fifth number, so it is $27 + 10$ or 37.

21. Numbers after the first are found by adding consecutive whole numbers. The sixth number is 6 more than the fifth number, so it is $15 + 6$ or 21.

22. Each number is the square root of the previous number. The next number is $\sqrt{2}$.

23. Numbers after the first are found by adding a zero after the decimal point of the previous number. So the next number is 1.00001.

24. 16 blocks **25.** 28 blocks

26.

figure	1	2	3	4	5
distance	4	8	12	16	20

27. Each distance is 4 times the figure number.

28. The twentieth figure would have a distance of 4×20 or 80 units.

29. The sum of any two odd numbers is an even number.

30. The product of any two odd numbers is an odd number.

31. The product of a number $(n - 1)$ and the number $(n + 1)$ is always equal to the difference of the square of the number and 1 $(n^2 - 1)$.

32. $101 \times 34 = 3434$

$101 \times 25 = 2525$

$101 \times 97 = 9797$

$101 \times 49 = 4949$

The product of 101 and any two digit number is the four-digit number formed by writing the two digits in order twice.

33. $11 \times 11 = 121$

$111 \times 111 = 12{,}321$

$1111 \times 1111 = 1{,}234{,}321$

$11{,}111 \times 11{,}111 = 123{,}454{,}321$

The square of the n-digit number consisting of all ones is the number obtained by writing the digits from 1 to n in increasing order, then the digits from $n - 1$ to 1 in decreasing order. This pattern does not continue beyond $n = 9$.

34. The counterexample is 2. The number 2 is prime, but it is not odd.

35.–39. Sample answers are given.

35. $-2 + 5 = 3$

Three is not larger than 5, which is the larger number.

36. $2 \times 3 = 6$

The product is even, but 3 is not even.

37. $(-2) \times (-3) = 6$

The product is positive, but neither factor is positive.

38. $\sqrt{\frac{1}{4}} = \frac{1}{2}$ but $\frac{1}{2}$ is not less than $\frac{1}{4}$.

39. Let $m = -2$.

$$\frac{m + 1}{m} = \frac{-2 + 1}{-2} = \frac{-1}{-2} = \frac{1}{2}$$

$\frac{1}{2}$ is not greater than 1.

40. Answers may vary.

Sample answer:

$20 = 3 + 17$ $32 = 13 + 19$

$22 = 5 + 17$ $34 = 11 + 23$

$24 = 7 + 17$ $36 = 17 + 19$

$26 = 7 + 19$ $38 = 7 + 31$

$28 = 11 + 17$ $40 = 17 + 23$

$30 = 13 + 17$

41. Answers may vary.

Sample answer:

$17 = 1 + 16$ $17 = 5 + 12$

$17 = 2 + 15$ $17 = 6 + 11$

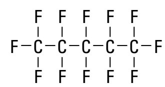
$17 = 3 + 14$ $17 = 7 + 10$

$17 = 4 + 13$ $17 = 8 + 9$

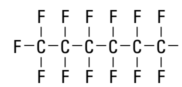
These are all of the possibilities for the number 17. None of these have two addends that are prime.

42. After 8 doubling periods, there will be $3 \times 2^8 = 768$ billion bacteria.

43.



C_5F_{12}



C_6F_{14}

44. The pattern is that the y-coordinate is half the opposite of the x-coordinate. So the y-coordinate is $\frac{1}{2} \cdot (-3) = -1\frac{1}{2}$.

45. The y-coordinate is $\frac{1}{2}$ more than the opposite of the x-coordinate. So the y-coordinate is $\frac{1}{2} + (-3) = -2\frac{1}{2}$.

46. The y-coordinate is one less than half of the x-coordinate. The y-coordinate is $\frac{1}{2}(3) - 1 = \frac{3}{2} - 1 = \frac{1}{2}$.

47. E   **48.** D

49.

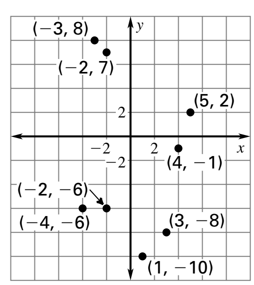
Number of points on circle	2	3	4	5	6
Maximum number of regions	2	4	8	16	

50. *Conjecture:* For n points on the circle, there are 2^{n-1} regions in the circle. (This conjecture is not true.)

51. There are only 31 sections with 6 points on the circle. So the conjecture is false.

1.1 Mixed Review (p. 9)

52.–59.



60. $3^2 = 3 \cdot 3 = 9$ **61.** $5^2 = 5 \cdot 5 = 25$

62. $(-4)^2 = (-4)(-4) = 16$ **63.** $-7^2 = -(7 \cdot 7) = -49$

64. $3^2 + 4^2 = 3 \cdot 3 + 4 \cdot 4 = 9 + 16 = 25$

65. $5^2 + 12^2 = 5 \cdot 5 + 12 \cdot 12 = 25 + 144 = 169$

66. $(-2)^2 + 2^2 = (-2)(-2) + 2 \cdot 2 = 4 + 4 = 8$

67. $(-10)^2 + (-5)^2 = (-10)(-10) + (-5)(-5)$

$= 100 + 25 = 125$

68. 625 **69.** 40,000.4 **70.** 19 **71.** +3

Lesson 1.2

Developing Concepts Activity (p. 12)

1. The intersection of $\overline{AB}$ and $\overline{CD}$ is point G.

   The intersection of $\overline{AB}$ and $\overline{EF}$ is point G.
2. The intersection of $\overline{CD}$ and $\overline{EF}$ is point G.
3. The intersection of planes M and N is $\overleftrightarrow{AB}$.
4. Yes; *Sample answer:* They lie in plane CEG.

1.2 Guided Practice (p. 13)

1. The symbol $\overline{PQ}$ means the line segment PQ or the endpoints, P and Q, and all the points on line PQ that are between P and Q.

   The symbol $\overrightarrow{PQ}$ means the ray with initial point P and all the points on line PQ that lie on the same side of P as Q. The symbol PQ means the line that passes through P and Q. The symbol $\overrightarrow{QP}$ means the ray with initial point Q and all the points on line PQ that lie on the same side of Q as P.
2. 

   A. This is true because points R and T are on the same side of S.

   B. This is true because the three points are collinear.

   C. This is false because the points R and T cannot both be an initial point of the ray unless they are the same point.

   D. This is true because point R is between point S and T.

   E. This is true because they both mean the points S and T and all the points on $\overleftrightarrow{ST}$ between S and T.

   F. This is false because the rays go in opposite directions even though they share the points on $\overline{ST}$.

3. False **4.** True **5.** False **6.** True **7.** True **8.** False

1.2 Practice and Applications (pp. 13–16)

9. False **10.** False **11.** True **12.** True **13.** True

14. True **15.** False **16.** True **17.** K **18.** N **19.** M

20. F **21.** L **22.** F **23.** J **24.** M

25. N, P and R; N, Q, and R; R, P, and Q

26. R, S, and T; S, T, and U; T, U, and V; V, T, and S; V, T, and R; U, T, and R

27. A, W, and X; A, W, and Z; A, X, and Y; A, Y, and Z; W, X, and Y; W, X, and Z; W, Y, and Z; X, Y, and Z

28. D **29.** G **30.** H **31.** H **32.** E **33.** E **34.** G

35. H **36.** P, Q, R, and S **37.** K, R, Q, and N

38. K, L, R, and S **39.** M, N, P, and Q

40. K, L, M, and N **41.** L, M, P, and S

42. L, M, R, and Q **43.** M, N, R, and S

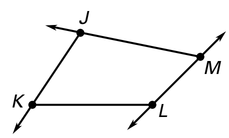
44. $\overline{AB}$ consists of the endpoints A and B and all the points on the line AB that lie between A and B.

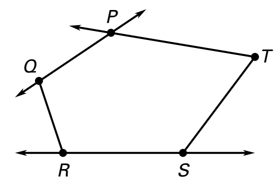
45. $\overrightarrow{CD}$ consists of the initial point C and all the points on the line CD that lie on the same side of C as point D.

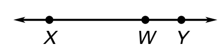
46. Two rays or segments are collinear if they are on the same line.

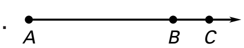
47. $\overrightarrow{CA}$ and $\overrightarrow{CB}$ are opposite rays if A, B, and C are collinear and C is between A and B.

48.–51. Sample figures are given.

48. 

49. 

50. 

51. 

52. The railroad tracks illustrate the intersection of two lines.

53. The dart and dartboard illustrate the intersection of a line and a plane.

54. The two mirrors illustrate the intersection of two planes.

55. $\overleftrightarrow{AB}$ and $\overleftrightarrow{BC}$ intersect at B.

56. $\overleftrightarrow{AD}$ and $\overleftrightarrow{AE}$ intersect at A.

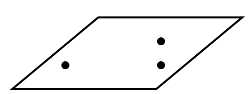
57. $\overleftrightarrow{HG}$ and $\overleftrightarrow{DH}$ intersect at H.

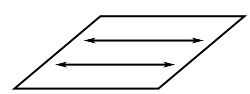
58. Plane ABC and plane DCG intersect at line DC.

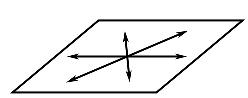
59. Plane GHD and plane DHE intersect at line DH.

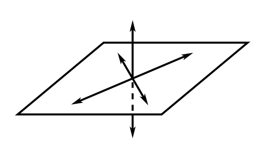
60. Plane EAD and plane BCD intersect at line AD.

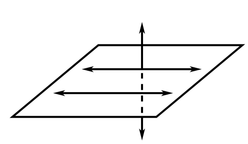
61.–67. Sample figures are given.

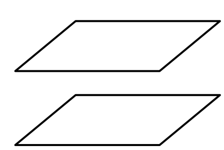
61. 

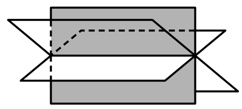
62. 

63. 

64. 

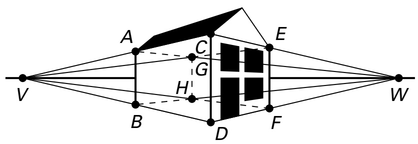
65. 

66. 

67. 

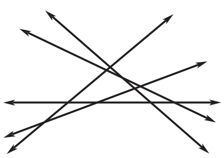
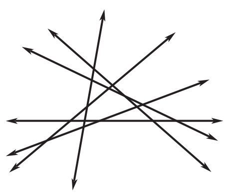
68. Lines CA and DB intersect at the vanishing point V.

69. Lines CE and DF intersect at the vanishing point W.

70.–72. 

The dashed lines are the hidden lines of the house.

73. C **74.** B **75.** D

76.  

5 lines have 10 intersections

6 lines have 15 intersections

Yes there is a pattern. Each time a line is added to a figure with n lines, n points of intersection are added.

1.2 Mixed Review (p. 16)

77. Each number is 6 times the previous number. So the next number is 216×6 or 1296.

78. The numbers alternate between 2 and -2. Since the last number is 2, the next number is -2.

79. Numbers after the first are found by adding an 8 immediately before the decimal point of the previous number and a 1 immediately after the decimal point. Since the last number had four eights and four ones, the next number is 88,888.11111.

80. Numbers after the first are found by adding consecutive multiples of 3. So the sixth number is 15 more than the fifth or $15 + 30$ or 45.

81. $0 - 2 = 0 + (-2) = -2$

82. $3 - 9 = 3 + (-9) = -6$

83. $9 - (-4) = 9 + 4 = 13$

84. $-5 - (-2) = -5 + 2 = -3$

85. $5 - 0 = 5$ **86.** $4 - 7 = 4 + (-7) = -3$

87. $3 - (-8) = 3 + 8 = 11$

88. $-7 - (-5) = -7 + 5 = -2$

89. $\sqrt{21 + 100} = \sqrt{121} = 11$

90. $\sqrt{40 + 60} = \sqrt{100} = 10$

91. $\sqrt{25 + 144} = \sqrt{169} = 13$ **92.** $\sqrt{9 + 16} = \sqrt{25} = 5$

93. $\sqrt{5^2 + 7^2} = \sqrt{25 + 49} = \sqrt{74} \approx 8.60$

94. $\sqrt{3^2 + (-2)^2} = \sqrt{9 + 4} = \sqrt{13} \approx 3.61$

95. $\sqrt{(-3)^2 + 3^2} = \sqrt{9 + 9} = \sqrt{18} \approx 4.24$

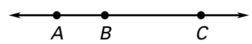
96. $\sqrt{(-5)^2 + 10^2} = \sqrt{25 + 100} = \sqrt{125} \approx 11.18$

Lesson 1.3

1.3 Guided Practice (p. 21)

1. A postulate is a geometric rule that is accepted without proof.

2. *Sample Answer*:



$AB + BC = AC.$

3. $BD = BC + CD$

$AB + BD = AD$

Subtract AB from both sides, and we get $BD = AD - AB$.

4. $CD = \sqrt{(5 - 0)^2 + (2 - 0)^2}$

$= \sqrt{5^2 + 2^2}$

$= \sqrt{25 + 4}$

$= \sqrt{29}$

5. $GH = \sqrt{(8 - 3)^2 + (10 - 0)^2}$

$= \sqrt{5^2 + 10^2}$

$= \sqrt{25 + 100}$

$= \sqrt{125}$

$= \sqrt{25} \cdot \sqrt{5}$

$= 5\sqrt{5}$

6. $MN = \sqrt{(3 - 1)^2 + (5 - (-3))^2}$

$= \sqrt{2^2 + 8^2}$

$= \sqrt{4 + 64}$

$= \sqrt{68}$

$= \sqrt{4} \cdot \sqrt{17}$

$= 2\sqrt{17}$

7. $PQ = \sqrt{(-3 - (-8))^2 + (-6 - 0))^2}$

$= \sqrt{5^2 + (-6)^2}$

$= \sqrt{25 + 36}$

$= \sqrt{61}$

8. $ST = \sqrt{(1 - 7)^2(-5 - 3)^2}$

$= \sqrt{(-6)^2 + (-8)^2}$

$= \sqrt{36 - 64}$

$= \sqrt{100}$

$= 10$

9. $VW = \sqrt{(1 - (-2))^2 + (-2 - (-6))^2}$
$= \sqrt{3^2 + 4^2}$
$= \sqrt{9 + 16}$
$= \sqrt{25}$
$= 5$

10. $JK = \sqrt{(-1 - 3)^2 + (2 - (-5))^2}$
$= \sqrt{(-4)^2 + 7^2}$
$= \sqrt{16 + 49}$
$= \sqrt{65}$
$= \sqrt{(-5(-1))^2 + (-5 - 2)^2}$
$= \sqrt{(-4)^2 + (-7)^2}$
$= \sqrt{16 + 49}$
$= \sqrt{65}$

Yes, $\overline{JK} \cong \overline{KL}$ because they have the same length.

11. $JK = \sqrt{(4 - 0)^2 + (3 - (-8))^2}$
$= \sqrt{4^2 + 11^2}$
$= \sqrt{16 + 121}$
$= \sqrt{137}$

$KL = \sqrt{(-2 - 4)^2 + (-7 - 3)^2}$
$= \sqrt{(-6)^2 + (-10)^2}$
$= \sqrt{36 + 100}$
$= \sqrt{136}$
$= \sqrt{4} \cdot \sqrt{34}$
$= 2\sqrt{34}$

No, $\overline{JK}$ and $\overline{KL}$ are not congruent because they do not have the same length.

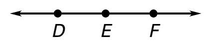
12. $JK = \sqrt{(7 - 10)^2 + (-3 - 2)^2}$
$= \sqrt{(-3)^2 + (-5)^2}$
$= \sqrt{9 + 25}$
$= \sqrt{34}$

$KL = \sqrt{(4 - 7)^2 + (-8 - (-3))^2}$
$= \sqrt{(-3)^2 + (-5)^2}$
$= \sqrt{9 + 25}$
$= \sqrt{34}$

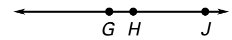
Yes, $\overline{JK} \cong \overline{KL}$ because they have the same length.

1.3 Practice and Applications (pp. 21–24)

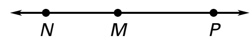
13. 30 mm **14.** 33 mm **15.** 24 mm **16.** 27 mm
17. 18 mm **18.** 34 mm

19. 

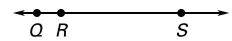
$DE + EF = DF$

20. 

$GH + HJ = GJ$

21. 

$NM + MP = NP$

22. 

$QR + RS = QS$

23. $QS = QR + RS$
$6 = QR + QR$
$6 = 2(QR)$
$3 = QR$

24. $QR = RS$
$3 = RS$

25. $PQ = QR$
$PQ = 3$

26. $PQ + QR + RS + ST = PT$
$3 + 3 + 3 + ST = 20$
$9 + ST = 20$
$ST = 11$

27. $RP = PQ + QR = 3 + 3 = 6$

28. $RT = RS + ST = 3 + 11 = 14$

29. $SP = PQ + QR + RS = 3 + 3 + 3 = 9$

30. $QT = QR + RS + ST = 3 + 3 + 11 = 17$

31. $LN = LM + MN$
$23 = 3x + 8 + 2x - 5$
$23 = 5x + 3$
$20 = 5x$
$4 = x$

$LN = 23$
$LM = 3x + 8$
$= 3 \cdot 4 + 8$
$= 12 + 8$
$= 20$

$MN = 2x - 5 = 2 \cdot 4 - 5 = 8 - 5 = 3$

32. $LN = LM + MN$
$143 = 7y + 9 + 3y + 4$
$143 = 10y + 13$
$130 = 10y$
$13 = y$
$LN = 143$

$LM = 7y + 9$
$= 7 \cdot 13 + 9$
$= 91 + 9$
$= 100$

$MN = 3y + 4 = 3 \cdot 13 + 4 = 39 + 4 = 43$

33. $LN = LM + MN$
$5z + 2 = \frac{1}{2}z + 2 + 3z + \frac{3}{2}$
$5z + 2 = \frac{7}{2}z + \frac{7}{2}$
$10z + 4 = 7z + 7$
$10z = 7z + 3$
$3z = 3$
$z = 1$

$LN = 5z + 2$
$= 5 \cdot 1 + 2$
$= 5 + 2$
$= 7$

$LM = \frac{1}{2}z + 2$
$= \frac{1}{2} \cdot 1 + 2$
$= \frac{1}{2} + 2$
$= 2\frac{1}{2}$

$MN = 3z + \frac{3}{2} = 3 \cdot 1 + \frac{3}{2} = 3 + 1\frac{1}{2} = 4\frac{1}{2}$

34. $AB = \sqrt{(6-(-4))^2 + (2-7)^2}$
$= \sqrt{10^2 + (-5)^2}$
$= \sqrt{100 + 25}$
$= \sqrt{125}$
$= \sqrt{25} \cdot \sqrt{5}$
$= 5\sqrt{5}$

$BC = \sqrt{(3-6)^2 + (-2-2)^2}$
$= \sqrt{(-3)^2 + (-4)^2}$
$= \sqrt{9 + 16}$
$= \sqrt{25}$
$= 5$

$AC = \sqrt{(3-(-4))^2 + (-2-7)^2}$
$= \sqrt{7^2 + (-9)^2}$
$= \sqrt{49 + 81}$
$= \sqrt{130}$

35. $DE = \sqrt{(6-(-3))^2 + (8-6)^2}$
$= \sqrt{9^2 + 2^2}$
$= \sqrt{81 + 4}$
$= \sqrt{85}$

$EF = \sqrt{(0-6)^2 + (2-8)^2}$
$= \sqrt{(-6)^2 + (-6)^2}$
$= \sqrt{36 + 36}$
$= \sqrt{72}$
$= \sqrt{36} \cdot \sqrt{2}$
$= 6\sqrt{2}$

$DF = \sqrt{(0-(-3))^2 + (2-6)^2}$
$= \sqrt{3^2 + (-4)^2}$
$= \sqrt{9 + 16}$
$= \sqrt{25}$
$= 5$

36. $GH = \sqrt{(5-(-2))^2 + (5-4)^2}$
$= \sqrt{7^2 + 1^2}$
$= \sqrt{49 + 1}$
$= \sqrt{50}$
$= \sqrt{25} \cdot \sqrt{2}$
$= 5\sqrt{2}$

$HJ = \sqrt{(4-5)^2 + (-1-5)^2}$
$= \sqrt{(-1)^2 + (-6)^2}$
$= \sqrt{1 + 36}$
$= \sqrt{37}$

$GJ = \sqrt{(4-(-2))^2 + (-1-4)^2}$
$= \sqrt{6^2 + (-5)^2}$
$= \sqrt{36 + 25}$
$= \sqrt{61}$

37. $AC = \sqrt{(0-(-3))^2 + (2-8)^2}$
$= \sqrt{3^2 + (-6)^2}$
$= \sqrt{9 + 36}$
$= \sqrt{45}$
$= \sqrt{9} \cdot \sqrt{5}$
$= 3\sqrt{5}$

$BC = \sqrt{(0-6)^2 + (2-5)^2}$
$= \sqrt{(-6)^2 + (-3)^2}$
$= \sqrt{36 + 9}$
$= \sqrt{45}$
$= \sqrt{9} \cdot \sqrt{5}$
$= 3\sqrt{5}$

$CD = \sqrt{(2-0)^2 + (-4-2)^2}$
$= \sqrt{2^2 + (-6)^2}$
$= \sqrt{4 + 36}$
$= \sqrt{40}$
$= \sqrt{4} \cdot \sqrt{10}$
$= 2\sqrt{10}$

$\overline{AC}$ and $\overline{BC}$ have the same length.

38. $FG = \sqrt{(5-5)^2 + (6-1)^2}$
$= \sqrt{0^2 + 5^2}$
$= \sqrt{25}$
$= 5$

$EG = \sqrt{(1-5)^2 + (4-1)^2}$
$= \sqrt{(-4)^2 + 3^2}$
$= \sqrt{16 + 9}$
$= \sqrt{25}$
$= 5$

$GH = \sqrt{(5-4)^2 + (1-(-4))^2}$
$= \sqrt{1^2 + 5^2}$
$= \sqrt{1 + 25}$
$= \sqrt{26}$

$\overline{FG}$ and $\overline{EG}$ have the same length.

39. $$\begin{aligned} LN &= \sqrt{(-2-(-8))^2+(-3-6)^2} \\ &= \sqrt{6^2+(-9)^2} \\ &= \sqrt{36+81} \\ &= \sqrt{117} \\ &= \sqrt{9}\cdot\sqrt{13} \\ &= 3\sqrt{13} \end{aligned}$$

$$\begin{aligned} MN &= \sqrt{(-2-1)^2+(-3-7)^2} \\ &= \sqrt{(-3)^2+(-10)^2} \\ &= \sqrt{9+100} \\ &= \sqrt{109} \end{aligned}$$

$$\begin{aligned} PN &= \sqrt{(-2-7)^2+(-3-(-6))^2} \\ &= \sqrt{(-9)^2+3^2} \\ &= \sqrt{81+9} \\ &= \sqrt{90} \\ &= \sqrt{9}\cdot\sqrt{10} \\ &= 3\sqrt{10} \end{aligned}$$

No two segments have the same length.

40. $$\begin{aligned} PQ &= \sqrt{(1-4)^2+(-6-(-4))^2} \\ &= \sqrt{(-3)^2+(-2)^2} \\ &= \sqrt{9+4} \\ &= \sqrt{13} \end{aligned}$$

$$\begin{aligned} QR &= \sqrt{(-1-1)^2+(-3-(-6))^2} \\ &= \sqrt{(-2)^2+3^2} \\ &= \sqrt{4+9} \\ &= \sqrt{13} \end{aligned}$$

$\overline{PQ} \cong \overline{QR}$ because they have the same length.

41. $$\begin{aligned} PQ &= \sqrt{(-8-(-1))^2+(5-(-6))^2} \\ &= \sqrt{(-7)^2+112} \\ &= \sqrt{49+121} \\ &= \sqrt{170} \end{aligned}$$

$$\begin{aligned} QR &= \sqrt{(3-(-8))^2+(-2-5)^2} \\ &= \sqrt{11^2+(-7)^2} \\ &= \sqrt{121+49} \\ &= \sqrt{170} \end{aligned}$$

$\overline{PQ} \cong \overline{QR}$ because they have the same length.

42. $$\begin{aligned} PQ &= \sqrt{(-5-5)^2+(-7-1)^2} \\ &= \sqrt{(-10)^2+(-8)^2} \\ &= \sqrt{100+64} \\ &= \sqrt{164} \\ &= \sqrt{4}\cdot\sqrt{41} \\ &= 2\sqrt{41} \end{aligned}$$

$$\begin{aligned} QR &= \sqrt{(-3-(-5))^2+(6-(-7))^2} \\ &= \sqrt{2^2+13^2} \\ &= \sqrt{4+169} \\ &= \sqrt{173} \end{aligned}$$

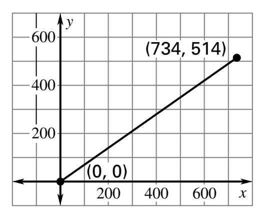
$\overline{PQ}$ and $\overline{QR}$ are not congruent because they do not have the same length.

43. $$\begin{aligned} PQ &= \sqrt{(10-(-2))^2+(-14-0)^2} \\ &= \sqrt{12^2+(-14)^2} \\ &= \sqrt{144+196} \\ &= \sqrt{340} \\ &= \sqrt{4}\cdot\sqrt{85} \\ &= 2\sqrt{85} \end{aligned}$$

$$\begin{aligned} QR &= \sqrt{(-4-10)^2+(-2-(-14))^2} \\ &= \sqrt{(-14)^2+12^2} \\ &= \sqrt{196+144} \\ &= \sqrt{340} \\ &= \sqrt{4}\cdot\sqrt{85} \\ &= 2\sqrt{85} \end{aligned}$$

$\overline{PQ} \cong \overline{QR}$ because they have the same length.

44.



45. $$\begin{aligned} \text{length of track} &= \sqrt{(734-0)^2+(514-0)^2} \\ &= \sqrt{734^2+514^2} \\ &= \sqrt{538{,}756+264{,}196} \\ &= \sqrt{802{,}952} \\ &\approx 896 \text{ feet} \end{aligned}$$

The length of the track is about 896 feet.

46. $$\begin{aligned} AE &= \sqrt{(26-26)^2+(1-56)^2} \\ &= \sqrt{0^2+(-55)^2} \\ &= \sqrt{0+3025} \\ &= \sqrt{3025} \\ &= 55 \end{aligned}$$

The distance from Alexandria to Eunice by flying directly is 55 miles.

47. $AK + KE = \sqrt{(0-26)^2 + (0-56)^2} + \sqrt{(26-0)^2 + (1-0)^2}$

$= \sqrt{(-26)^2 + (-56)^2} + \sqrt{26^2 + 1^2}$

$= \sqrt{676 + 3136} + \sqrt{676 + 1}$

$= \sqrt{3812} + \sqrt{677} \approx 62 + 26 \approx 88$ miles

$AB + BV + VE = \sqrt{(40-26)^2 + (32-56)^2} + \sqrt{(36-40)^2 + (12-32)^2} + \sqrt{(26-36)^2 + (1-12)^2}$

$= \sqrt{14^2 + (-24)^2} + \sqrt{(-4)^2 + (-20)^2} + \sqrt{(-10)^2 + (-11)^2}$

$= \sqrt{196 + 576} + \sqrt{16 + 400} + \sqrt{100 + 121}$

$= \sqrt{772} + \sqrt{416} + \sqrt{221}$

$\approx 28 + 20 + 15$

≈ 63 miles

The approximate shortest driving distance from Alexandria to Eunice is 63 miles by way of Bunkie and Ville Platte.

48. Buffalo and Dallas

$= \sqrt{(8436 - 5075)^2 + (4034 - 2326)^2}$

$= \sqrt{3361^2 + 1708^2}$

$= \sqrt{11{,}296{,}321 + 2{,}917{,}264}$

$= \sqrt{14{,}213{,}585}$

≈ 3770 units

49. Chicago and Seattle

$= \sqrt{(6336 - 5986)^2 + (8896 - 3426)^2}$

$= \sqrt{350^2 + 5470^2}$

$= \sqrt{122{,}500 + 29{,}920{,}900}$

$= \sqrt{30{,}043{,}400}$

≈ 5481 units

50. Miami and Omaha

$= \sqrt{(6687 - 8351)^2 + (4595 - 527)^2}$

$= \sqrt{(-1664)^2 + 4068^2}$

$= \sqrt{2{,}768{,}896 + 16{,}548{,}624}$

$= \sqrt{19{,}317{,}520}$

≈ 4395 units

51. Providence and San Diego

$= \sqrt{(9468 - 4550)^2 + (7629 - 1219)^2}$

$= \sqrt{(4918^2 + 6410^2}$

$= \sqrt{24{,}186{,}724 + 41{,}088{,}100}$

$= \sqrt{65{,}274{,}824}$

≈ 8079 units

52. Buffalo and Dallas: $3770 \cdot \sqrt{0.1} \approx 1192$ miles

Chicago and Seattle: $5481 \cdot \sqrt{0.1} \approx 1733$ miles

Miami and Omaha: $4395 \cdot \sqrt{0.1} \approx 1390$ miles

Providence and San Diego: $8079 \cdot \sqrt{0.1} \approx 2555$ miles

53. $AB = AD + DE + EB$

$= \sqrt{(50-0)^2 + (0-0)^2} + \sqrt{(50-50)^2 + (30-0)^2} + \sqrt{(50-15)^2 + (30-30)^2}$

$= \sqrt{50^2 + 0^2} + \sqrt{0^2 + 30^2} + \sqrt{35^2 + 0^2}$

$= \sqrt{2500 + 0} + \sqrt{0 + 900} + \sqrt{1225 + 0}$

$= 50 + 30 + 35$

$= 115$ yards

$BC = BF + FC$

$= \sqrt{(-50 - 15)^2 + (30 - 30)^2} + \sqrt{(-50 - (-50))^2 + (15 - 30)^2}$

$= \sqrt{(-65)^2 + 0^2} + \sqrt{0^2 + (-15)^2}$

$= \sqrt{4225} + \sqrt{225}$

$= 65 + 15$

$= 80$ yards

$CA = CG + GA$

$= \sqrt{(-50 - (-50))^2 + (0 - 15)^2} + \sqrt{(0 - (-50))^2 + (0 - 0)^2}$

$= \sqrt{0^2 + (-15)^2} + \sqrt{50^2 + 0^2}$

$= \sqrt{0 + 225} + \sqrt{2500 + 0}$

$= \sqrt{225} + \sqrt{2500}$

$= 15 + 50$

$= 65$ yards

54. $AB = \sqrt{(15 - 0)^2 + (30 - 0)^2}$

$= \sqrt{15^2 + 30^2}$

$= \sqrt{225 + 900}$

$= \sqrt{1125}$

≈ 34 yards

$BC = \sqrt{(-50 - 15)^2 + (15 - 30)^2}$

$= \sqrt{(-65)^2 + (-15)^2}$

$= \sqrt{4225 + 225}$

$= \sqrt{4450}$

≈ 67 yards

$CA = \sqrt{(0 - (-50)^2 + (0 - 15)^2}$

$= \sqrt{50^2 + (-15)^2}$

$= \sqrt{2500 + 225}$

$= \sqrt{2725}$

≈ 52 yards

55. C

56. $CM + MD = CD$

$2(MD) + MD = CD$

$3(MD) = CD$

$3(MD) = 18$

$MD = 6$

B

57. $PQ = \sqrt{(2 - 0)^2 + (-10 - 20)^2 + (-20 - (-32))^2}$

$= \sqrt{2^2 + (-30)^2 + 12^2}$

$= \sqrt{4 + 900 + 144}$

$= \sqrt{1048}$

$= 2\sqrt{262}$

58. $AB = \sqrt{(10 - (-8))^2 + (1 - 15)^2 + (-6 - (-4))^2}$

$= \sqrt{18^2 + (-14)^2 + (-2)^2}$

$= \sqrt{324 + 196 + 4}$

$= \sqrt{524}$

$= 2\sqrt{131}$

59. $FG = \sqrt{(-7 - 4)^2 + (-11 - (-42))^2 + (38 - 60)^2}$

$= \sqrt{(-11)^2 + 31^2 + (-22)^2}$

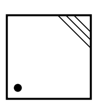
$= \sqrt{121 + 961 + 484}$

$= \sqrt{1566}$

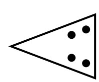
$= 3\sqrt{174}$

1.3 Mixed Review (p. 24)

60.



61.



62. True **63.** False **64.** False **65.** True **66.** True

67. True **68.** $\overrightarrow{NM}, \overrightarrow{PM}$ **69.** $\overrightarrow{NQ}, \overrightarrow{NM}$ **70.** $\overrightarrow{PM}$ and $\overrightarrow{PQ}$

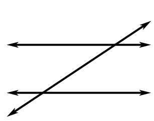
71. $\overrightarrow{NM}$ and $\overrightarrow{NQ}$

Quiz 1 (p. 25)

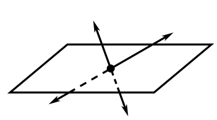
1. 8 **2.** 6 **3.–6.** *Sample answers are given.*

3.

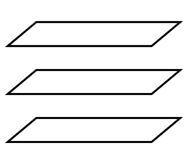
4.



5.



6.



7. $TB = \sqrt{(3 - 0)^2 + (4 - 0)^2}$

$= \sqrt{3^2 + 4^2}$

$= \sqrt{9 + 16}$

$= \sqrt{25}$

$= 5$ feet

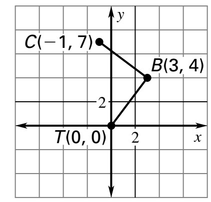
$BC = \sqrt{(-1 - 3)^2 + (7 - 4)^2}$

$= \sqrt{(-4)^2 + 3^2}$

$= \sqrt{16 + 9}$

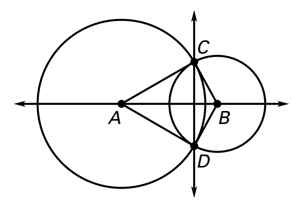
$= \sqrt{25}$

$= 5$ feet



Math and History (p. 25)

1.–2.



3. $\overline{AC} \cong \overline{AD}$ and $\overline{BC} \cong \overline{BD}$ because they are radii of the circles. It appears that $\overleftrightarrow{AB}$ and $\overleftrightarrow{CD}$ intersect at right angles.

Lesson 1.4

1.4 Guided Practice (p. 29)

1. C **2.** D **3.** B **4.** A

5. Yes, $\angle DEF \cong \angle FEG$ because their measures are equal.

6. Yes, $\angle DEG \cong \angle HEG$ because their measures are equal.

7. Yes, $\angle DEF$ and $\angle FEH$ are adjacent because they share a common vertex, E, share a common side, $\overrightarrow{EF}$, and do not share any interior points.

8. No, $\angle GED$ and $\angle DEF$ are not adjacent because they share the points in the interior of $\angle DEF$.

9. E, $\overrightarrow{ED}$, $\overrightarrow{EF}$; about 35° **10.** M, $\overrightarrow{ML}$, $\overrightarrow{MN}$; about 120°

11. J, $\overrightarrow{JH}$, $\overrightarrow{JK}$; about 75° **12.** S, $\overrightarrow{SR}$, $\overrightarrow{ST}$; about 90°

13. straight **14.** right **15.** obtuse **16.** acute

Practice and Applications (pp. 29–32)

17. X, $\overrightarrow{XF}$, $\overrightarrow{XT}$ **18.** N, $\overrightarrow{NK}$, $\overrightarrow{NE}$ **19.** Q, $\overrightarrow{QR}$, $\overrightarrow{QS}$

20. $\angle A, \angle EAU, \angle UAE$ **21.** $\angle C, \angle BCD, \angle DCB$

22. $\angle T, \angle PTS, \angle STP$

23. $m\angle ABC = 55°$ **24.** $m\angle XYZ = 25°$

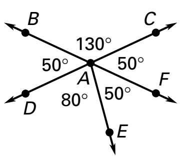
25. $m\angle DEF = 140°$

26. $m\angle ABC = m\angle ABD + m\angle DBC$
$= 45° + 60°$
$= 105°$

27. $m\angle DEF = m\angle DEG + m\angle GEF$
$= 60° + 120°$
$= 180°$

28. $m\angle PQR = m\angle PQS - m\angle RQS$
$= 160° - 20°$
$= 140°$

Figure for 29–34



29. $m\angle FAC = m\angle EAC - m\angle EAF$
$m\angle FAC = 100° - m\angle FAC \quad (m\angle EAF = m\angle FAC)$
$2m\angle FAC = 100°$
$m\angle FAC = 50°$

30. $m\angle BAD = m\angle FAC = 50°$

31. $m\angle FAB = m\angle BAC + m\angle FAC = 130° + 50° = 180°$

32. $m\angle DAE = m\angle FAB - m\angle BAD - m\angle EFA$
$= 180° - 50° - 50°$
$= 80°$
$(m\angle BAD = m\angle EAF = m\angle FAC)$

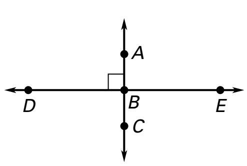
33. $m\angle FAD = m\angle EAF + m\angle DAE = 50° + 80° = 130°$

34. $m\angle BAE = m\angle BAD + m\angle DAE = 50° + 80° = 130°$

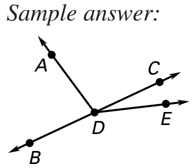
35. acute; about 40°. **36.** right; about 90°

37. obtuse; about 150°

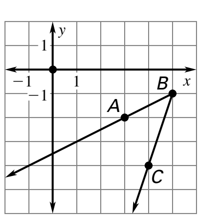
38.



39. *Sample answer:*

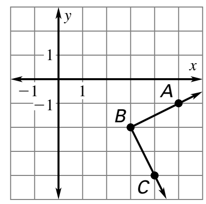


40.



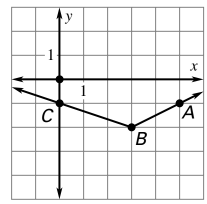
acute; answers may vary
Sample answer:
(2, −4) is in the interior of $\angle ABC$.
(2, 1) is in the exterior of $\angle ABC$.

41.



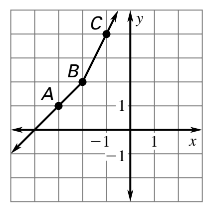
right; answers may vary.
Sample answer:
(8, −3) is in the interior of $\angle ABC$.
(1, −5) is in the exterior of $\angle ABC$.

42.



obtuse; answers may vary.
Sample answer:
(3, 0) is in the interior of $\angle ABC$.
(0, −3) is in the exterior of $\angle ABC$.

43.



obtuse; answers may vary.
Sample answer:
(−3, 3) is in the interior of $\angle ABC$.
(1, 1) is in the exterior of $\angle ABC$.

44. about 68° **45.** about 148° **46.** about 38°

47. about 140° **48.** about 22° **49.** about 132°

50. 14 points **51.** 12 points **52.** 18 points **53.** 40 points

54. **a.** $\angle AOB$, $\angle BOC$, $\angle COD$, $\angle DOE$, $\angle EOF$, $\angle FOG$, $\angle GOH$, and $\angle HOA$

b. $\angle AOC$, $\angle BOD$, $\angle COE$, $\angle DOF$, $\angle EOG$, $\angle FOH$, $\angle GOA$, and $\angle HOB$

c. $\angle AOD$, $\angle BOE$, $\angle COF$, $\angle DOG$, $\angle EOH$, $\angle FOA$, $\angle GOB$, and $\angle HOC$

d. Answers may vary.
Sample answer: $\angle AOB$ and $\angle BOE$

55. $m\angle 1 = 18(10) - 15(10) = 180° - 150° = 30°$

56. $m\angle 2 = 18(10) - 3(10) = 180° - 30° = 150°$

57. $m\angle 3 = 15(10) - 3(10) = 150° - 30° = 120°$

58. $m\angle 4 = (3 + 18)(10) - 15(10)$
$= 21(10) - 150$
$= 210° - 150°$
$= 60°$

59. The difference between the numbers on each end of a runway is 18. So the runway opposite that of runway 3 would be $3 + 18 = 21$.

60. The difference between the numbers at the opposite ends of a runway is always 18 because they form a straight line and the measure of the angle formed is 180°. Runway numbers are determined by angle measurements divided by 10. Since the opposite runways differ by 180°, their numbers differ by $180 \div 10 = 18$.

1.4 Mixed Review (p. 32)

61. $\frac{x + 3}{2} = 3$

$x + 3 = 6$

$x = 3$

62. $\frac{5 + x}{2} = 5$

$5 + x = 10$

$x = 5$

63. $\frac{x + 4}{2} = -4$

$x + 4 = -8$

$x = -12$

64. $\frac{-8 + x}{2} = 12$

$-8 + x = 24$

$x = 32$

65. $\frac{x + 7}{2} = -10$

$x + 7 = -20$

$x = -27$

66. $\frac{-9 + x}{2} = -7$

$-9 + x = -14$

$x = -5$

67. $\frac{x + (-1)}{2} = 7$

$x - 1 = 14$

$x = 15$

68. $\frac{8 + x}{2} = -1$

$8 + x = -2$

$x = -10$

69. $\frac{x + (-3)}{2} = -4$

$x - 3 = -8$

$x = -5$

70. true **71.** false **72.** false **73.** false

74. $AB = \sqrt{(-2 - 3)^2 + (-2 - 10)^2}$

$= \sqrt{(-5)^2 + (-12)^2}$

$= \sqrt{25 + 144}$

$= \sqrt{169}$

$= 13$

75. $CD = \sqrt{(-8 - 0)^2 + (3 - 8)^2}$

$= \sqrt{(-8)^2 + (-5)^2}$

$= \sqrt{64 + 25}$

$= \sqrt{89}$

76. $EF = \sqrt{(4 - (-3))^2 + (4 - 11)^2}$

$= \sqrt{7^2 + (-7)^2}$

$= \sqrt{49 + 49}$

$= \sqrt{98}$

$= \sqrt{49} \cdot \sqrt{2}$

$= 7\sqrt{2}$

77. $GH = \sqrt{(0 - 10)^2 + (9 - (-2))^2}$

$= \sqrt{(-10)^2 + 11^2}$

$= \sqrt{100 + 121}$

$= \sqrt{221}$

78. $JK = \sqrt{(7 - 5)^2 + (5 - 7)^2}$

$= \sqrt{2^2 + (-2)^2}$

$= \sqrt{4 + 4}$

$= \sqrt{8}$

$= \sqrt{4} \cdot \sqrt{2}$

$= 2\sqrt{2}$

79. $LM = \sqrt{(-3 - 0)^2 + (0 - (-3))^2}$

$= \sqrt{(-3)^2 + 3^2}$

$= \sqrt{9 + 9}$

$= \sqrt{18}$

$= \sqrt{9} \cdot \sqrt{2}$

$= 3\sqrt{2}$

Lesson 1.5

Drawing Conclusions (p. 33)

1. The segments have the same length.

2. The angles have the same measure.

1.5 Guided Practice (p. 38)

1. An angle bisector is a ray.

2. Congruent segments in a diagram are indicated by matching congruence marks.

Congruent angles in a diagram are indicated by matching congruence arcs.

3. If $A(0, 0)$ and $B(x, y)$ are points in a coordinate plane, then the midpoint of $\overline{AB}$ has coordinates $\left(\frac{x}{2}, \frac{y}{2}\right)$.

4. $M = \left(\frac{5 + (-3)}{2}, \frac{4 + 2}{2}\right) = \left(\frac{2}{2}, \frac{6}{2}\right) = (1, 3)$

5. $M = \left(\frac{-1 + 11}{2}, \frac{-9 + (-5)}{2}\right) = \left(\frac{10}{2}, \frac{-14}{2}\right) = (5, -7)$

6. $M = \left(\frac{6 + 1}{2}, \frac{-4 + 8}{2}\right) = \left(\frac{7}{2}, \frac{4}{2}\right) = \left(\frac{7}{2}, 2\right)$

7. $\frac{x + 3}{2} = 3$ $\frac{y + 0}{2} = 4$

$x + 3 = 6$ $y = 8$

$x = 3$ $(3, 8)$

8. $\frac{x + 5}{2} = 7$ $\frac{y + 2}{2} = 6$

$x + 5 = 14$ $y + 2 = 12$

$x = 9$ $y = 10$

$(9, 10)$

9. $\dfrac{x + (-4)}{2} = -3 \qquad \dfrac{y + 2}{2} = -2$

$x - 4 = -6 \qquad y + 2 = -4$

$x = -2 \qquad y = -6$

$(-2, -6)$

10. $m\angle JKM = m\angle LKM = \dfrac{m\angle JKL}{2} = \dfrac{90^\circ}{2} = 45^\circ$

11. $m\angle SQR = m\angle PQS = 40^\circ$

$m\angle PQR = 2m\angle SQR$

$= 2(40^\circ)$

$= 80^\circ$

12. $m\angle PQS = m\angle SQR = \dfrac{m\angle PQR}{2} = \dfrac{64^\circ}{2} = 32^\circ$

13. $m\angle PQS = m\angle SQR = 52^\circ$

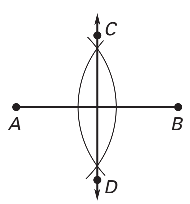
$m\angle PQR = 2 \cdot m\angle SQR$

$= 2 \cdot 52^\circ$

$= 104^\circ$

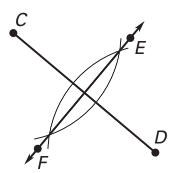
1.5 Practice and Applications (pp. 38–41)

14.



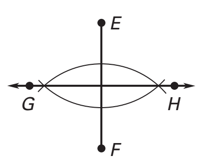
$\overleftrightarrow{CD}$ is the segment bisector of $\overline{AB}$.

15.



$\overleftrightarrow{EF}$ is the segment bisector of $\overline{CD}$.

16.



$\overleftrightarrow{GH}$ is the segment bisector of $\overline{EF}$.

17. $M = \left(\dfrac{0 + (-8)}{2}, \dfrac{0 + 6}{2}\right) = \left(\dfrac{-8}{2}, \dfrac{6}{2}\right) = (-4, 3)$

18. $M = \left(\dfrac{-1 + 3}{2}, \dfrac{7 + (-3)}{2}\right) = \left(\dfrac{2}{2}, \dfrac{4}{2}\right) = (1, 2)$

19. $M = \left(\dfrac{10 + (-2)}{2}, \dfrac{8 + 5}{2}\right) = \left(\dfrac{8}{2}, \dfrac{13}{2}\right) = \left(4, \dfrac{13}{2}\right)$

20. $M = \left(\dfrac{-12 + 2}{2}, \dfrac{-9 + 10}{2}\right) = \left(\dfrac{-10}{2}, \dfrac{1}{2}\right) = \left(-5, \dfrac{1}{2}\right)$

21. $M = \left(\dfrac{0 + (-6)}{2}, \dfrac{-8 + 14}{2}\right) = \left(\dfrac{-6}{2}, \dfrac{6}{2}\right) = (-3, 3)$

22. $M = \left(\dfrac{4 + 4}{2}, \dfrac{4 + (-18)}{2}\right) = \left(\dfrac{8}{2}, \dfrac{-14}{2}\right) = (4, -7)$

23. $M = \left(\dfrac{-1.5 + 0.25}{2}, \dfrac{8 + (-1)}{2}\right) = \left(\dfrac{-1.25}{2}, \dfrac{7}{2}\right)$

$= (-0.625, 3.5)$

24. $M = \left(\dfrac{-5.5 + (-0.5)}{2}, \dfrac{-6.1 + 9.1}{2}\right) = \left(\dfrac{-6}{2}, \dfrac{3}{2}\right)$

$= \left(-3, \dfrac{3}{2}\right)$

25. $\dfrac{x + 2}{2} = -1$

$x + 2 = -2$

$x = -4$

$\dfrac{y + 6}{2} = 1$

$y + 6 = 2$

$y = -4$

$(-4, -4)$

26. $\dfrac{x + (-8)}{2} = 0$

$x - 8 = 0$

$x = 8$

$\dfrac{y + (-1)}{2} = 3$

$y - 1 = 6$

$y = 7$

$(8, 7)$

27. $\dfrac{x + 3}{2} = 2$

$x + 3 = 4$

$x = 1$

$\dfrac{y + (-12)}{2} = -1$

$y - 12 = -2$

$y = 10$

$(1, 10)$

28. $\dfrac{x + (-5)}{2} = -8$

$x - 5 = -16$

$x = -11$

$\dfrac{y + 9}{2} = -2$

$y + 9 = -4$

$y = -13$

$(-11, -13)$

29. $\dfrac{x + 6}{2} = 10$

$x + 6 = 20$

$x = 14$

$\dfrac{y + 7}{2} = -7$

$y + 7 = -14$

$y = -21$

$(14, -21)$

30. $\dfrac{x + (-3.5)}{2} = 1.5$

$x - 3.5 = 3$

$x = 6.5$

$\dfrac{y + (-6)}{2} = 4.5$

$y - 6 = 9$

$y = 15$

$(6.5, 15)$

31. $\overline{AC} \cong \overline{BC}$,

$\angle A \cong \angle B$

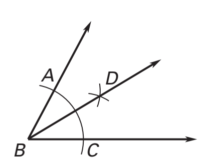
32. $\overline{DG} \cong \overline{FG}$

$\angle DGE \cong \angle EGF$

33. $\overline{WX} \cong \overline{XY}$

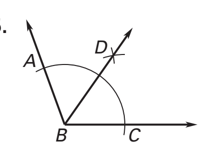
$\angle WXZ \cong \angle YXZ$

34.

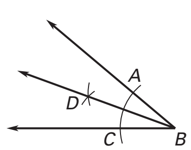


$\overrightarrow{BD}$ is the angle bisector of $\angle ABC$.

35.



$\overrightarrow{BD}$ is the angle bisector of $\angle ABC$.

36. 

$\overrightarrow{BD}$ is the angle bisector of $\angle ABC$.

37. $m\angle PQS = m\angle SQR = 22°$

$$\begin{aligned} m\angle PQR &= 2 \cdot m\angle SQR \\ &= 2 \cdot 22° \\ &= 44° \end{aligned}$$

38. $m\angle PQS = m\angle SQR = \frac{m\angle PQR}{2} = \frac{91°}{2} = 45.5°$

39. $m\angle SQR = m\angle PQS = 80°$

$$\begin{aligned} m\angle PQR &= 2 \cdot m\angle PQS \\ &= 2 \cdot 80° \\ &= 160° \end{aligned}$$

40. $m\angle PQS = m\angle SQR = \frac{m\angle PQR}{2} = \frac{75°}{2} = 37.5°$

41. $m\angle SQR = m\angle PQS = 45°$

$$\begin{aligned} m\angle PQR &= 2 \cdot m\angle PQS \\ &= 2 \cdot 45° \\ &= 90° \end{aligned}$$

42. $m\angle PQS = m\angle SQR = \frac{m\angle PQR}{2} = \frac{124°}{2} = 62°$

43. No; yes; the angle bisector of an angle of a triangle passes through the midpoint of the opposite side if the two sides of the triangle contained in the angle are congruent.

44.
$$\begin{aligned} m\angle ABD &= m\angle DBC \\ (x + 15)° &= (4x - 45)° \\ x + 60 &= 4x \\ 60 &= 3x \\ 20 &= x \end{aligned}$$

45.
$$\begin{aligned} m\angle ABD &= m\angle DBC \\ (2x + 35)° &= (5x - 22)° \\ 2x + 57 &= 5x \\ 57 &= 3x \\ 19 &= x \end{aligned}$$

46.
$$\begin{aligned} m\angle ABD &= m\angle DBC \\ (10x - 51)° &= (6x - 11)° \\ 10x - 40 &= 6x \\ -40 &= -4x \\ 10 &= x \end{aligned}$$

47.
$$\begin{aligned} m\angle ABD &= m\angle DBC \\ (2x + 7)° &= (4x - 9)° \\ 2x + 16 &= 4x \\ 16 &= 2x \\ 8 &= x \end{aligned}$$

48.
$$\begin{aligned} m\angle ABD &= m\angle DBC \\ (15x + 18)° &= (23x - 14)° \\ 15x + 32 &= 23x \\ 32 &= 8x \\ 4 &= x \end{aligned}$$

49.
$$\begin{aligned} m\angle ABD &= m\angle DBC \\ \left(\frac{1}{2}x + 20°\right) &= (3x - 85)° \\ x + 40 &= 6x - 170 \\ x + 210 &= 6x \\ 210 &= 5x \\ 42 &= x \end{aligned}$$

50.
$$\begin{aligned} T &= \frac{42 + 60}{2} \\ &= \frac{102}{2} \\ &= 51 \end{aligned}$$

51. $T = \frac{45 + 63}{2} = \frac{108}{2} = 54$

52. $m\angle 1 = m\angle 2 = \frac{106°}{2} = 53°$

$m\angle 3 = m\angle 4 = 90° - 53° = 37°$

53. $m\angle 1 = m\angle 2 = \frac{130°}{2} = 65°$

$m\angle 3 = m\angle 4 = 90° - 65° = 25°$

54. $m\angle 4 = m\angle 3 = 60°$

$m\angle 1 = m\angle 2 = 90° - 60° = 30°$

55. *Sample Answer:*

$\overline{AB} \cong \overline{AL}$, $\overline{AC} \cong \overline{AK}$, $\overline{AN} \cong \overline{AM}$, $\overline{DN} \cong \overline{MJ}$, $\overline{AE} \cong \overline{AI}$, $\overline{NE} \cong \overline{MI}$, $\overline{NF} \cong \overline{MH}$, $\overline{FG} \cong \overline{GH}$, $\overline{DE} \cong \overline{JI}$, $\overline{CD} \cong \overline{KJ}$, $\overline{BC} \cong \overline{LK}$, $\overline{BD} \cong \overline{LJ}$, $\overline{BE} \cong \overline{LI}$, $\angle BAC$, $\angle CAN$, $\angle NAG$, $\angle GAM$, $\angle MAK$, and $\angle KAL$; $\angle DNE$, $\angle ENF$, $\angle HMI$, and $\angle JMI$.

56. *Sample answer:* To divide a line segment into 4 congruent segments using a compass and a straightedge, follow these steps.

1. Place a compass point at *A*. Use a compass setting greater than half the length of $\overline{AB}$. Draw an arc.
2. Keep the same compass setting. Place the compass point at *B*. Draw an arc. It should intersect the other arc in two places.
3. Use a straightedge to draw a segment through the points of intersection. This segment bisects $\overline{AB}$ at *M*, the midpoint of $\overline{AB}$.
4. Place the compass point at *A*. Use a compass setting greater than half the length of $\overline{AM}$. Draw an arc.
5. Keep the same compass setting as in Step 4. Place the compass point at *M*. Draw an arc. It should intersect the other arc in two places.
6. Use a straightedge to draw a segment through the points of intersection from Step 5. This segment bisects $\overline{AM}$ at *N*, the midpoint of $\overline{AM}$.
7. Place a compass point at *M*. Use a compass setting greater than half the length of $\overline{MB}$. Draw an arc.
8. Keep the same compass setting from Step 7. Place the compass point at *B*. Draw an arc. It should intersect the other arc in two places.

—CONTINUED—

56. —CONTINUED—

9. Use a straightedge to draw a segment through the points of intersection from Step 8. This segment bisects $\overline{MB}$ at P, the midpoint of $\overline{MB}$.
10. This should result with $\overline{AN} \cong \overline{NM} \cong \overline{MP} \cong \overline{PB}$.

To divide a line segment into 4 congruent segments using the Midpoint Formula, start with $A(x_1, y_1)$ and $B(x_2, y_2)$ as the endpoints of the segment. The midpoint, M, of $\overline{AB}$ would have coordinates

$$\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right).$$

Now we must find the midpoint N, of $\overline{AM}$.

The coordinates of

$$N = \left(\frac{x_1 + \frac{x_1 + x_2}{2}}{2}, \frac{y_1 + \frac{y_1 + y_2}{2}}{2}\right)$$
$$= \left(\frac{\frac{2x_1 + x_1 + x_2}{2}}{2}, \frac{\frac{2y_1 + y_1 + y_2}{2}}{2}\right)$$
$$= \left(\frac{3x_1 + x_2}{4}, \frac{3y_1 + y_2}{4}\right).$$

Lastly, the coordinates of

$$P = \left(\frac{\frac{x_1 + x_2}{2} + x_2}{2}, \frac{\frac{y_1 + y_2}{2} + y_2}{2}\right)$$
$$= \left(\frac{\frac{x_1 + x_2 + 2x_2}{2}}{2}, \frac{\frac{y_1 + y_2 + 2y_2}{2}}{2}\right)$$
$$= \left(\frac{x_1 + 3x_2}{4}, \frac{y_1 + 3y_2}{4}\right).$$

57. (17) $M = \left[0 + \frac{1}{2}((-8 - 0), 0 + \frac{1}{2}(6 - 0)\right]$
$= \left[0 + \frac{1}{2}(-8), 0 + \frac{1}{2}(6)\right]$
$= \left[0 + (-4), 0 + 3\right]$
$= (-4, 3)$

(18) $M = \left[-1 + \frac{1}{2}(3 - (-1)), 7 + \frac{1}{2}((-3) - 7\right]$
$= \left[-1 + \frac{1}{2}(4), 7 + \frac{1}{2}(-10)\right]$
$= \left[-1 + 2, 7 + (-5)\right]$
$= (1, 2)$

(19) $M = \left[10 + \frac{1}{2}((-2) - 10), 8 + \frac{1}{2}(5 - 8)\right]$
$= \left[10 + \frac{1}{2}(-12), 8 + \frac{1}{2}(-3)\right]$
$= \left[10 + (-6), 8 + \frac{(-3)}{2}\right]$
$= \left[4, \frac{16}{2} + \frac{(-3)}{2}\right]$
$= \left(4, \frac{13}{2}\right)$

(20) $M = \left[-12 + \frac{1}{2}(2 - (-12)), -9 + \frac{1}{2}(10 - (-9))\right]$
$= \left[-12 + \frac{1}{2}(14), -9 + \frac{1}{2}(19)\right]$
$= \left[-12 + 7, -9 + \frac{19}{2}\right]$
$= \left[-5, -\frac{18}{2} + \frac{19}{2}\right]$
$= \left(-5, \frac{1}{2}\right)$

(21) $M = \left[0 + \frac{1}{2}(-6 - 0), -8 + \frac{1}{2}(14 - (-8))\right]$
$= \left[0 + \frac{1}{2}(-6), -8 + \frac{1}{2}(22)\right]$
$= \left[0 + (-3), -8 + 11\right]$
$= (-3, 3)$

(22) $M = \left[4 + \frac{1}{2}(4 - 4), 4 + \frac{1}{2}(-18 - 4)\right]$
$= \left[4 + \frac{1}{2}(0), 4 + \frac{1}{2}(-22)\right]$
$= [4 + 0, 4 + (-11)]$
$= (4, -7)$

(23) $M = \left[-1.5 + \frac{1}{2}(0.25 - (-1.5)), 8 + \frac{1}{2}(-1 - 8)\right]$
$= \left[-1.5 + \frac{1}{2}(1.75), 8 + \frac{1}{2}(-9)\right]$
$= \left[-1.5 + 0.875, 8 + (-4.5)\right]$
$= (-0.625, 3.5)$

(24) $M = \left[-5.5 + \frac{1}{2}(-0.5 - (-5.5)), -6.1 + \frac{1}{2}(9.1 - (-6.1))\right]$
$= \left[-5.5 + \frac{1}{2}(5), -6.1 + \frac{1}{2}(15.2)\right]$
$= (-5.5 + 2.5, -6.1 + 7.6)$
$= (-3, 1.5)$

Yes, the answers came out the same.

$$x_1 + \frac{1}{2}(x_2 - x_1) = x_1 + \frac{x_2 - x_1}{2}$$
$$= \frac{2x_1}{2} + \frac{x_2 - x_1}{2}$$
$$= \frac{2x_1 + x_2 - x_1}{2}$$
$$= \frac{x_1 + x_2}{2}$$

(This is the x-coordinate of the midpoint when the Midpoint formula is used.)

—CONTINUED—

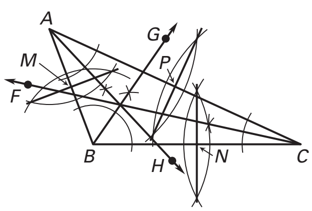
57. —CONTINUED—

$$y_1 + \frac{1}{2}(y_2 - y_1) = y_1 + \frac{y_2 - y_1}{2}$$
$$= \frac{2y_1}{2} + \frac{y_2 - y_1}{2}$$
$$= \frac{2y_1 + y_2 - y_1}{2}$$
$$= \frac{y_1 + y_2}{2}$$

(This is the y-coordinate of the midpoint when the Midpoint Formula is used.)

58. *Sample answer:*

a.



M is the midpoint of $\overline{AB}$.

N is the midpoint of $\overline{BC}$.

P is the midpoint of $\overline{AC}$.

$\overrightarrow{CF}$ bisects $\angle ACB$.

$\overrightarrow{BG}$ bisects $\angle ABC$.

$\overrightarrow{AH}$ bisects $\angle BAC$.

b. None of the angle bisectors pass through the midpoints of the opposite sides.

c. None of the angle bisectors passed through the midpoints of the opposite sides. This is due to the fact that all three sides had different length. If an equilateral triangle had been used, each angle bisector would have passed through the midpoint of its opposite side. If two of the sides had been congruent, the angle bisector of the angle which was made up of the congruent sides would have passed through the midpoint of the opposite side.

59.

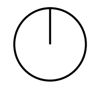
$$100 - 50 = 50$$
$$50 + 25 = 75$$
$$75 - 12.5 = 62.5$$
$$62.5 + 6.25 = 68.75$$
$$68.75 - 3.125 = 65.625$$
$$65.625 + 1.5625 = 67.1875$$
$$67.1875 - 0.78125 = 66.40625$$
$$66.40625 + 0.390625 = 66.796875$$
$$66.796875 - 0.1953125 = 66.6015625$$
$$66.6015625 + 0.09765625 = 66.69921875$$
$$66.69921875 - 0.48828125 = 66.65039063$$

It seems to be approaching $66.\overline{6}$ yards from 0.

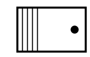
60. $100 + 50 + 25 + 12.5 + 6.25 + 3.125 + 1.5625 + 0.78125$ is approximately 200 yards.

1.5 Mixed Review (p. 42)

61.



62.



63. $AB = \sqrt{(-5 - 3)^2 + (-1 - 12)^2}$
$= \sqrt{(-8)^2 + (-13)^2}$
$= \sqrt{64 + 169}$
$= \sqrt{233}$

64. $CD = \sqrt{(-2 - (-6))^2 + (-7 - 9)^2}$
$= \sqrt{4^2 + (-16)^2}$
$= \sqrt{16 + 256}$
$= \sqrt{272}$
$= \sqrt{16} \cdot \sqrt{17}$
$= 4\sqrt{17}$

65. $EF = \sqrt{(2 - 8)^2 + (14 - (-8))^2}$
$= \sqrt{(-6)^2 + 22^2}$
$= \sqrt{36 + 484}$
$= \sqrt{520}$
$= \sqrt{4} \cdot \sqrt{130}$
$= 2\sqrt{130}$

66. $GH = \sqrt{(0 - 3)^2 + (-2 - (-8))^2}$
$= \sqrt{(-3)^2 + 6^2}$
$= \sqrt{9 + 36}$
$= \sqrt{45}$
$= \sqrt{9} \cdot \sqrt{5}$
$= 3\sqrt{5}$

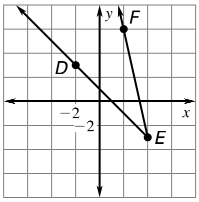
67. $JK = \sqrt{(5 - (-4))^2 + (-1 - (-5))^2}$
$= \sqrt{9^2 + 4^2}$
$= \sqrt{81 + 16}$
$= \sqrt{97}$

68. $LM = \sqrt{(-4 - (-10))^2 + (9 - 1)^2}$
$= \sqrt{6^2 + 8^2}$
$= \sqrt{36 + 64}$
$= \sqrt{100}$
$= 10$

69. $20°$ **70.** $130°$ **71.** $115°$ **72.** $35°$

Quiz 2 (p. 42)

1. If Q is in the interior of $\angle PSR$, then $m\angle PSQ + m\angle QSR = m\angle PSR$.

2. 

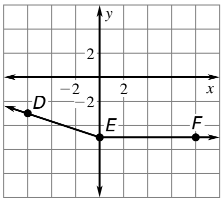
acute;

Answers may vary.

Sample answer:

(0, 4) is in the interior of $\angle DEF$.

(0, −3) is in the exterior of $\angle DEF$.

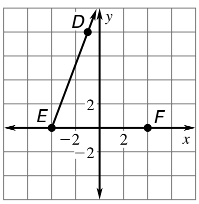
3. 

obtuse;

Answers may vary.

Sample answer: (0, 0) is in the interior of $\angle DEF$.

(0, −7) is in the exterior of $\angle DEF$.

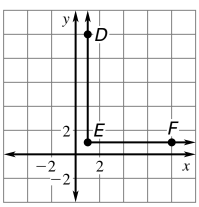
4. 

acute;

Answers may vary.

Sample answer: (0, 3) is in the interior of $\angle DEF$.

(0, −2) is in the exterior of $\angle DEF$.

5. 

right;

Answers may vary.

Sample answer: (4, 4) is in the interior of $\angle DEF$.

(0, −2) is in the exterior of $\angle DEF$.

6. $m\angle MKL = m\angle JKM = 21^\circ$

$m\angle JKL = 2 \cdot m\angle JKM$

$= 2 \cdot 21^\circ$

$= 42^\circ$

Lesson 1.6

Technology Activity (p. 43)

1. Nonadjacent angles have the same measure.

2. Answers may vary.

Sample answer:

$m\angle AEC + m\angle AED = 41^\circ + 139^\circ = 180^\circ$

3. Answers may vary.

Sample answer:

$m\angle AEC + m\angle AED = 71^\circ + 109^\circ = 180^\circ$

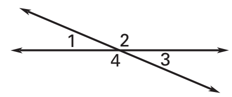
4. The sum of the measures of adjacent angles formed by intersecting lines is 180°.

1.6 Guided Practice (p. 47)

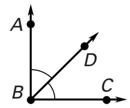
1. Two angles are complementary angles if the sum of their measures is 90°.

Two angles are supplementary angles if the sum of their measures is 180°.

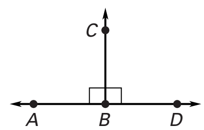
2. *Sample answer:*



$\angle 1$ and $\angle 3$ are acute vertical angles because their measures are between 0° and 90°, $\angle 2$ and $\angle 4$ are obtuse vertical angles because their measures are between 90° and 180°.

3. 

$\angle ABD$ and $\angle DBC$ are adjacent congruent complementary angles.



$\angle ABC$ and $\angle CBD$ are adjacent congruent supplementary angles.

4. $m\angle 1 + 60^\circ = 180^\circ$

$m\angle 1 = 120^\circ$

5. $m\angle 1 + 160^\circ = 180^\circ$

$m\angle 1 = 20^\circ$

6. $m\angle 1 + 35^\circ = 90^\circ$

$m\angle 1 = 55^\circ$

7. $x + m\angle 1 = 90^\circ$

$x + 50^\circ = 90^\circ$

$x = 40^\circ$

Practice and Applications • (pages 47–50)

8. No **9.** Yes **10.** No **11.** Yes **12.** No **13.** No

14. never **15.** always **16.** sometimes **17.** always

18. always **19.** never

20. $m\angle 7 + m\angle 6 = 180^\circ$

$m\angle 7 + 72^\circ = 180^\circ$

$m\angle 7 = 108^\circ$

21. $m\angle 6 = m\angle 8$

$m\angle 6 = 80^\circ$

22. $m\angle 8 + m\angle 9 = 180^\circ$

$m\angle 8 + 110^\circ = 180^\circ$

$m\angle 8 = 70^\circ$

23. $m\angle 7 = m\angle 9 = 123^\circ$

24. $m\angle 8 + m\angle 7 = 180^\circ$

$m\angle 8 + 142^\circ = 180^\circ$

$m\angle 8 = 38^\circ$

25. $m\angle 9 + m\angle 6 = 180^\circ$

$m\angle 9 + 13^\circ = 180^\circ$

$m\angle 9 = 167^\circ$

26. $m\angle 6 + m\angle 9 = 180^\circ$

$m\angle 6 + 170^\circ = 180^\circ$

$m\angle 6 = 10^\circ$

27. $m\angle 7 + m\angle 8 = 180^\circ$

$m\angle 7 + 26^\circ = 180^\circ$

$m\angle 7 = 154^\circ$

28. $(2x - 11)^\circ = 105^\circ$

$2x = 116$

$x = 58$

29. $x^\circ + (6x + 19)^\circ = 180^\circ$

$7x + 19 = 180$

$7x = 161$

$x = 23$

30. $(5x - 2)^\circ = 78^\circ$

$5x = 80$

$x = 16$

31. $(y - 12)^\circ + (3y - 8)^\circ = 180^\circ$

$4y - 20 = 180$

$4y = 200$

$y = 50$

$(6x - 20)^\circ + (2x - 20) = 180^\circ$

$8x - 52 = 180$

$8x = 232$

$x = 29$

32. $(2y + 28)^\circ + (4y + 26)^\circ = 180^\circ$

$6y + 54 = 180$

$6y = 126$

$y = 21$

$(4x + 10)^\circ + (3x - 5)^\circ = 180^\circ$

$7x + 5 = 180$

$7x = 175$

$x = 25$

33. $(9y - 187)^\circ + (11y - 253)^\circ = 180^\circ$

$20y - 440 = 180$

$20y = 620$

$y = 31$

$(7x - 248)^\circ + (x + 44)^\circ = 180^\circ$

$8x - 204 = 180$

$8x = 384$

$x = 48$

34. $(3x + 20)^\circ = (5x - 50)^\circ$

$3x + 70 = 5x$

$70 = 2x$

$35 = x$

$y^\circ + (3x + 20)^\circ = 180^\circ$

$y + [3(35) + 20] = 180$

$y + [105 + 20] = 180$

$y + 125 = 180$

$y = 55$

35. $6x^\circ = (4x + 16)^\circ$

$2x = 16$

$x = 8$

$11y^\circ + 6x^\circ = 180^\circ$

$11y + 6(8) = 180$

$11y + 48 = 180$

$11y = 132$

$y = 12$

36. $7x^\circ = 56^\circ$

$x = 8$

$y^\circ + 2x^\circ + 7x^\circ = 180^\circ$

$y + 2(8) + 7(8) = 180$

$y + 16 + 56 = 180$

$y + 72 = 180$

$y = 108$

37. supplementary **38.** neither **39.** complementary

40. neither

41.

$m\angle 1$	2°	10°	25°	33°	40°
$m\angle 2$	88°	80°	65°	57°	50°

$m\angle 1$	49°	55°	62°	76°	86°
$m\angle 2$	41°	35°	28°	14°	4°

42.

$m\angle 1$	4°	16°	48°	72°	90°
$m\angle 2$	176°	164°	132°	108°	90°

$m\angle 1$	99°	120°	152°	169°	178°
$m\angle 2$	81°	60°	28°	11°	2°

43. $m\angle B = 3(m\angle A)$

$m\angle A + m\angle B = 90^\circ$

$m\angle A + 3(m\angle A) = 90^\circ$

$4(m\angle A) = 90^\circ$

$m\angle A = 22.5^\circ$

$m\angle B = 3(m\angle A) = 3(22.5^\circ) = 67.5^\circ$

44. $m\angle D = 8(m\angle C)$

$m\angle C + m\angle D = 180^\circ$

$m\angle C + 8(m\angle C) = 180^\circ$

$9(m\angle C) = 180^\circ$

$m\angle C = 20^\circ$

$m\angle D = 8(m\angle C) = 8(20) = 160^\circ$

45. $m\angle A + m\angle B = 90^\circ$

$5x + 8 + x + 4 = 90$

$6x + 12 = 90$

$6x = 78$

$x = 13$

$m\angle A = 5x + 8 = 5(13) + 8 = 65 + 8 = 73^\circ$

$m\angle B = x + 4 = 13 + 4 = 17^\circ$

46. $m\angle A + m\angle B = 90°$

$3x - 7 + 11x - 1 = 90$

$14x - 8 = 90$

$14x = 98$

$x = 7$

$m\angle A = 3x - 7 = 3(7) - 7 = 21 - 7 = 14°$

$m\angle B = 11x - 1 = 11(7) - 1 = 77 - 1 = 76°$

47. $m\angle A + m\angle B = 90°$

$8x - 7 + x - 11 = 90$

$9x - 18 = 90$

$9x = 108$

$x = 12$

$m\angle A = 8x - 7 = 8(12) - 7 = 96 - 7 = 89°$

$m\angle B = x - 11 = 12 - 11 = 1°$

48. $m\angle A + m\angle B = 90°$

$\frac{3}{4}x - 13 + 3x - 17 = 90$

$3x - 52 + 12x - 68 = 360$

$15x - 120 = 360$

$15x = 480$

$x = 32$

$m\angle A = \frac{3}{4}x - 13 = \frac{3}{4}(32) - 13 = 24 - 13 = 11°$

$m\angle B = 3x - 17 = 3(32) - 17 = 96 - 17 = 79°$

49. $m\angle A + m\angle B = 180°$

$3x + x + 8 = 180$

$4x + 8 = 180$

$4x = 172$

$x = 43$

$m\angle A = 3x = 3(43) = 129°$

$m\angle B = x + 8 = 43 + 8 = 51°$

50. $m\angle A + m\angle B = 180°$

$6x - 1 + 5x - 17 = 180$

$11x - 18 = 180$

$11x = 198$

$x = 18$

$m\angle A = 6x - 1 = 6(18) - 1 = 108 - 1 = 107°$

$m\angle B = 5x - 17 = 5(18) - 17 = 90 - 17 = 73°$

51. $m\angle A + m\angle B = 180°$

$12x + 1 + x + 10 = 180$

$13x + 11 = 180$

$13x = 169$

$x = 13$

$m\angle A = 12x + 1 = 12(13) + 1 = 156 + 1 = 157°$

$m\angle B = x + 10 = 13 + 10 = 23°$

52. $m\angle A + m\angle B = 180°$

$\frac{3}{8}x + 50 + x + 31 = 180$

$3x + 400 + 8x + 248 = 1440$

$11x + 648 = 1440$

$11x = 792$

$x = 72$

$m\angle A = \frac{3}{8}x + 50 = \frac{3}{8}(72) + 50 = 27 + 50 = 77°$

$m\angle B = x + 31 = 72 + 31 = 103°$

53. Let $x°$ be the supplement of $\angle 1$.

$x° + m\angle 1 = 180°$

$x° + 58° = 180°$

$x° = 122°$

Let $y°$ be the supplement of $\angle 2$.

$y° + m\angle 2 = 180°$

$y° + 24° = 180°$

$y° = 156°$

54. $x° + 34° = 90°$

$x° = 56°$

The measure of the angle between the first base foul line and the path of the baseball is 56°.

55. $m\angle 2 = 3(m\angle 1)$

$m\angle 1 + m\angle 2 = 180°$

$m\angle 1 + 3(m\angle 1) = 180°$

$4(m\angle 1) = 180°$

$m\angle 1 = 45°$

$m\angle 2 = 3(m\angle 1)$

$m\angle 2 = 3(45°)$

$m\angle 2 = 135°$

The acute angle's measure is 45° and the obtuse angle's measure is 135°.

56. Answers may vary.

Sample answer:

An angle of measure 112° does not have a complement. An angle that has a complement must have a measure between 0° and 90°.

57. $(7x - 20)° + (9x - 88)° = 180°$

$$16x - 108 = 180$$
$$16x = 288$$
$$x = 18$$
$$\left(\tfrac{1}{2}y + 27\right)° + (y + 12)° = 180°$$
$$y + 54 + 2y + 24 = 360$$
$$3y + 78 = 360$$
$$3y = 282$$
$$y = 94$$

E

58.
$$m\angle G = 6\tfrac{1}{2}(m\angle F)$$
$$m\angle F + m\angle G = 180°$$
$$m\angle F + \tfrac{13}{2}(m\angle F) = 180°$$
$$2(m\angle F) + 13(m\angle F) = 360°$$
$$15(m\angle F) = 360°$$
$$m\angle F = 24°$$

B

59. $2x + y + 90 = 180$

$$x + y + 10 = 90$$
$$2x + y = 90$$
$$x + y = 80$$
$$2x + y = 90$$
$$-x - y = -80$$
$$x = 10$$
$$x + y + 10 = 90$$
$$10 + y + 10 = 90$$
$$y + 20 = 90$$
$$y = 70$$

1.6 Mixed Review (p. 50)

60. $3x = 96$

$x = 32$

61. $\tfrac{1}{2} \cdot 5 \cdot h = 20$

$5 \cdot h = 40$

$h = 8$

62. $\tfrac{1}{2} \cdot b \cdot 6 = 15$

$3 \cdot b = 15$

$b = 5$

63. $s^2 = 200$

$s = \pm\sqrt{200}$

$s = \pm\sqrt{100}$

$s = \pm 10\sqrt{2}$

64. $2 \cdot 3.14 \cdot r = 40$

$6.28 \cdot r = 40$

$r \approx 6.37$

65. $3.14 \cdot r^2 = 314$

$r^2 = 100$

$r = \pm\sqrt{100}$

$r = \pm 10$

66. *E* or *D* **67.** *C* **68.** *B* or *C* **69.** *A*

70. $M = \left(\frac{0 + (-6)}{2}, \frac{0 + (-4)}{2}\right) = \left(\frac{-6}{2}, \frac{-4}{2}\right) = (-3, -2)$

71. $M = \left(\frac{2 + (-10)}{2}, \frac{5 + 7}{2}\right) = \left(\frac{-8}{2}, \frac{12}{2}\right) = (-4, 6)$

72. $M = \left(\frac{8 + (-2)}{2}, \frac{-6 + (-2)}{2}\right) = \left(\frac{6}{2}, \frac{-8}{2}\right) = (3, -4)$

73. $M = \left(\frac{-14 + 0}{2}, \frac{-9 + 11}{2}\right) = \left(\frac{-14}{2}, \frac{2}{2}\right) = (-7, 1)$

74. $M = \left(\frac{-1.5 + 5}{2}, \frac{4 + (-9)}{2}\right) = \left(\frac{3.5}{2}, \frac{-5}{2}\right)$

$= (1.75, -2.5)$

75. $M = \left(\frac{-2.4 + 7.6}{2}, \frac{5 + 9}{2}\right) = \left(\frac{5.2}{2}, \frac{14}{2}\right) = (2.6, 7)$

Lesson 1.7

1.7 Guided Practice (p. 55)

1. The perimeter of a circle is called its circumference.

2. To find the perimeter of the rectangle, find the sum of twice its length and twice its width.

3. $A = \tfrac{1}{2}bh$

$= \tfrac{1}{2} \cdot 9 \cdot 8$

$= 36$ square units

4. $A = lw$

$= 13 \cdot 7$

$= 91$ square units

5. $A = \pi r^2$

$\approx 3.14(3)^2$

$\approx 3.14 \cdot 9$

≈ 28.26 square units

6. $P = 12$

$4s = 12$

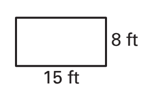
$s = 3$ m

7. $C = 2\pi r$

$\approx 2 \cdot 3.14 \cdot 4$

≈ 25.12 in.^{2}

8. $P = 2l + 2w$



$= 2 \cdot 15 + 2 \cdot 8$

$= 30 + 16$

$= 46$ feet

You will need 46 feet of fence.

1.7 Practice and Applications (pp. 55–57)

9. $P = 2l + 2w$

$= 2 \cdot 10 + 2 \cdot 6$

$= 20 + 12$

$= 32$ units

$A = lw$

$= 10 \cdot 6$

$= 60$ square units

10. $P = 4s$

$= 4 \cdot 9$

$= 36$ units

$A = s^2$

$= 9^2$

$= 81$ square units

11. $P = a + b + c$
$= 5 + 6 + 5$
$= 16$ units
$A = \frac{1}{2}bh$
$= \frac{1}{2} \cdot 6 \cdot 4$
$= 12$ square units

12. $C = 2\pi r$
$\approx 2 \cdot 3.14 \cdot 7$
≈ 43.96 units
$A = \pi r^2$
$\approx 3.14(7)^2$
$\approx 3.14 \cdot 49$
≈ 153.86 square units

13. $P = a + b + c$
$= 10 + 21 + 17$
$= 48$ units
$A = \frac{1}{2}bh$
$= \frac{1}{2} \cdot 21 \cdot 8$
$= 84$ square units

14. $P = 2l + 2w$
$= 2 \cdot 75 + 2 \cdot 10.5$
$= 15 + 21$
$= 36$ units
$A = lw$
$= 7.5 \cdot 10.5$
$= 78.75$ square units

15. $P = a + b + c$
$= 31 + 21 + 20$
$= 54$ units
$A = \frac{1}{2}bh$
$= \frac{1}{2} \cdot 21 \cdot 12$
$= 126$ square units

16. $C = 2\pi r$
$\approx 2 \cdot 3.14 \cdot 5.5$
≈ 34.54 units
$A = \pi r^2$
$\approx 3.14 \cdot (5.5)^2$
$\approx 3.14 \cdot 30.25$
≈ 94.985 square units

17. $P = 4s$
$= 4 \cdot 15$
$= 60$ units
$A = s^2$
$= (15)^2$
$= 225$ square units

18. Use the Pythagorean Theorem to find b.
$a^2 + b^2 = c^2$
$6^2 + b^2 = 10^2$
$36 + b^2 = 100$
$b^2 = 64$
$b = 8$

$P = 2l + 2w$
$= 2 \cdot 8 + 2 \cdot 6$
$= 16 + 12$
$= 28$ units

$A = lw$
$= 8 \cdot 6$
$= 48$ square units

19. $P = a + b + c$
$= 5 + 5 + 5\sqrt{2}$
$= 10 + 5\sqrt{2}$ units

$A = \frac{1}{2}bh$
$= \frac{1}{2} \cdot 5 \cdot 5$
$= \frac{25}{5}$
$= 12.5$ square units

20. The perimeter is twice the radius plus half of the circumference.
$P = 2r + \frac{1}{2}(2\pi r)$
$= 2r + \pi r$
$\approx 2 \cdot 8 + 3.14 \cdot 8$
$\approx 16 + 25.12$
≈ 41.12 units

The area is half the area of a circle.
$A = \frac{1}{2}(\pi r^2) \approx \frac{1}{2} \cdot 3.14 \cdot 8^2 = 100.48$ square units

21. $A = \frac{1}{2}bh$
$= \frac{1}{2} \cdot 5 \cdot 6$
$= 15\text{ cm}^2$

22. $A = lw$
$= 12 \cdot 9$
$= 108\text{ yd}^2$

23. $A = s^2$
$= 8^2$
$= 64\text{ ft}^2$

24. $A = \pi r^2$
$\approx 3.14(10)^2$
$\approx 3.14 \cdot 100$
$\approx 314\text{ m}^2$

25. $P = 24$ m
$4s = 24$
$s = 6$ m

$A = s^2$
$= 6^2$
$= 36\text{ m}^2$

26. $d = 100$ ft
$2r = 100$
$r = 50$ ft

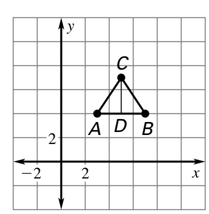
$A = \pi r^2$
$\approx 3.14(50)^2$
$\approx 3.14 \cdot 2500$
$\approx 7850\text{ ft}^2$

27. $AC = 5 - 1 = 4,$
$BD = 5 - 2 = 3$
$A = \frac{1}{2}bh$
$= \frac{1}{2} \cdot 4 \cdot 3$
$= 6$ square units

28. $EF = 4 - (-1) = 5,$
$FG = 3 - (-2) = 5,$
$HG = 4 - (-1) = 5,$
$HE = 3 - (-2) = 5$
$A = s^2 = 5^2 = 25$ square units

29. $r = -1 - (-3) = 2$
$A = \pi r^2$
$\approx 3.14(2)^2$
$\approx 3.14 \cdot 4$
≈ 12.56 square units

30. $AB = 7 - 3 = 4$
$CD = 7 - 4 = 3$
$A = \frac{1}{2}bh$
$= \frac{1}{2} \cdot 4 \cdot 3$
$= 6$ square units



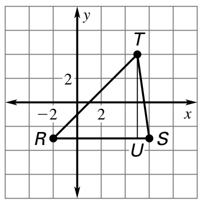
31. $RS = 6 - (-2) = 8$

$TU = 4 - (-3) = 7$

$A = \frac{1}{2}bh$

$= \frac{1}{2} \cdot 8 \cdot 7$

$= 28$ square units



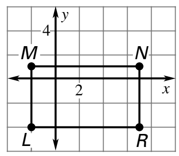
32. $LM = 1 - (-4) = 5$

$MN = 7 - (-2) = 9$

$A = lw$

$= 9 \cdot 5$

$= 45$ square units



33. $WX = \sqrt{(0-5)^2 + (5-0)^2}$

$= \sqrt{(-5)^2 + 5^2}$

$= \sqrt{25 + 25}$

$= \sqrt{50}$

$= \sqrt{25} \cdot \sqrt{2}$

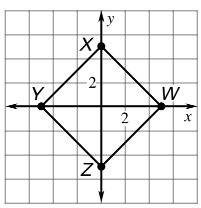
$= 5\sqrt{2}$

$A = s^2$

$= (5\sqrt{2})^2$

$= 25 \cdot 2$

$= 50$ square units



34. 15 ft = 5 yd

25 ft = $\frac{25}{3}$ yd

$A = lw$

$= 5 \cdot \frac{25}{3}$

$= \frac{125}{3}$

$= 41\frac{2}{3}$ yd^2

$41\frac{2}{3}$ square yards of carpet will be needed to cover the room.

35. The entire width of the window with frame is 2 in. + 12 in. + 2 in. = 16 in. The entire length of the window with frame is 2 in. + 18 in. + 2 in. = 22 in.

$A = lw = 22 \cdot 16 = 352$ in.^{2}

The area of the window, including the frame, is 352 square inches.

36. $d = 320$ m

$2r = 320$ m

$r = 160$ m

$C = 2\pi r$

$\approx 2 \cdot 3.14 \cdot 160$

≈ 1004.8 m

The circumference of the covered land is 1004.8 meters. $A = \pi r^2 \approx 3.14(160)^2 \approx 3.14 \cdot 25{,}600 \approx 80{,}384$ m^2 The area covered is about 80,384 square meters.

37. Perimeter of Rectangle

	A	B	C	D	E	F	G
1.	***Length***	1.00	2.00	3.00	4.00	5.00	6.00
2.	***Width***	100.00	50.00	33.33	25.00	20.00	16.67
3.	***Area***	100.00	100.00	100.00	100.00	100.00	100.00
4.	***Perimeter***	202.00	104.00	72.67	58.00	50.00	45.33

	H	I	J	K	L	M
1.	7.00	8.00	9.00	10.00	11.00	12.00
2.	14.29	12.5	11.11	10.00	9.09	8.33
3.	100.00	100.00	100.00	100.00	100.00	100.00
4.	42.57	41.00	40.22	40.00	40.18	40.67

To find the width, divide 100 by the length.

To find the area, multiply the length and the width.

To find the perimeter, use $P = 2l + 2w$.

Notice the pattern for the perimeters. The numbers decrease to 40 then increase. The rectangle with the smallest perimeter has dimensions of 10 m × 10 m.

38. $A = \pi r^2$

$\approx 3.14(5.5)^2$

$\approx 3.14 \cdot 30.25$

≈ 94.985 m^2

About 95 square meters of cranberries could be gathered.

39. $C = 2\pi r$

$\approx 2 \cdot 3.14 \cdot 21$

≈ 131.88 in.

Each time a bicycle tire rotates one complete time it travels a distance of 131.88 in. So to find the number of rotations, divide the total distance of 420 inches by one complete rotation, 131.88 inches. The bicycle tire rotates about 3.18 times.

40. Area of ring = Area of larger circle − Area of smaller circle

$= \pi\left(\frac{13}{2}\right)^2 - \pi\left(\frac{10}{2}\right)^2$

$\approx 3.14 \cdot 42.25 - 3.14 \cdot 25$

$\approx 132.665 - 78.5$

≈ 54.165 in.^{2}

The area of the ring is about 54.2 square inches.

41. $A = lw$

$36 = 9w$

$4 = w$

$P = 2l + 2w$

$= 2 \cdot 9 + 2 \cdot 4$

$= 18 + 8$

$= 26$ in.

42. $A = s^2$

$10{,}000 = s^2$

$100 = s$

$P = 4s$

$= 4 \cdot 100$

$= 400$ m

43. $A = \frac{1}{2}bh$

$48 = \frac{1}{2} \cdot 16 \cdot h$

$48 = 8h$

$6 \text{ ft} = h$

44. $A = \frac{1}{2}bh$

$52 = \frac{1}{2} \cdot b \cdot 13$

$104 = 13b$

$8 \text{ yd} = b$

45. $A = \pi r^2$

$200\pi = \pi r^2$

$200 = r^2$

$\sqrt{200} = r$

$\sqrt{100} \cdot \sqrt{2} = r$

$10\sqrt{2} \text{ cm} = r$

46. $A = \pi r^2$

$1 = \pi r^2$

$0.32 \approx r^2$

$\sqrt{0.32} \approx r$

$0.56 \approx r$

$d = 2r$

$d \approx 2 \cdot 0.56$

$d \approx 1.12 \text{ m}$

47. $C = 2\pi r$

$100 = 2\pi r$

$100 \approx 2 \cdot 3.14 \cdot r$

$100 \approx 6.28r$

$15.92 \approx r$

$A = \pi r^2$

$\approx 3.14(15.92)^2$

$\approx 3.14 \cdot 253.4464$

$\approx 795.8 \text{ yd}^2$

48. 7.5 cm is the largest measurement, so it must go with the longest side, which is the hypotenuse of the right triangle.

$A = \frac{1}{2}bh$

$= \frac{1}{2} \cdot 6 \cdot 4.5$

$= 13.5 \text{ cm}^2$

49. a. $C = 2\pi r$

$\approx 2 \cdot 3.14 \cdot 20{,}908{,}800$

$\approx 131{,}307{,}264 \text{ ft}$

The length of the cable would be 131,307,264 feet.

b. $131{,}307{,}264 + 6 = 131{,}307{,}270 \text{ ft}$

$C = 2\pi r$

$131{,}307{,}270 \approx 2 \cdot 3.14 \cdot r$

$131{,}307{,}270 \approx 6.28r$

$20{,}908{,}800.96 \text{ ft} \approx r$

The radius of the circle would be about 20,908,801 ft.

c. height off ground $\approx 20{,}908{,}801 - 20{,}908{,}800 = 1$. It would be about 1 foot above the ground.

d. No, the answer to part (c) would not be different for a different planet with a different radius. By adding 6 ft to the circumference, you are only adding $6 \div 2\pi$ or about 1 to the radius. This will remain constant.

$C = 2\pi r$

$C + 6 = 2\pi r_2$ This is the new circumference.

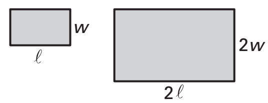
$\frac{C + 6}{2\pi} = r_2$

$\frac{C}{2\pi} + \frac{6}{2\pi} = r_2$

$r_1 + \frac{6}{2\pi} = r_2 \quad \left(\text{Since } C = 2\pi r_1, \text{ then } \frac{C}{2\pi} = r_1.\right)$

Therefore, the radius changes by $\frac{6}{2\pi}$ feet without regard to the actual number r_1 represents.

50.



Original rectangle:

$P = 2l + 2w \qquad A = lw$

Enlarged rectangle:

$P = 2 \cdot 2l + 2 \cdot 2w \qquad A = 2l \cdot 2w$

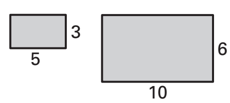
$= 4 \cdot l + 4 \cdot w \qquad = 4 \cdot l \cdot w$

$= 2(2l + 2w) \qquad = 4(lw)$

The enlarged rectangle has double the perimeter of the original rectangle and four times the area of the original rectangle.

Answers may vary.

Sample answer:



Original rectangle:

$P = 2l + 2w \qquad A = lw$

$= 2 \cdot 5 + 2 \cdot 3 \qquad = 5 \cdot 3$

$= 10 + 6 \qquad = 15$ square units

$= 16$ units

Enlarged rectangle:

$P = 2l + 2w \qquad A = lw$

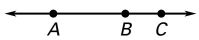
$= 2 \cdot 10 + 2 \cdot 6 \qquad = 10 \cdot 6$

$= 20 + 12 \qquad = 60$ square units

$= 32$ units

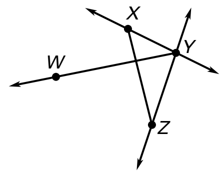
The perimeter of the enlarged rectangle is 32 units which is twice the area of the original rectangle. The area of the enlarged rectangle is 60 square units which is four times the area of the original rectangle.

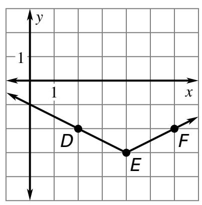
Mixed Review (p. 58)

51. 

52. Answers may vary.

Sample answer:



53. 

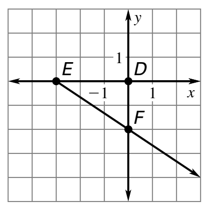
obtuse

Answers may vary.

Sample answer:

(4, 0) is in the interior of $\angle DEF$.

(4, −5) is in the exterior of $\angle DEF$.

54. 

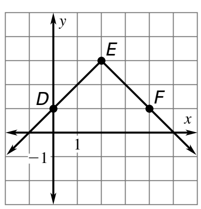
acute

Answers may vary.

Sample answer:

(3, −1) is in the interior of $\angle DEF$.

(−4, −2) is in the exterior of $\angle DEF$.

55. 

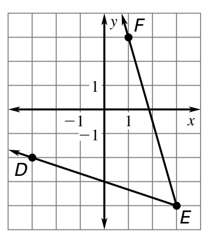
right

Answers may vary.

Sample answer:

(2, 0) is in the interior of $\angle DEF$.

(−2, 3) is in the exterior of $\angle DEF$.

56. 

acute angle

Answers may vary.

Sample answer:

(−2, 0) is in the interior of $\angle DEF$.

(4, 0) is in the exterior of $\angle DEF$.

57. $M = \left(\frac{0+5}{2}, \frac{0+3}{2}\right)$

$= \left(\frac{5}{2}, \frac{3}{2}\right)$

58. $M = \left(\frac{2+4}{2}, \frac{-3+4}{2}\right) = \left(\frac{6}{2}, \frac{1}{2}\right) = \left(3, \frac{1}{2}\right)$

59. $M = \left(\frac{-3+(-2)}{2}, \frac{4+(-1)}{2}\right) = \left(-\frac{5}{2}, \frac{3}{2}\right)$

60. $M = \left(\frac{-2+(-7)}{2}, \frac{0+(-6)}{2}\right)$

$= \left(\frac{-9}{2}, \frac{-6}{2}\right)$

$= \left(-\frac{9}{2}, -3\right)$

61. $M = \left(\frac{0+14}{2}, \frac{5+1}{2}\right) = \left(\frac{14}{2}, \frac{6}{2}\right) = (7, 3)$

62. $M = \left(\frac{-44+6}{2}, \frac{9+(-7)}{2}\right) = \left(\frac{-38}{2}, \frac{2}{2}\right) = (-19, 1)$

Quiz 3 (p. 58)

1. Let $\angle B$ be the complement of $\angle A$.

$m\angle A + m\angle B = 90°$

$41° + m\angle B = 90°$

$m\angle B = 49°$

The complement of $\angle A$ has a measure of 49°.

2. Let $\angle A$ be the supplement of $\angle B$.

$m\angle A + m\angle B = 180°$

$m\angle A + 127° = 180°$

$m\angle A = 53°$

The supplement of $\angle B$ has a measure of 53°.

3. Let $\angle D$ be the supplement of $\angle C$.

$m\angle C + m\angle D = 180°$

$22° + m\angle D = 180°$

$m\angle D = 158°$

The supplement of $\angle C$ has a measure of 158°.

4. Let $\angle C$ be the complement of $\angle D$.

$m\angle C + m\angle D = 90°$

$m\angle C + 35° = 90°$

$m\angle C = 55°$

The complement of $\angle D$ has a measure of 55°.

5. $m\angle A = 5(m\angle B)$

$m\angle A + m\angle B = 90°$

$5(m\angle B) + m\angle B = 90°$

$6(m\angle B) = 90°$

$m\angle B = 15°$

$m\angle A = 5(m\angle B)$

$m\angle A = 5(15°)$

$m\angle A = 75°$

6. $A = \pi r^2$

$\approx 3.14(18)^2$

$\approx 3.14 \cdot 324$

$\approx 1017.36 \text{ m}^2$

$C = 2\pi r^2$

$\approx 2 \cdot 3.14 \cdot 18$

$\approx 113.04 \text{ m}$

7. $A = \frac{1}{2}bh$

$= \frac{1}{2} \cdot 13 \cdot 11$

$= 71.5 \text{ in.}^2$

8. $A = lw$

$= 10 \cdot 4.6$

$= 46 \text{ cm}^2$

$P = 2l + 2w$

$= 2 \cdot 10 + 2 \cdot 4.6$

$= 20 + 9.2$

$= 29.2 \text{ cm}$

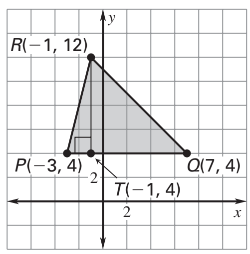
9. $PQ = 7 - (-3) = 10$

$RT = 12 - 4 = 8$

$A = \frac{1}{2}bh$

$= \frac{1}{2} \cdot 10 \cdot 8$

$= 40$ square units



10. First, we must find the total area of all 4 walls. There are 2 walls that are 8 ft by 12 ft and 2 walls that are 8 ft by 24 ft.

Total Area $= 2 \cdot 8 \cdot 12 + 2 \cdot 8 \cdot 24$

Total Area $= 192 + 384$

Total Area $= 576 \text{ ft}^2$

To find the number of rolls of wallpaper needed, divide the total area (576 ft^2) by the number of square feet per roll (28 ft^2). So $576 \div 28 = 20.6$ or 21 rolls of wallpaper will be needed.

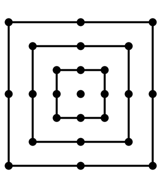
Chapter 1 Review • (pages 60–62)

1. Each number is 7 more than the previous number.

2. The numbers after the first number are found by adding consecutive powers of 2.

3. Each number is the previous number multiplied by 3.

4.



5. If 1 is added to the product of four consecutive positive integers, n through $n + 3$, the sum is equal to the square of $[n(n + 3) + 1]$.

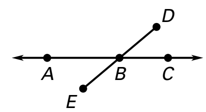
6. Answers may vary.

Sample answer:

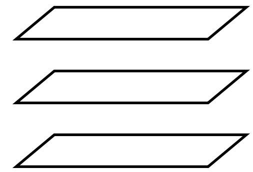
The cube of $\frac{1}{2}$ is $\frac{1}{8}$ which is not greater than $\frac{1}{2}$.

7. Answers may vary.

Sample answer:

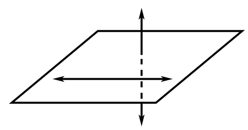


8.



9. Answers may vary.

Sample answer:



10. $PQ = QR$

$PQ = \frac{1}{2} \cdot QS$

$PQ = \frac{1}{2} \cdot 16$

$PQ = 8$

$PQ + QR + RS + ST = PT$

$ST = PT - PQ - QR - RS$

$ST = 30 - 8 - 8 - 8$

$ST = 6$

$RP = PQ + QR$

$RP = 8 + 8$

$RP = 16$

11. $PQ = \sqrt{(-2 - (-4))^2 + (1 - 3)^2}$

$= \sqrt{2^2 + (-2)^2}$

$= \sqrt{4 + 4}$

$= \sqrt{8}$

$= \sqrt{4} \cdot \sqrt{2}$

$= 2\sqrt{2}$

$QR = \sqrt{(0 - (-2))^2 + (-1 - 1)^2}$

$= \sqrt{2^2 + (-2)^2}$

$= \sqrt{4 + 4}$

$= \sqrt{8}$

$= \sqrt{4} \cdot \sqrt{2}$

$= 2\sqrt{2}$

$\overline{PQ} \cong \overline{QR}$ because they have the same length.

12. $PQ = \sqrt{(1-(-3))^2 + (3-5)^2}$

$= \sqrt{4^2 + (-2))^2}$

$= \sqrt{16+4}$

$= \sqrt{20}$

$= \sqrt{4} \cdot \sqrt{5}$

$= 2\sqrt{5}$

$QR = \sqrt{(4-1)^2 + (1-3)^2}$

$= \sqrt{3^2 + (-2)^2}$

$= \sqrt{9+4}$

$= \sqrt{13}$

$\overline{PQ}$ and $\overline{QR}$ are not congruent because they do not have the same length.

13. $PQ = \sqrt{(0-(-2))^2 + (1-(-2))^2}$

$= \sqrt{2^2 + 3^2}$

$= \sqrt{4+9}$

$= \sqrt{13}$

$QR = \sqrt{(1-0)^2 + (4-1)^2}$

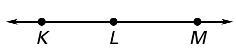
$= \sqrt{1^2 + 3^2}$

$= \sqrt{1+9}$

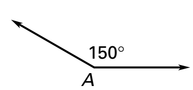
$= \sqrt{10}$

$\overline{PQ}$ and $\overline{QR}$ are not congruent because they do not have the same length.

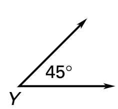
14. straight



15. obtuse



16. acute



17. $m\angle DEF = m\angle DEG + m\angle GEF$

$m\angle DEF = 60° + 45°$

$m\angle DEF = 105°$

18. $m\angle HJL + m\angle LJK = m\angle HJK$

$m\angle HJL + 40° = 90°$

$m\angle HJL = 50°$

19. $m\angle QNM + m\angle QNP = m\angle MNP$

$m\angle QNM + 110° = 180°$

$m\angle QNM = 70°$

20. $M = \left(\frac{0+(-8)}{2}, \frac{0+6}{2}\right) = \left(\frac{-8}{2}, \frac{6}{2}\right) = (-4, 3)$

21. $M = \left(\frac{-1+3}{2}, \frac{7+(-3)}{2}\right) = \left(\frac{2}{2}, \frac{4}{2}\right) = (1, 2)$

22. $M = \left(\frac{-12+2}{2}, \frac{-9+10}{2}\right) = \left(\frac{-10}{2}, \frac{1}{2}\right) = \left(-5, \frac{1}{2}\right)$

23. $m\angle SQR = m\angle PQS = 50°$

$m\angle PQR = 2(m\angle PQS)$

$m\angle PQR = 2(50°)$

$m\angle PQR = 100°$

24. $m\angle RQS = m\angle SQP = \frac{m\angle PQR}{2} = \frac{50°}{2} = 25°$

25. $m\angle SQR = m\angle PQS = 46°$

$m\angle PQR = 2(m\angle PQS)$

$m\angle PQR = 2(46°)$

$m\angle PQR = 92°$

26. always **27.** sometimes **28.** never **29.** sometimes

30. $P = 2l + 2w$

$= 2 \cdot 10 + 2 \cdot 4.5$

$= 20 + 9$

$= 29$ cm

$A = lw$

$= 10 \cdot 4.5$

$= 45 \text{ cm}^2$

31. $C = 2\pi r$

$\approx 2 \cdot 3.14 \cdot 9$

≈ 56.52 in.

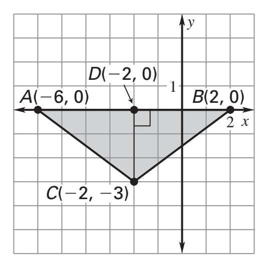
$A = \pi r^2$

$\approx 3.14(9)^2$

$\approx 3.14 \cdot 81$

$\approx 254.34 \text{ in.}^2$

32. To find the perimeter, find the sum of *AB, BC,* and *CA*.



$AB = 2 - (-6) = 8$

$BC = \sqrt{(-2-2)^2 + (-3-0)^2}$

$= \sqrt{(-4)^2 + (-3)^2}$

$= \sqrt{16+9}$

$= \sqrt{25}$

$= 5$

$CA = \sqrt{(-6-(-2))^2 + (0-(-3))^2}$

$= \sqrt{(-4)^2 + 3^2}$

$= \sqrt{16+9}$

$= \sqrt{25}$

$= 5$

The perimeter of $\triangle ABC$ is $8 + 5 + 5$ or 18 units.

$CD = 0 - (-3) = 3$

$A = \frac{1}{2}bh$

$= \frac{1}{2} \cdot 8 \cdot 3$

$= 12$ square units

The area of $\triangle ABC$ is 12 square units.

33. $P = 4s$

$= 4(14)$

$= 56$ ft

The perimeter of the garden is 56 ft.

Chapter 1 Test *(p. 63)*

1. *Sample answer:*

Q, T, and N

2. *Sample answer:*

Q, N, M, and R

3. *Sample answer:*

$\overrightarrow{TQ}$ and $\overrightarrow{TN}$

4. *Sample answer:*

$\overleftrightarrow{QN}$ and $\overleftrightarrow{LQ}$

5. $\overleftrightarrow{QL}$ **6.** $MP = \frac{1}{2}(MN) = \frac{1}{2}(8) = 4$ **7.** $SM = MP = 4$

8. $SM + MN + NR = SR$

$4 + 8 + NR = 26$

$12 + NR = 26$

$NR = 14$

9. $MR = MN + NR$

$= 8 + 14$

$= 22$

10. $m\angle DBE + m\angle EBF = m\angle DBF$

$m\angle DBE + 45° = 90°$

$m\angle DBE = 45°$

11. $m\angle FBC = m\angle FBE + m\angle EBD + m\angle DBC$

$m\angle FBC = 45° + 45° + 50°$

$= 140°$

12. $m\angle ABF + m\angle FBC = 180°$

$m\angle ABF + 140° = 180°$

$m\angle ABF = 40°$

13. $m\angle DBA + m\angle DBC = 180°$

$m\angle DBA + 50° = 180°$

$m\angle DBA = 130°$

14. *Sample answer:*

$\angle ABD$ is an obtuse angle. $\angle DBC$ is an acute angle. $\angle FBD$ is right angle. $\angle FBE$ and $\angle EBD$ are complementary angles.

15. $PQ + QR = PR$

$2w - 3 + 4 + w = 34$

$3w + 1 = 34$

$3w = 33$

$w = 11$

$PQ = 2w - 3$

$= 2 \cdot 11 - 3$

$= 22 - 3$

$= 19$

$QR = 4 + w$

$= 4 + 11$

$= 15$

16. $S = \left(\frac{-3 + 3}{2}, \frac{8 + 6}{2}\right)$

$= \left(\frac{0}{2}, \frac{14}{2}\right)$

$= (0, 7)$

The coordinates of point S are $(0, 7)$.

$RS = \sqrt{(0 - (-3))^2 + (7 - 8)^2}$

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

$= \sqrt{9 + 1}$

$= \sqrt{10}$

$ST = \sqrt{(3 - 0)^2 + (6 - 7)^2}$

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

$= \sqrt{9 + 1}$

$= \sqrt{10}$

So $RS = ST$.

17. $m\angle 4 + m\angle 3 = 180°$

$m\angle 4 + 68° = 180$

$m\angle 4 = 112°$

$m\angle 5 = m\angle 3 = 68°$

18. $m\angle PQT = \frac{1}{2}(m\angle PQR)$

$= \frac{1}{2} \cdot 130°$

$= 65°$

19.

figure	1	2	3	4	5
distance	8	10	12	14	16

20. The distance is 6 more than twice the figure number. For the 20th figure, the distance is $2(20) + 6$.

$2(20) + 6 = 40 + 6$

$= 46$

The distance around the 20th figure is 46 units.

21. $C = 2\pi r$

$\approx 2 \cdot 3.14 \cdot 560$

≈ 3517

They would have walked about 3517 feet.

22. $A = \pi r^2$

$\approx 3.14(560)^2$

$\approx 3.14 \cdot 313{,}600$

$\approx 984{,}704$

The area of the watered region is about 984,704 square feet.

Chapter 1 Standardized Test *(pp. 64–65)*

1. C **2.** E

3. $AC = \sqrt{(1 - (-2))^2 + (-4 - 4)^2}$
$= \sqrt{3^2 + (-8)^2}$
$= \sqrt{9 + 64}$
$= \sqrt{73}$
$AE = \sqrt{(-9(-2))^2 + (10 - 4)^2}$
$= \sqrt{(-7)^2 + 6^2}$
$= \sqrt{49 + 36}$
$= \sqrt{85}$
$AB = \sqrt{(6 - (-2))^2 + (7 - 4)^2}$
$= \sqrt{8^2 + 3^2}$
$= \sqrt{64 + 9}$
$= \sqrt{73}$
$AC = AB$
E

4. $AB = BD = DC = \frac{1}{2}(BC) = \frac{1}{2} \cdot 10 = 5$
$AB + BD + DC + CE = AE$
$5 + 5 + 5 + CE = 28$
$15 + CE = 28$
$CE = 13$
D

5. $m\angle 4 + m\angle 5 = 90°$
$19° + m\angle 5 = 90°$
$m\angle 5 = 71°$
B

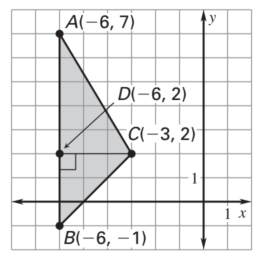
6. A

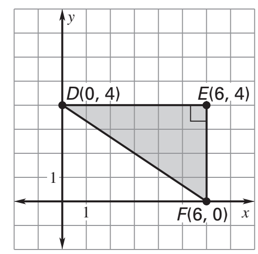
7. $C(x, y)$ $B(-1, 8)$ $M(-10, -16)$
$\frac{x + (-1)}{2} = -10 \qquad \frac{y + 8}{2} = -16$
$x - 1 = -20 \qquad y + 8 = -32$
$x = -19 \qquad y = -40$
$C(-19, -40)$
C

8. $m\angle PQS = m\angle SQR$
$(5x - 46)° = (2x + 5)°$
$5x = 2x + 51$
$3x = 51$
$x = 17$
$m\angle PQR = m\angle PQS + m\angle SQR$
$m\angle PQR = 5x - 46 + 2x + 5$
$m\angle PQR = 7x - 41$
$m\angle PQR = 7 \cdot 17 - 41$
$m\angle PQR = 119 - 41$
$m\angle PQR = 78°$
E

9. $m\angle 1 = 9(m\angle 2)$
$m\angle 1 + m\angle 2 = 90°$
$9(m\angle 2) + m\angle 2 = 90°$
$10(m\angle 2) = 90°$
$m\angle 2 = 9°$
$m\angle 1 = 9(m\angle 2)$
$m\angle 1 = 9(9°)$
$m\angle 1 = 81°$
C

10. $AB = 7 - (-1) = 8 \qquad DE = 6 - 0 = 6$
$CD = -3 - (-6) = 3 \qquad EF = 4 - 0 = 4$
$A = \frac{1}{2}bh \qquad A = \frac{1}{2}bh$
$= \frac{1}{2} \cdot 8 \cdot 3 \qquad = \frac{1}{2} \cdot 6 \cdot 4$
$= 12$ square units $\qquad = 12$ square units





C

11. *Sample answers:*
a. $\angle GAH$ is an acute angle.
b. $\angle FEB$ is an obtuse angle.
c. $\angle SBE$ is a straight angle.
d. $\angle GAP$ is a right angle.

12. a. supplementary angles
b. complementary angles
c. supplementary angles
d. vertical angles

13. $m\angle GAH = m\angle BAH = \frac{m\angle GAB}{2} = \frac{90°}{2} = 45°$

14. $m\angle QFA + m\angle QFN = 180°$
$m\angle QFA + x° = 180°$
$m\angle QFA = (180 - x)°$
$m\angle AFE = m\angle QFN$
$m\angle AFE = x°$
$m\angle EFN = m\angle QFA$
$m\angle EFN = (180 - x)°$

15.

Width (in.)	*Perimeter (in.)*	*Length (in.)*	*Area* $(in.^2)$
1	24	11	11
2	24	10	20
3	24	9	27
4	24	8	32
5	24	7	35
6	24	6	36
7	24	5	35

$w = 1$

$P = 2l + 2w$

$24 = 2l \cdot 2 \cdot 1$

$24 = 2l + 2$

$22 = 2l$

$11 \text{ in.} = l$

$A = lw$

$= 11 \cdot 1$

$= 11 \text{ in.}^2$

$w = 2$

$P = 2l + 2w$

$24 = 2l + 2 \cdot 2$

$24 = 2l + 4$

$20 = 2l$

$10 \text{ in.} = l$

$A = lw$

$= 10 \cdot 2$

$= 20 \text{ in.}^2$

$w = 3$

$P = 2l + 2w$

$24 = 2l + 2 \cdot 3$

$24 = 2l + 6$

$18 = 2l$

$9 \text{ in.} = l$

$A = lw$

$= 9 \cdot 3$

$= 27 \text{ in.}^2$

$w = 4$

$P = 2l + 2w$

$24 = 2l + 2 \cdot 4$

$24 = 2l + 8$

$16 = 2l$

$8 \text{ in.} = l$

$A = lw$

$= 8 \cdot 4$

$= 32 \text{ in.}^2$

$w = 5$

$P = 2l + 2w$

$24 = 2l + 2 \cdot 5$

$24 = 2l + 10$

$14 = 2l$

$7 \text{ in.} = l$

$A = lw$

$= 7 \cdot 5$

$= 35 \text{ in.}^2$

$w = 6$

$P = 2l + 2w$

$24 = 2l + 2 \cdot 6$

$24 = 2l + 12$

$12 = 2l$

$6 \text{ in.} = l$

$A = lw$

$= 6 \cdot 6$

$= 36 \text{ in.}^2$

$w = 7$

$P = 2l + 2w$

$24 = 2l + 2 \cdot 7$

$24 = 2l + 14$

$10 = 2l$

$5 \text{ in.} = l$

$A = lw$

$= 5 \cdot 7$

$= 35 \text{ in.}^2$

16. The 6 in. by 6 in. rectangle had the greatest area.

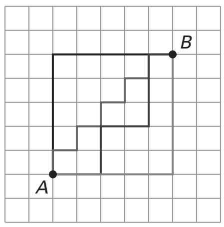
17. The sum of the length and width is 12. The length of a rectangle with a width of 3.5 inches would be $12 - 3.5$ or 8.5 inches.

18. If the perimeter of a rectangle is known, the rectangle with the greatest area is a square with the length of a side equal to $\frac{1}{4}$ of the perimeter. To test the conjecture, one could try many rectangles of different perimeters and make a chart as in problem 15. Or one could try to make a generalized chart with $4n$ as a perimeter.

Chapter 1 Project (pp. 66–67)

1. No, the distances aren't always the same. In the example on page 66, 3 different distances were shown. The shortest distance from A to B is 10.

2. Yes, there are other paths from A to B with a taxicab distance of 10.



Here are a few.

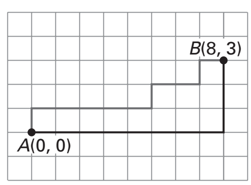
3. If point A is $(0, 0)$, then point B is $(5, 5)$.

$$\begin{aligned} AB &= \sqrt{(5-0)^2 + (5-0)^2} \\ &= \sqrt{5^2 + 5^2} \\ &= \sqrt{25 + 25} \\ &= \sqrt{50} \\ &= \sqrt{25} \cdot \sqrt{2} \\ &= 5\sqrt{2} \approx 7.07 \end{aligned}$$

Since $10 > 5\sqrt{2}$, then the taxicab distance is greater than the Euclidean distance.

4. Answers may vary.
Sample answer:

Taxicab distance for AB is 11.

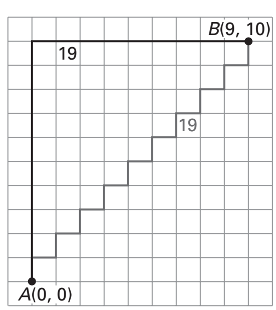


$$\begin{aligned} AB &= \sqrt{(8-0)^2 + (3-0)^2} \\ &= \sqrt{64 + 9} \\ &= \sqrt{73} \approx 8.5 \end{aligned}$$

The taxicab distance is greater than the Euclidean distance.

The taxicab distance AB is 19.

$$\begin{aligned} AB &= \sqrt{(9-0)^2 + (10-0)^2} \\ &= \sqrt{9^2 + 10^2} \\ &= \sqrt{81 + 100} \\ &= \sqrt{181} \approx 13.5 \end{aligned}$$

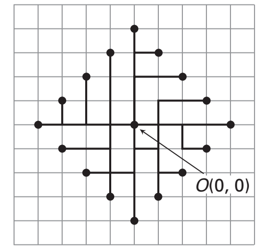


The taxicab distance is greater than the Euclidean distance.

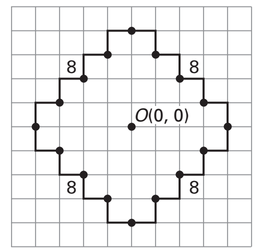
The taxicab distance will always be greater than or equal to the Euclidean distance.

5. If $A(x_1, y_1)$ and $B(x_2, y_2)$ are two points, then the taxicab distance from A to B is $|x_2 - x_1| + |y_2 - y_1|$.

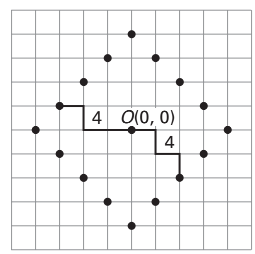
6. The points are arranged like points on a diamond or square centered around the point $O(0, 0)$.



7. Total distance $= 4 \cdot 8 = 32$ blocks



8. diameter $= 2 \cdot 4 = 8$ blocks



9. Yes, π would have a constant value of $\frac{32}{8}$ or 4.

Present Your Results:

A distance in taxicab geometry is greater than or equal to the corresponding Euclidean distance. A circle is associated with a location and a distance in both Euclidean and taxicab geometry, but the circles have different shapes and circumferences in the two geometries. Their diameters, however, are the same: twice the given distance.

Extensions:

The answers below assume that A and B do not lie on a horizontal or verical line.

The points that lie *between* two points A and B form a rectangle with A and B at two corners. All the grid points on the perimeter of the rectangle (except A and B) and all the grid points inside the rectangle lie *between* A and B in taxicab geometry.

Yes; the set of points lies on a line that is tilted 45° from horizontal. The line divides the rectangular region of points between A and B into two regions. All the points in one region are closer to A than to B. All the points in the other region are closer to B than to A.