

Chapter 1

Trigonometric Functions

Section 1.1: Angles

1. (a) 60° (b) 150°
2. (a) 30° (b) 120°
3. (a) 45° (b) 135°
4. (a) 72° (b) 162°
5. (a) 36° (b) 126°
6. (a) 1° (b) 91°
7. (a) 89° (b) 179°
8. (a) 80° (b) 170°
9. (a) $75^\circ 40'$ (b) $165^\circ 40'$
10. (a) $50^\circ 10'$ (b) $140^\circ 10'$
11. (a) $69^\circ 49' 30''$ (b) $159^\circ 49' 30''$
12. (a) $39^\circ 19' 10''$ (b) $129^\circ 19' 10''$
13. 70° ; 110° .
14. 150° ; 30° .
15. 60° ; 30° .
16. 55° ; 35° .
17. 40° ; 140° .
18. 90° ; 90°
19. 107° ; 73°
20. 80° ; 100°
21. 69° ; 21°
22. 40° ; 50°
23. 45°
24. 90°
25. 150°
26. $142^\circ 30'$
27. $7^\circ 30'$
28. 90°
29. $(90 - x)^\circ$
30. $(180 - x)^\circ$
31. $(x - 360)^\circ$
32. $(x + 360)^\circ$
33. $83^\circ 59'$
34. $158^\circ 47'$
35. $23^\circ 49'$
36. $-26^\circ 25'$
37. $38^\circ 32'$
38. $72^\circ 47'$
39. $60^\circ 34'$
40. $55^\circ 9'$
41. $30^\circ 27'$
42. $59^\circ 59'$
43. $17^\circ 1' 49''$
44. $53^\circ 41' 13''$
45. 35.5°
46. 82.5°
47. 112.25°
48. 133.75°
49. -60.2°
50. -70.8°
51. 20.9°
52. 38.7°
53. 91.598°
54. 34.860°
55. 274.316°
56. 165.853°
57. $39^\circ 15' 00''$
58. $46^\circ 45' 00''$
59. $126^\circ 45' 36''$
60. $174^\circ 15' 18''$
61. $-18^\circ 30' 54''$

2 Chapter 1: Trigonometric Functions

- 62. $-25^{\circ}29'6''$
- 63. $31^{\circ}25'47''$
- 64. $59^{\circ}5'7''$
- 65. $89^{\circ}54'1''$
- 66. $102^{\circ}22'38''$
- 67. $178^{\circ}35'58''$
- 68. $122^{\circ}41'7''$
- 69. 392°
- 70. 446°
- 71. $386^{\circ}30'$
- 72. $418^{\circ}40'$
- 73. 320°
- 74. 262°
- 75. 235°
- 76. 157°
- 77. 1°
- 78. 181°
- 79. 359°
- 80. 179°
- 81. 179°
- 82. 339°
- 83. 130°
- 84. 280°
- 85. 240°
- 86. 160°
- 87. 120°
- 88. 200°

In exercises 89–92, answers may vary.

- 89. $450^{\circ}, 810^{\circ}; 270^{\circ}, -630^{\circ}$
- 90. 180° is coterminal with $540^{\circ}, 900^{\circ}; -180^{\circ}, -540^{\circ}$
- 91. $360^{\circ}, 720^{\circ}; -360^{\circ}, -720^{\circ}$
- 92. $630^{\circ}, 990^{\circ}; -90^{\circ}, -450^{\circ}$
- 93. $30^{\circ} + n \cdot 360^{\circ}$
- 94. $45^{\circ} + n \cdot 360^{\circ}$
- 95. $135^{\circ} + n \cdot 360^{\circ}$
- 96. $225^{\circ} + n \cdot 360^{\circ}$

- 97. $-90^{\circ} + n \cdot 360^{\circ}$
- 98. $-180^{\circ} + n \cdot 360^{\circ}$
- 99. $0^{\circ} + n \cdot 360^{\circ}$ or $n \cdot 360^{\circ}$

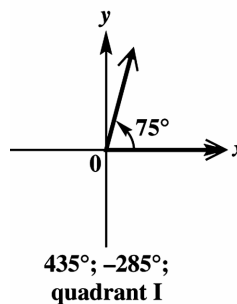
100. $360^{\circ} + n \cdot 360^{\circ}$, or $n \cdot 360^{\circ}$

101. The answers to Exercises 99 and 100 give the same set of angles since 0° is coterminal with $0^{\circ} + 360^{\circ} = 360^{\circ}$.

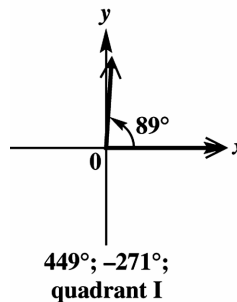
102. C and D

For Exercises 103–114, angles other than those given are possible.

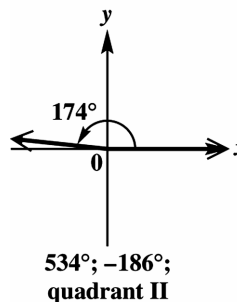
103.



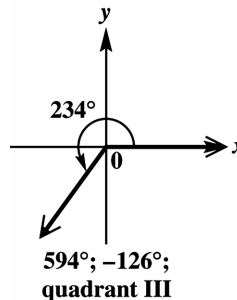
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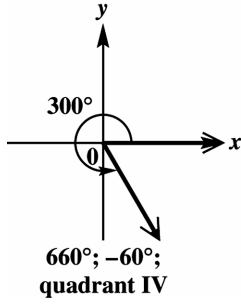
105.



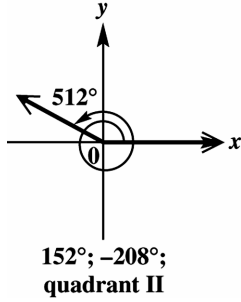
106.



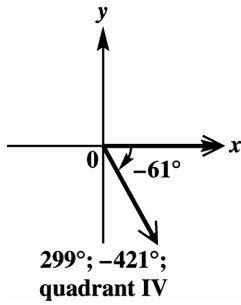
107.



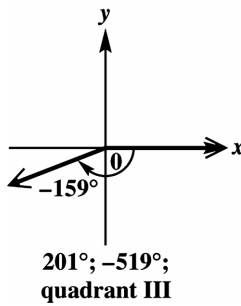
108.



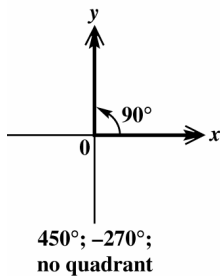
109.



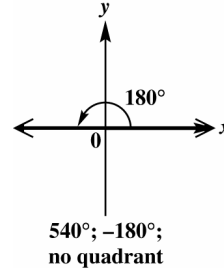
110.



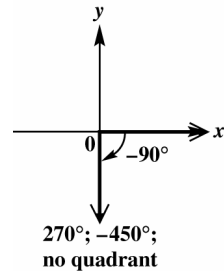
111.



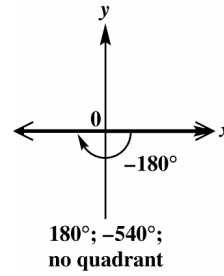
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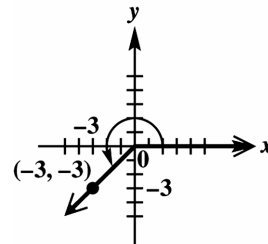
113.



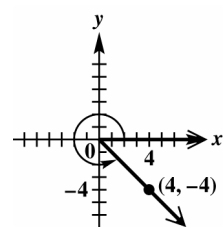
114.



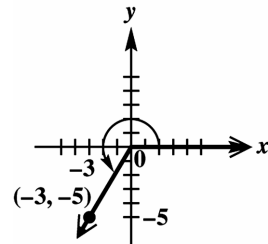
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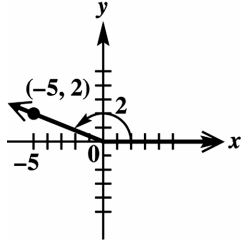
116.



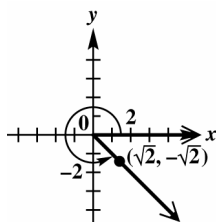
117.



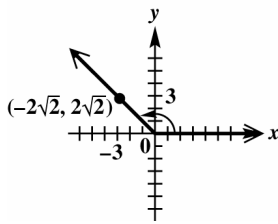
118.



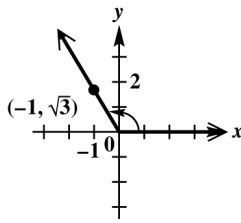
119.



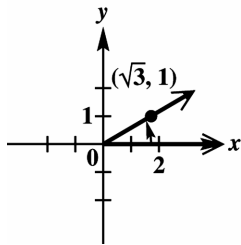
120.



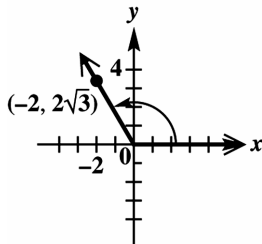
121.



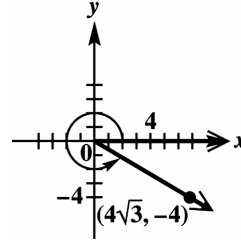
122.



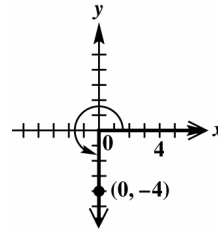
123.



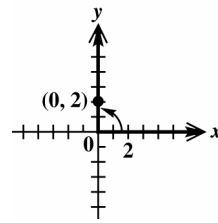
124.



125.



126.



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

128. 1.5

129. 1800°

130. 6000°

131. 12.5 rotations in 1 hr.

132. $5'$ or $.08^\circ$

133. 4 sec

134. 36° .

Section 1.2: Angle Relationships and Similar Triangles

1. $55^\circ; 65^\circ$
 $60^\circ; 60^\circ$
 $60^\circ; 120^\circ$
 $60^\circ; 60^\circ$
 $55^\circ; 55^\circ$

2. You can determine the measure of angle 2. Since the measure of angle 2 is the same as measures of angles 3, 6, and 8, you know the measures of all eight angles.

3. $51^\circ; 51^\circ$
4. 139° and 139°
5. $50^\circ, 60^\circ,$ and 70°

6. 20° , 30° , and 130°
 7. 60° ; 60° ; 60°
 8. 60° ; 60° ; 60°
 9. 45° , 75° , and 120°
 10. 20° , 35° , and 55°
 11. 49° ; 49°
 12. 117° ; 117°
 13. 48° ; 132°
 14. 141° ; 141°
 15. 91°
 16. 47°
 17. $2^\circ 29'$
 18. $1^\circ 32'$
 19. 25.4°
 20. 100.7°
 21. $22^\circ 29' 34''$
 22. $66^\circ 06' 37''$
 23. A triangle cannot have angles of measures 85° and 100° . The sum of the measures of these two angles is $85^\circ + 100^\circ = 185^\circ$, which exceeds 180° .
 24. A triangle cannot have two obtuse angles. Since an obtuse angle measures between 90° and 180° , the sum of two obtuse angles would be between 180° and 360° , which exceeds 180° .
 25. right; scalene
 26. obtuse; scalene.
 27. acute; equilateral
 28. acute; isosceles.
 29. right; scalene.
 30. obtuse; isosceles.
 31. right; isosceles.
 32. right; scalene.
 33. obtuse; scalene.
 34. acute; equilateral.
 35. acute; isosceles.
 36. right; scalene.
 37.–39. Answers will vary.
 40. Connect the right end of the semicircle to the point where the arc crosses the semicircle. Since the setting of the compass has never changed, the triangle is equilateral. Therefore, each of its angles measures 60° .
 41. A and P , B and Q , C and R . AC and PR , BC and QR , AB and PQ .
 42. A and P , C and R , B and Q .
 AC and PR , CB and RQ , AB and PQ .
 43. A and C , E and D , ABE and CBD .
 EB and DB , AB and CB , AE and CD
 44. H and F , K and E , HGK and FGE .
 HK and FE , GK and GE , HG and FG .
 45. Q is 42° ; $B = R = 48^\circ$.
 46. P is 78° ; $M = 46^\circ$
 $A = N = 56^\circ$
 47. B is 106° ; $A = M = 44^\circ$.
 48. T is 74° ; Y is 28° ; $Z = W = 78^\circ$.
 49. $X = M = 52^\circ$
 50. T is 20° ; V is 64° ; $R = U = 96^\circ$
- In Exercises 51–56, corresponding sides of similar triangles are proportional. Other proportions are possible in solving these exercises.
51. $a = 20$; $b = 15$
 52. $a = 30$; $b = 60$
 53. $a = 6$; $b = 7\frac{1}{2}$
 54. $a = 2$
 55. $x = 6$
 56. $m = 18$
 57. 30 m
 58. 108 ft
 59. 500 m; 700 m
 60. 14 m
 61. 112.5 ft
 62. $506\frac{2}{3}$ ft
 63. $x = 110$
 64. $y = 12$
 65. $c \approx 111.1$
 66. $m \approx 85.3$
 67. The unknown side in the first quadrilateral is 40 cm. The unknown sides in the second quadrilateral are 27 cm and 36 cm.
 68. Phoenix to Tucson is about 153.3 km. Tucson to Yuma is about 325.8 km.
 69. (a) $\approx 236,000$ mi (b) No
 70. (a) $\approx 5,438,000$ mi (b) Yes

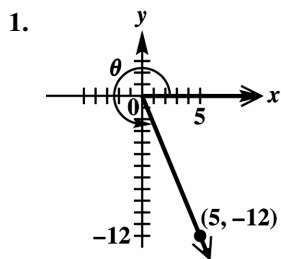
71. (a) ≈ 2900 mi (b) No
 72. (a) $\approx 1,830,000$ mi (b) Yes
 73. (a) approximately $\frac{1}{4}$
 (b) approximately 30 arc degrees.
 74. $x = 10; y = 2$.
 75. $x = 10; y = 5$.

Chapter 1 Quiz

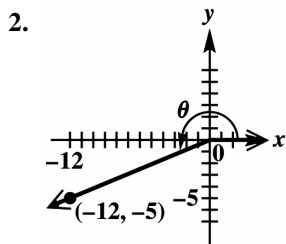
(Sections 1.1–1.2)

1. (a) 71° (b) 161°
 2. $65^\circ; 115^\circ$
 3. $64^\circ; 26^\circ$.
 4. $24^\circ, 136^\circ$, and 20°
 5. $130^\circ; 50^\circ$
 6. (a) 77.2025° (b) $22^\circ 1' 30''$
 7. (a) 50° . (b) 300° .
 (c) 170° . (d) 417° .
 8. 1800°
 9. 10 ft
 10. $x = 12; y = 10$

Section 1.3: Trigonometric Functions



$$-\frac{12}{13}; \frac{5}{13}; -\frac{12}{5}; \frac{13}{5}; -\frac{13}{12}$$



$$-\frac{5}{13}; -\frac{12}{13}; \frac{5}{12}; \frac{12}{5}; -\frac{13}{12}; -\frac{13}{5}$$

3. $\frac{4}{5}; -\frac{3}{5}; -\frac{4}{3}; -\frac{3}{4}; -\frac{5}{3}; \frac{5}{4}$
 4. $-\frac{3}{5}; -\frac{4}{5}; \frac{3}{4}; \frac{4}{3}; -\frac{5}{4}; -\frac{5}{3}$
 5. $\frac{15}{17}; -\frac{8}{17}; -\frac{15}{8}; -\frac{8}{15}; -\frac{17}{8}; \frac{17}{15}$
 6. $-\frac{8}{17}; \frac{15}{17}; -\frac{8}{15}; -\frac{15}{8}; \frac{17}{15}; -\frac{17}{8}$
 7. $-\frac{24}{25}; \frac{7}{25}; -\frac{24}{7}; -\frac{7}{24}; \frac{25}{7}; -\frac{25}{24}$
 8. $-\frac{7}{25}; -\frac{24}{25}; \frac{7}{24}; \frac{24}{7}; -\frac{25}{24}; -\frac{25}{7}$
 9. 1; 0; undefined; 0; undefined; 1
 10. 1; 0; undefined; 0; undefined; 1
 11. 0; -1; 0; undefined; -1; undefined
 12. 0; -1; 0; undefined; -1; undefined
 13. -1; 0; undefined; 0; undefined; -1
 14. -1; 0; undefined; 0; undefined; -1
 15. $\frac{\sqrt{3}}{2}; \frac{1}{2}; \sqrt{3}; \frac{\sqrt{3}}{3}; 2; \frac{2\sqrt{3}}{3}$
 16. $\frac{\sqrt{3}}{2}; -\frac{1}{2}; -\sqrt{3}; -\frac{\sqrt{3}}{3}; -2; \frac{2\sqrt{3}}{3}$
 17. $\frac{\sqrt{2}}{2}; \frac{\sqrt{2}}{2}; 1; 1; \sqrt{2}; \sqrt{2}$
 18. $-\frac{\sqrt{2}}{2}; -\frac{\sqrt{2}}{2}; 1; 1; -\sqrt{2}; -\sqrt{2}$
 19. $-\frac{1}{2}; -\frac{\sqrt{3}}{2}; \frac{\sqrt{3}}{3}; \sqrt{3}; -\frac{2\sqrt{3}}{3}; -2$
 20. $\frac{1}{2}; -\frac{\sqrt{3}}{2}; -\frac{\sqrt{3}}{3}; -\sqrt{3}; -\frac{2\sqrt{3}}{3}; 2$
 21. Answers will vary. For any nonquadrantal angle θ , a point on the terminal side of θ will be of the form (x, y) where $x, y \neq 0$.
 Now $\sin \theta = \frac{y}{r}$ and $\csc \theta = \frac{r}{y}$ both exist and are simply reciprocals of each other, and hence will have the same sign.
 22. r is the distance from (x, y) to the origin.
 23. 0

24. $\tan \theta$ and $\cot \theta$ are positive; all other function values are negative.

In Exercises 25–44, $r = \sqrt{x^2 + y^2}$, which is positive.

25. negative. 26. negative.
 27. negative. 28. negative.
 29. positive. 30. negative.
 31. positive. 32. negative.
 33. negative. 34. negative.
 35. positive. 36. positive.
 37. negative. 38. negative.
 39. positive. 40. positive.
 41. positive. 42. positive.
 43. positive. 44. positive.
45. $-\frac{2\sqrt{5}}{5}; \frac{\sqrt{5}}{5}; -2; -\frac{1}{2}; \sqrt{5}; -\frac{\sqrt{5}}{2}$
 46. $-\frac{3\sqrt{34}}{34}; \frac{5\sqrt{34}}{34}; -\frac{3}{5}; -\frac{5}{3}; \frac{\sqrt{34}}{5}; -\frac{\sqrt{34}}{3}$
 47. $\frac{6\sqrt{37}}{37}; -\frac{\sqrt{37}}{37}; -6; -\frac{1}{6}; -\sqrt{37}; \frac{\sqrt{37}}{6}$
 48. $\frac{5\sqrt{34}}{34}; -\frac{3\sqrt{34}}{34}; -\frac{5}{3}; -\frac{3}{5}; -\frac{\sqrt{34}}{3}; \frac{\sqrt{34}}{5}$
 49. $-\frac{4\sqrt{65}}{65}; -\frac{7\sqrt{65}}{65}; \frac{4}{7}; \frac{7}{4}; -\frac{\sqrt{65}}{7}; -\frac{\sqrt{65}}{4}$
 50. $\frac{6\sqrt{61}}{61}; \frac{5\sqrt{61}}{61}; \frac{6}{5}; \frac{5}{6}; \frac{\sqrt{61}}{5}; \frac{\sqrt{61}}{6}$
 51. $-\frac{\sqrt{2}}{2}; \frac{\sqrt{2}}{2}; -1; -1; \sqrt{2}; -\sqrt{2}$
 52. $\frac{\sqrt{2}}{2}; \frac{\sqrt{2}}{2}; 1; 1; \sqrt{2}; \sqrt{2}$
 53. $-\frac{\sqrt{3}}{2}; -\frac{1}{2}; \sqrt{3}; \frac{\sqrt{3}}{3}; -2; -\frac{2\sqrt{3}}{3}$
 54. $\frac{\sqrt{3}}{2}; -\frac{1}{2}; -\sqrt{3}; -\frac{\sqrt{3}}{3}; -2; \frac{2\sqrt{3}}{3}$
 55. 0 56. 1
 57. 0 58. 0
 59. -1 60. -1
 61. 1 62. 0
 63. undefined 64. undefined
 65. -1 66. -1

67. 0 68. 1
 69. undefined 70. undefined
 71. 1 72. 0
 73. -3 74. -6
 75. -3 76. -7
 77. 5 78. 3
 79. 1 80. 1
 81. 0 82. 5
 83. 0 84. -7
 85. 0 86. 0
 87. 0 88. undefined
 89. -1 90. undefined
 91. 0 92. 1
 93. undefined 94. undefined
 95. They are equal.
 96. They are equal.
 97. The sines are negatives of each other.
 98. The cosines are equal.

In Exercises 99–104, make sure your calculator is in the modes indicated in the instructions.

99. about .940, and $\sin 20^\circ$ is about .342.
 100. $T = 40^\circ$.
 101. $T = 35^\circ$.
 102. $T = 45^\circ$.
 103. decreases; increases.
 104. decreases; decreases.

Section 1.4: Using the Definitions of the Trigonometric Functions

1. $\frac{3}{2}$ 2. $\frac{8}{5}$
 3. $-\frac{7}{3}$ 4. $-\frac{43}{8}$
 5. $\frac{1}{5}$ 6. $\frac{1}{18}$
 7. $-\frac{2}{5}$ 8. $-\frac{7}{11}$
 9. $\frac{\sqrt{2}}{2}$ 10. $\frac{\sqrt{6}}{4}$
 11. -4 12. -100
 13. .70069071
 14. .10199657

15. No
16. The value of $\cos \theta$ cannot exceed 1.
17. Since $\tan 90^\circ$ is undefined, it does not have a reciprocal.
18. $\cot \theta = \frac{1}{\tan \theta}$.
19. All are positive.
20. All are positive.
21. Tangent and cotangent are positive; all others are negative.
22. Tangent and cotangent are positive; all others are negative.
23. Sine and cosecant are positive; all others are negative.
24. Sine and cosecant are positive; all others are negative.
25. Cosine and secant are positive; all others are negative.
26. Cosine and secant are positive; all others are negative.
27. Sine and cosecant are positive; all others are negative.
28. Cosine and secant are positive; all others are negative.
29. All are positive.
30. All are positive.
31. I, II 32. I, IV 33. I
34. I 35. II 36. III
37. I 38. I 39. III
40. II 41. III, IV 42. II, IV
45. impossible 46. impossible
47. possible 48. possible
49. possible 50. possible
51. impossible 52. impossible
53. possible 54. possible
55. possible 56. possible
57. possible 58. impossible
59. impossible 61. $-\frac{4}{5}$
62. $-\frac{3}{5}$ 63. $-\frac{\sqrt{5}}{2}$

64. $-\frac{4}{3}$ 65. $-\frac{\sqrt{3}}{3}$

66. $\sqrt{3}$

67. 3.44701905

68. -0.56616682

In Exercises 69-80, we give, in order, sine, cosine, tangent, cotangent, secant, and cosecant.

69. $\frac{15}{17}; -\frac{8}{17}; -\frac{15}{8}; -\frac{8}{15}; -\frac{17}{8}; \frac{17}{15}$

70. $-\frac{4}{5}; -\frac{3}{5}; \frac{4}{3}; \frac{3}{4}; -\frac{5}{3}; -\frac{5}{4}$

71. $\frac{\sqrt{5}}{7}; \frac{2\sqrt{11}}{7}; \frac{\sqrt{55}}{22}; \frac{2\sqrt{55}}{5}; \frac{7\sqrt{11}}{22}; \frac{7\sqrt{5}}{5}$

72. $-\frac{\sqrt{3}}{2}; -\frac{1}{2}; \sqrt{3}; \frac{\sqrt{3}}{3}; -2; -\frac{2\sqrt{3}}{3}$

73. $\frac{8\sqrt{67}}{67}; \frac{\sqrt{201}}{67}; \frac{8\sqrt{3}}{3}; \frac{\sqrt{3}}{8}; \frac{\sqrt{201}}{3}; \frac{\sqrt{67}}{8}$

74. $\frac{1}{2}; -\frac{\sqrt{3}}{2}; -\frac{\sqrt{3}}{3}; -\sqrt{3}; -\frac{2\sqrt{3}}{3}; 2$

75. $\frac{\sqrt{2}}{6}; -\frac{\sqrt{34}}{6}; -\frac{\sqrt{17}}{17}; -\sqrt{17}; -\frac{3\sqrt{34}}{17}; 3\sqrt{2}$

76. $-\frac{\sqrt{59}}{8}; \frac{\sqrt{5}}{8}; -\frac{\sqrt{295}}{5}; -\frac{\sqrt{295}}{59}; \frac{8\sqrt{5}}{5}; -\frac{8\sqrt{59}}{59}$

77. $\frac{\sqrt{15}}{4}; -\frac{1}{4}; -\sqrt{15}; -\frac{\sqrt{15}}{15}; -4; \frac{4\sqrt{15}}{15}$

78. $-\frac{1}{3}; \frac{2\sqrt{2}}{3}; -\frac{\sqrt{2}}{4}; -2\sqrt{2}; \frac{3\sqrt{2}}{4}; -3$

79. .164215 ; -.986425 ; -.166475 ; -6.00691
-1.01376 ; 6.08958

80. $-.555762 ; .831342 ; -.668512 ; -1.49586$
1.20287 ; -1.79933

82. $\cot \theta$

83. The statement is false. For example,
 $\sin 180^\circ + \cos 180^\circ = 0 + (-1) = -1 \neq 1$.

84. This statement is false. There is no value for u
for which $\sin \theta = 2$.

85. negative 86. positive

87. negative 88. negative

89. positive 90. negative
 91. positive 92. negative
 93. 2° 94. 1°
 95. 3° 96. 5°

97. Quadrant II is the only quadrant in which the cosine is negative and the sine is positive.

98. III

Chapter 1 Review Exercises

- complement of 55° ; supplement of 145°
- 309°
- 186°
- 72°
- $y = 30^\circ$; $x = 30^\circ$
- 1280° in $\frac{2}{3}$ sec.
- 9360° in 2.4 sec.
- 47.420°
- 119.134°
- $-61^\circ 30' 12''$
- $275^\circ 6' 2''$
- $58^\circ, 58^\circ$
- $40^\circ, 60^\circ$, and 80° .
- $\theta = \beta - \alpha$
- $BA = .25$ km
- $V = 41^\circ$; $Z = 32^\circ$; $m\angle Y = 107^\circ$
 Since angle U corresponds to angle Y , the measure of angle U is 107° .
- $N = 12^\circ$; $R = 82^\circ$; $M = 86^\circ$
- $m = 45$
 $n = 60$
- $p = q = 7$.
- $r = 15.4$
- 14
- proportional; equal.
- 12 ft
- $-\frac{\sqrt{2}}{2}$; $-\frac{\sqrt{2}}{2}$; 1; 1; $-\sqrt{2}$; $-\sqrt{2}$
- $-\frac{\sqrt{3}}{2}$; $\frac{1}{2}$; $-\sqrt{3}$; $-\frac{\sqrt{3}}{3}$; 2; $-\frac{2\sqrt{3}}{3}$

26. 0 ; -1 ; 0 ; $\frac{-1}{0}$ undefined; -1 ; $\frac{1}{0}$ undefined

27. $-\frac{4}{5}$; $\frac{3}{5}$; $-\frac{4}{3}$; $-\frac{3}{4}$; $\frac{5}{3}$; $-\frac{5}{4}$

28. $-\frac{2\sqrt{85}}{85}$; $\frac{9\sqrt{85}}{85}$; $-\frac{2}{9}$; $-\frac{9}{2}$; $\frac{\sqrt{85}}{9}$; $-\frac{\sqrt{85}}{2}$

29. $\frac{15}{17}$; $-\frac{8}{17}$; $-\frac{15}{8}$; $-\frac{8}{15}$; $-\frac{17}{8}$; $\frac{17}{15}$

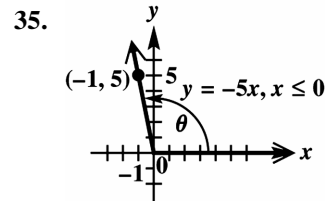
30. $-\frac{5\sqrt{26}}{26}$; $\frac{\sqrt{26}}{26}$; -5 ; $-\frac{1}{5}$; $\sqrt{26}$; $-\frac{\sqrt{26}}{5}$

31. $-\frac{1}{2}$; $\frac{\sqrt{3}}{2}$; $-\frac{\sqrt{3}}{3}$; $-\sqrt{3}$; $\frac{2\sqrt{3}}{3}$; -2

32. $\frac{\sqrt{2}}{2}$; $-\frac{\sqrt{2}}{2}$; -1 ; -1 ; $-\sqrt{2}$; $\sqrt{2}$

33. The tangent and secant are undefined.

34. $\frac{5\sqrt{34}}{34}$; $\frac{3\sqrt{34}}{34}$; $\frac{5}{3}$; $\frac{3}{5}$; $\frac{\sqrt{34}}{3}$; $\frac{\sqrt{34}}{5}$



36. $\sin \theta = \frac{5\sqrt{26}}{26}$; $\cos \theta = -\frac{\sqrt{26}}{26}$; $\tan \theta = -5$

$\cot \theta = -\frac{1}{5}$; $\sec \theta = -\sqrt{26}$; $\csc \theta = \frac{\sqrt{26}}{5}$

37. 0 , -1 , 0 ; undefined; -1 ; undefined

38. -1 , 0 ; undefined; 0 ; undefined; -1

39. (a) Impossible (b) Possible

(c) Possible

40. $\frac{\sqrt{3}}{5}$; $-\frac{\sqrt{22}}{5}$; $-\frac{\sqrt{66}}{22}$; $-\frac{\sqrt{66}}{3}$; $-\frac{5\sqrt{22}}{22}$;

$\frac{5\sqrt{3}}{3}$

41. $-\frac{\sqrt{39}}{8}$; $-\frac{5}{8}$; $\frac{\sqrt{39}}{5}$; $\frac{5\sqrt{39}}{39}$; $-\frac{8}{5}$; $-\frac{8\sqrt{39}}{39}$

42. $-\frac{2\sqrt{5}}{5}$; $-\frac{\sqrt{5}}{5}$; 2; $\frac{1}{2}$; $-\sqrt{5}$; $-\frac{\sqrt{5}}{2}$

43. $\frac{2\sqrt{5}}{5}$; $-\frac{\sqrt{5}}{5}$; -2 ; $-\frac{1}{2}$; $-\sqrt{5}$; $\frac{\sqrt{5}}{2}$

44. $-\frac{2}{5}; -\frac{\sqrt{21}}{5}; \frac{2\sqrt{21}}{21}; \frac{\sqrt{21}}{2}; -\frac{5\sqrt{21}}{21}; -\frac{5}{2}$

45. $-\frac{3}{5}; \frac{4}{5}; -\frac{3}{4}; -\frac{4}{3}; \frac{5}{4}; -\frac{5}{3}$

46. quadrant IV; negative.

47. 40 yards

48. 50 sec/yr

49. about 9500 feet deep.

50. 13,500 feet tall.

Chapter 1 Test

1. (a) 23° (b) 113°

2. 145° and 35° .

3. 20° and 70° .

4. The angles each measure 130° .

5. The angles each measure 110° .

6. The three angles measure 30° , 130° , and 20° .

7. (a) 74.31° (b) $45^\circ 12' 9''$

8. (a) 30° (b) 280°

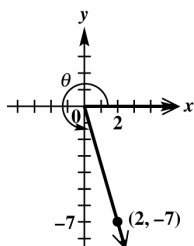
(c) 90°

9. 2700° in one second.

10. $10\frac{2}{3}$ ft, or 10 ft, 8 in.

11. $x = 8; y = 6$

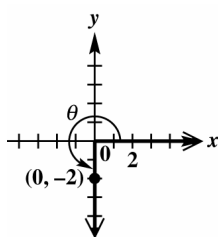
12.



$$\sin \theta = -\frac{7\sqrt{53}}{53}; \cos \theta = \frac{2\sqrt{53}}{53}; \tan \theta = -\frac{7}{2};$$

$$\cot \theta = -\frac{2}{7}; \sec \theta = \frac{\sqrt{53}}{2}; \csc \theta = -\frac{\sqrt{53}}{7}$$

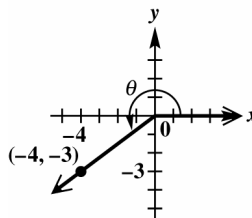
13.



$$\sin \theta = -1; \cos \theta = 0; \tan \theta = \frac{-2}{0} \text{ undefined};$$

$$\cot \theta = 0; \sec \theta = \frac{2}{0} \text{ undefined}; \csc \theta = -1$$

14.



$$3x - 4y = 0, x < 0$$

$$\sin \theta = -\frac{3}{5}; \cos \theta = -\frac{4}{5}; \tan \theta = \frac{3}{4};$$

$$\cot \theta = \frac{4}{3}; \sec \theta = -\frac{5}{4}; \csc \theta = -\frac{5}{3}$$

15. row 1: 1, 0, undefined, 0, undefined, 1;
row 2: 0, 1, 0, undefined, 1, undefined;
row 3: -1, 0, undefined, 0, undefined, -1.

16. undefined.

17. (a) I (b) III and IV.

(c) III

18. (a) Impossible (b) Possible

(c) Possible

19. $\sec \theta = -\frac{12}{7}$

20. $\cos \theta = -\frac{2\sqrt{10}}{7}; \tan \theta = -\frac{3\sqrt{10}}{20};$

$$\cot \theta = \frac{-2\sqrt{10}}{7}; \sec \theta = -\frac{7\sqrt{10}}{20};$$

$$\csc \theta = \frac{7}{3}$$

Chapter 1 Quantitative Reasoning

Step 1: The ratios of corresponding sides of similar triangles CAG and HAD are equal and $HD = 1$.

Step 2: The ratios of corresponding sides of similar triangles AGE and ADB are equal.

Step 3: $EF = BD = 1$ pace

Step 4: From Steps 1-3,

$$CG = \frac{AG}{AD} = \frac{EG}{EF} = \frac{EG}{1} = EG.$$

The height of the tree (in feet) is (approximately) the number of paces.