

Answer Key

Practice A

1. $\sin \theta = \frac{6\sqrt{85}}{85}$; $\cos \theta = \frac{7\sqrt{85}}{85}$;

$\tan \theta = \frac{6}{7}$; $\cot \theta = \frac{7}{6}$; $\sec \theta = \frac{\sqrt{85}}{7}$; $\csc \theta = \frac{\sqrt{85}}{6}$

2. $\sin \theta = \frac{3\sqrt{13}}{13}$; $\cos \theta = \frac{2\sqrt{13}}{13}$;

$\tan \theta = \frac{3}{2}$; $\cot \theta = \frac{2}{3}$; $\sec \theta = \frac{\sqrt{13}}{2}$; $\csc \theta = \frac{\sqrt{13}}{3}$

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

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

4. $\sin \theta = \frac{\sqrt{26}}{26}$; $\cos \theta = \frac{5\sqrt{26}}{26}$;

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

5. $\sin \theta = \frac{1}{6}$; $\cos \theta = \frac{\sqrt{35}}{6}$; $\tan \theta = \frac{\sqrt{35}}{35}$;

$\cot \theta = \sqrt{35}$; $\sec \theta = \frac{6\sqrt{35}}{35}$; $\csc \theta = 6$

6. $\sin \theta = \frac{5\sqrt{34}}{34}$; $\cos \theta = \frac{3\sqrt{34}}{34}$; $\tan \theta = \frac{5}{3}$;

$\cot \theta = \frac{3}{5}$; $\sec \theta = \frac{\sqrt{34}}{3}$; $\csc \theta = \frac{\sqrt{34}}{5}$

7. $x = 8$; $y = 4\sqrt{3}$ 8. $x = 4\sqrt{3}$; $y = 4$

9. $x = 2\sqrt{2}$; $y = 2\sqrt{2}$ 10. 0.2588

11. 0.6820 12. 2.1445 13. 3.2361

14. 1.1034 15. 0.5317 16. 0.9848

17. 0.9848 18. $A = 78^\circ$; $b \approx 0.9$; $c \approx 4.1$

19. $B = 16^\circ$; $a \approx 19.2$; $b \approx 5.5$

20. $B = 40^\circ$; $a \approx 9.5$; $c \approx 12.4$

21. $A = 52^\circ$; $a \approx 5.5$; $b \approx 4.3$

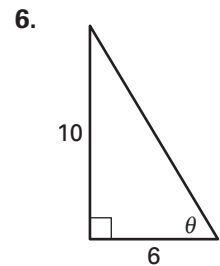
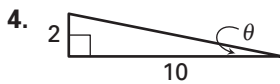
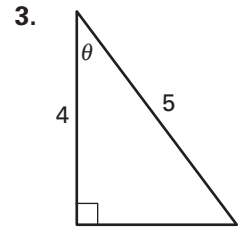
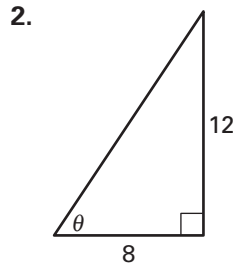
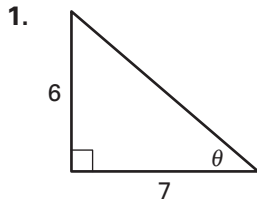
22. $B = 18^\circ$; $a \approx 55.4$; $c \approx 58.2$

23. $A = 68^\circ$; $b \approx 2.0$; $c \approx 5.4$ 24. about 346 ft

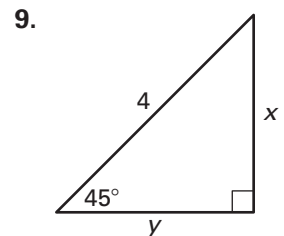
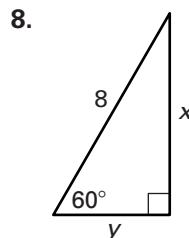
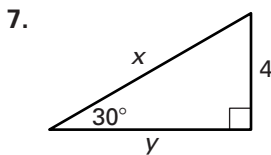
Practice A

For use with pages 769–775

Evaluate the six trigonometric functions of the angle θ .



Find the missing side lengths x and y .



Use a calculator to evaluate the trigonometric function. Round the result to four decimal places.

10. $\sin 15^\circ$

11. $\cos 47^\circ$

12. $\tan 65^\circ$

13. $\csc 18^\circ$

14. $\sec 25^\circ$

15. $\cot 62^\circ$

16. $\sin 80^\circ$

17. $\cos 10^\circ$

Solve $\triangle ABC$ using the diagram and the given measurements.

18. $B = 12^\circ, a = 4$

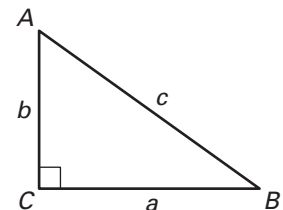
19. $A = 74^\circ, c = 20$

20. $A = 50^\circ, b = 8$

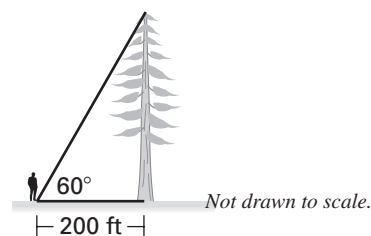
21. $B = 38^\circ, c = 7$

22. $A = 72^\circ, b = 18$

23. $B = 22^\circ, a = 5$



24. **Redwood Trees** You are standing 200 feet from the base of a redwood tree. You estimate the angle of elevation to the top of the tree is 60° . What is the approximate height of the tree?



Answer Key

Practice B

1. $\sin \theta = \frac{8}{17}$; $\cos \theta = \frac{15}{17}$; $\tan \theta = \frac{8}{15}$;

$\cot \theta = \frac{15}{8}$; $\sec \theta = \frac{17}{15}$; $\csc \theta = \frac{17}{8}$

2. $\sin \theta = \frac{2}{5}$; $\cos \theta = \frac{\sqrt{21}}{5}$; $\tan \theta = \frac{2\sqrt{21}}{21}$;

$\cot \theta = \frac{\sqrt{21}}{2}$; $\sec \theta = \frac{5\sqrt{21}}{21}$; $\csc \theta = \frac{5}{2}$

3. $\sin \theta = \frac{2\sqrt{2}}{3}$; $\cos \theta = \frac{1}{3}$; $\tan \theta = 2\sqrt{2}$;

$\cot \theta = \frac{\sqrt{2}}{4}$; $\sec \theta = 3$; $\csc \theta = \frac{3\sqrt{2}}{4}$

4. $x = 7\sqrt{2}$; $y = 7$ 5. $x = 5$; $y = 5\sqrt{3}$

6. $x = 2\sqrt{3}$; $y = \sqrt{3}$ 7. 0.8910

8. 0.0875 9. 0.7431 10. 0.1584

11. 2.5593 12. 2.4586 13. 4.3315

14. 0.5299

15. $B = 44^\circ$; $a \approx 8.3$; $c \approx 11.5$

16. $A = 66^\circ$; $a \approx 11.9$; $b \approx 5.3$

17. $A = 72^\circ$; $a \approx 9.5$; $b \approx 3.1$

18. $B = 35^\circ$; $b \approx 14.0$; $c \approx 24.4$

19. $A = 20^\circ$; $b \approx 16.5$; $c \approx 17.5$

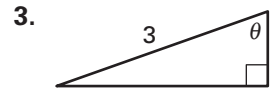
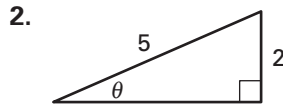
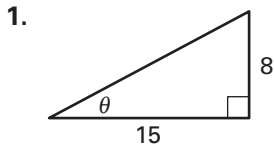
20. $B = 83^\circ$; $a \approx 2.2$; $c \approx 18.1$

21. about 14.4 ft 22. about 21,477 ft or 4.1 mi

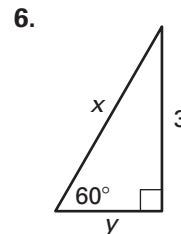
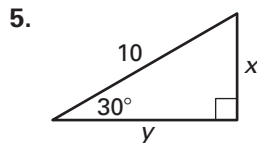
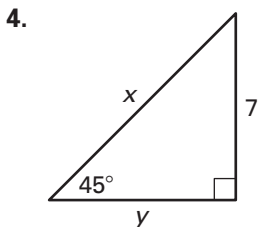
Practice B

For use with pages 769–775

Evaluate the six trigonometric functions of the angle θ .



Find the missing side lengths x and y .



Use a calculator to evaluate the trigonometric function. Round the result to four decimal places.

7. $\cos 27^\circ$

8. $\tan 5^\circ$

9. $\sin 48^\circ$

10. $\cot 81^\circ$

11. $\csc 23^\circ$

12. $\sec 66^\circ$

13. $\cot 13^\circ$

14. $\sin 32^\circ$

Solve $\triangle ABC$ using the diagram and the given measurements.

15. $A = 46^\circ, b = 8$

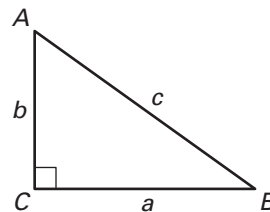
16. $B = 24^\circ, c = 13$

17. $B = 18^\circ, c = 10$

18. $A = 55^\circ, a = 20$

19. $B = 70^\circ, a = 6$

20. $A = 7^\circ, b = 18$



21. **Flagpole** You are standing 25 feet from the base of a flagpole. The angle of elevation to the top of the flagpole is 30° . What is the height of the flagpole to the nearest tenth?

22. **Mount Fuji** Mt. Fuji in Japan is approximately 12,400 feet high. Standing several miles away, you estimate the angle of elevation to the top of the mountain is 30° . Approximately how far away are you from the base of the mountain?

Answer Key

Practice C

1. $\sin \theta = \frac{10}{13}$; $\cos \theta = \frac{\sqrt{69}}{13}$; $\tan \theta = \frac{10\sqrt{69}}{69}$;

$\cot \theta = \frac{\sqrt{69}}{10}$; $\sec \theta = \frac{13\sqrt{69}}{69}$; $\csc \theta = \frac{13}{10}$

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

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

3. $\sin \theta = \frac{1}{2}$; $\cos \theta = \frac{\sqrt{3}}{2}$; $\tan \theta = \frac{\sqrt{3}}{3}$;

$\cot \theta = \sqrt{3}$; $\sec \theta = \frac{2\sqrt{3}}{3}$; $\csc \theta = 2$

4. $x = 10$; $y = 5\sqrt{3}$ 5. $x = 4\sqrt{2}$; $y = 4\sqrt{2}$

6. $x = 16\sqrt{3}$; $y = 32$ 7. 0.1763

8. 1.5557 9. 0.7771 10. 0.0175

11. 1.1434 12. 0.9986 13. 1.2799

14. 2.5593 15. $B = 76^\circ$; $b \approx 24.1$; $c \approx 24.8$

16. $B = 33^\circ$; $a \approx 18.5$; $c \approx 22.0$

17. $A = 58^\circ$; $a \approx 17.3$; $b \approx 10.8$

18. $B = 26^\circ$; $a \approx 11.5$; $b \approx 5.6$

19. $A = 17^\circ$; $b \approx 55.6$; $c \approx 58.1$

20. $A = 80^\circ$; $a \approx 79.4$; $c \approx 80.6$

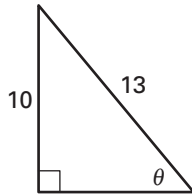
21. about 66.78 ft or 66 ft 9 in.

Practice C

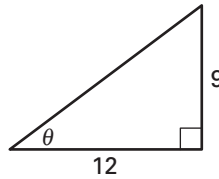
For use with pages 769–775

Evaluate the six trigonometric functions of the angle θ .

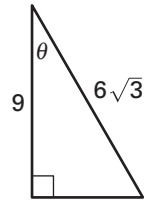
1.



2.

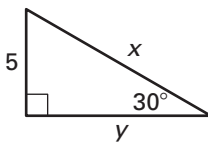


3.

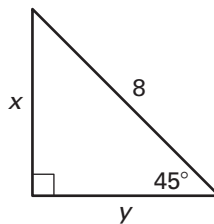


Find the missing side lengths x and y .

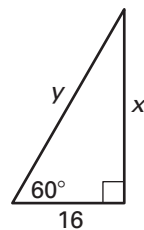
4.



5.



6.



Use a calculator to evaluate the trigonometric function. Round the result to four decimal places.

7. $\tan 10^\circ$

8. $\csc 40^\circ$

9. $\sin 51^\circ$

10. $\cos 89^\circ$

11. $\sec 29^\circ$

12. $\cos 3^\circ$

13. $\cot 38^\circ$

14. $\sec 67^\circ$

Solve $\triangle ABC$ using the diagram and the given measurements.

15. $A = 14^\circ, a = 6$

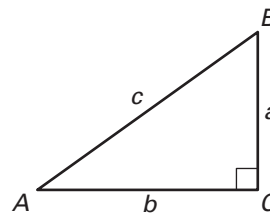
16. $A = 57^\circ, b = 12$

17. $B = 32^\circ, c = 20.4$

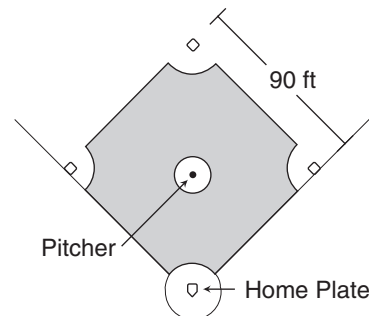
18. $A = 64^\circ, c = 12.8$

19. $B = 73^\circ, a = 17$

20. $B = 10^\circ, b = 14$



21. **Baseball Diamond** A baseball diamond is laid out so that the bases are 90 feet apart and at right angles as shown at the right. The distance from home plate to the pitcher's mound is 60 feet 6 inches. Find the distance from the pitcher's mound to second base. (*Hint: The pitcher's mound is not exactly halfway between home plate and second base.*)

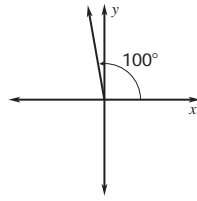


Answer Key

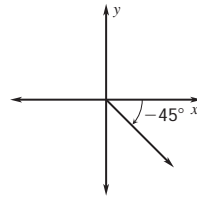
Practice A

1. B 2. A 3. C

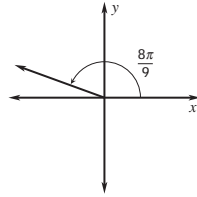
4.



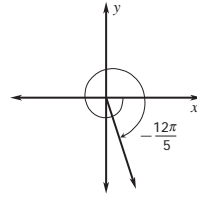
5.



6.



7.



8–11. Sample angles are given.

8. 585° ; -135° 9. 420° ; -300° 10. $\frac{3\pi}{2}$; $-\frac{\pi}{2}$

11. $\frac{6\pi}{5}$; $-\frac{4\pi}{5}$ 12. $\frac{3\pi}{4}$ 13. $\frac{2\pi}{9}$ 14. $\frac{13\pi}{9}$

15. $\frac{43\pi}{36}$ 16. 105° 17. -150° 18. 120°

19. 30° 20. $\frac{2\pi}{3}$ in.; $\frac{4\pi}{3}$ in.² 21. $\frac{5\pi}{12}$ m; $\frac{25\pi}{24}$ m²

22. 14π cm; 84π cm² 23. $\frac{1}{2}$ 24. 1

25. 0.9511 26. 0.9239 27. about 4.19 ft

Practice A

For use with pages 776–783

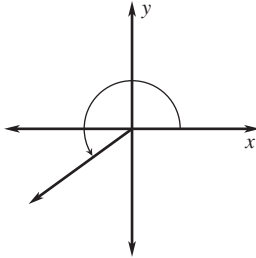
Match the angle measure with the angle.

1. -320°

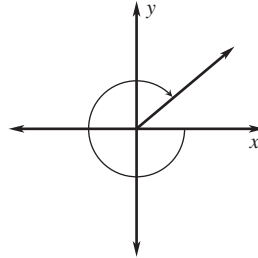
2. $\frac{6\pi}{5}$

3. $\frac{7\pi}{4}$

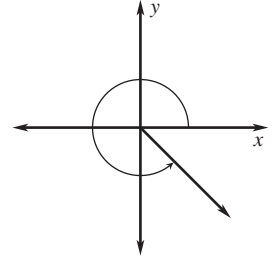
A.



B.



C.



Draw an angle with the given measure in standard position.

4. 100°

5. -45°

6. $\frac{8\pi}{9}$

7. $-\frac{12\pi}{5}$

Find one positive angle and one negative angle coterminal with the given angle.

8. 225°

9. 60°

10. $\frac{15\pi}{2}$

11. $\frac{16\pi}{5}$

Rewrite each degree measure in radians and each radian measure in degrees.

12. 135°

13. 40°

14. 260°

15. 215°

16. $\frac{7\pi}{12}$

17. $-\frac{5\pi}{6}$

18. $\frac{2\pi}{3}$

19. $\frac{\pi}{6}$

Find the arc length and area of a sector with the given radius r and central angle θ .

20. $r = 4$ in., $\theta = \frac{\pi}{6}$

21. $r = 5$ m, $\theta = \frac{\pi}{12}$

22. $r = 12$ cm, $\theta = 210^\circ$

Evaluate the trigonometric function using a calculator if necessary. If possible, give an exact answer.

23. $\cos \frac{\pi}{3}$

24. $\tan \frac{\pi}{4}$

25. $\sin \frac{2\pi}{5}$

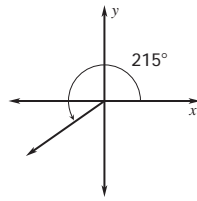
26. $\cos \frac{\pi}{8}$

27. **Pendulum** The pendulum of a grandfather clock is 4 feet long and swings back and forth creating a 60° angle. Find the length of the arc of the pendulum, after one swing.

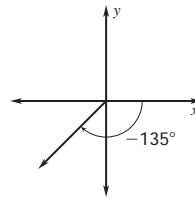
Answer Key

Practice B

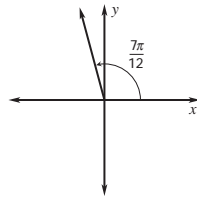
1.



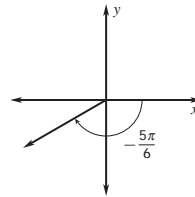
2.



3.



4.



5–8. Sample angles are given.

5. 700° ; -20° 6. 180° ; -180°

7. $\frac{2\pi}{3}$; $-\frac{4\pi}{3}$ 8. $\frac{2\pi}{5}$; $-\frac{8\pi}{5}$ 9. $\frac{7\pi}{6}$

10. $-\frac{17\pi}{9}$ 11. $\frac{11\pi}{12}$ 12. $\frac{5\pi}{9}$ 13. 585°

14. 480° 15. -120° 16. 15°

17. 18π ft; 108π ft² 18. $\frac{3\pi}{2}$ in.; $\frac{3\pi}{2}$ in.²

19. 20π m; 200π m² 20. $\frac{\sqrt{3}}{2}$ 21. 0.4142

22. 1 23. 0.9010 24. $\frac{2\sqrt{3}}{3}$ 25. $\sqrt{2}$

26. 0.1045 27. 0.4142 28. about 2.75 in.

29. 1080° ; 6π

Practice B

For use with pages 776–783

Draw an angle with the given measure in standard position.

1. 215° 2. -135° 3. $\frac{7\pi}{12}$ 4. $-\frac{5\pi}{6}$

Find one positive angle and one negative angle coterminal with the given angle.

5. 340° 6. 540° 7. $\frac{20\pi}{3}$ 8. $\frac{12\pi}{5}$

Rewrite each degree measure in radians and each radian measure in degrees.

9. 210° 10. -340° 11. 165° 12. 100°
 13. $\frac{13\pi}{4}$ 14. $\frac{8\pi}{3}$ 15. $-\frac{2\pi}{3}$ 16. $\frac{\pi}{12}$

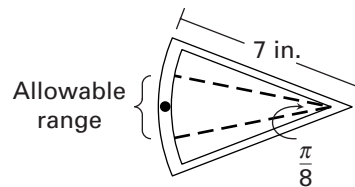
Find the arc length and area of a sector with the given radius r and central angle θ .

17. $r = 12$ ft, $\theta = \frac{3\pi}{2}$ 18. $r = 2$ in., $\theta = \frac{3\pi}{4}$ 19. $r = 20$ m, $\theta = 180^\circ$

Evaluate the trigonometric function using a calculator if necessary. If possible, give an exact answer.

20. $\sin \frac{\pi}{3}$ 21. $\tan \frac{\pi}{8}$ 22. $\sin \frac{\pi}{2}$ 23. $\cos \frac{\pi}{7}$
 24. $\sec \frac{\pi}{6}$ 25. $\csc \frac{\pi}{4}$ 26. $\cos \frac{7\pi}{15}$ 27. $\cot \frac{3\pi}{8}$

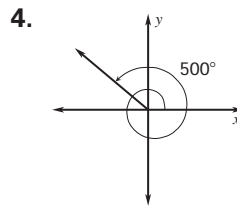
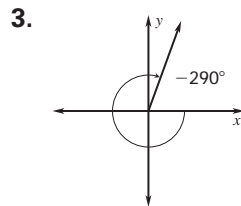
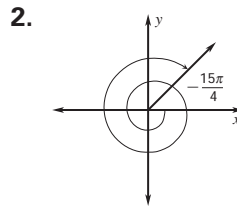
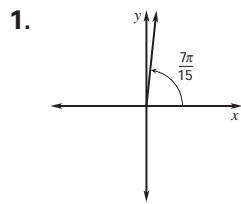
28. **Fire Truck Ladder** For the ladder on a fire truck to operate properly, the base of the ladder must be almost level. The diagram at the right shows part of a leveling device that is used to determine whether the level of the ladder's base is within the allowable range. Find the length of the arc that describes the allowable range.



29. **Snowboarding** During a competition, a snowboarder performs a trick involving three revolutions. Find the measure of the angle generated as the snowboarder performs the trick. Give the answer in both degrees and radians.

Answer Key

Practice C



5–8. Sample angles are given.

5. 465° ; -255° 6. 285° ; -435°

7. $\frac{10\pi}{3}$; $-\frac{2\pi}{3}$ 8. $\frac{7\pi}{4}$; $-\frac{9\pi}{4}$ 9. $\frac{7\pi}{4}$

10. $-\frac{5\pi}{12}$ 11. $\frac{\pi}{90}$ 12. $\frac{37\pi}{180}$ 13. 150°

14. -135° 15. 40° 16. about 172°

17. $\frac{26\pi}{3}$ cm; $\frac{169\pi}{3}$ cm² 18. $\frac{35\pi}{4}$ in.; $\frac{735}{16}\pi$ in.²

19. $\frac{28\pi}{3}$ m; $\frac{112\pi}{3}$ m² 20. $\frac{\sqrt{3}}{3}$ 21. $\sqrt{3}$

22. 2.6131 23. 0.3090 24. 0.9945

25. 2.6131 26. $\sqrt{3}$ 27. $\sqrt{2}$ 28. 540° ; 3π

29. about 4190 mi

Practice C

For use with pages 776–783

Draw an angle with the given measure in standard position.

1. $\frac{7\pi}{15}$

2. $-\frac{15\pi}{4}$

3. -290°

4. 500°

Find one positive angle and one negative angle coterminal with the given angle.

5. 105°

6. -75°

7. $\frac{4\pi}{3}$

8. $-\frac{\pi}{4}$

Rewrite each degree measure in radians and each radian measure in degrees.

9. 315°

10. -75°

11. 2°

12. 37°

13. $\frac{5\pi}{6}$

14. $-\frac{3\pi}{4}$

15. $\frac{2\pi}{9}$

16. 3

Find the arc length and area of a sector with the given radius r and central angle θ .

17. $r = 13$ cm, $\theta = \frac{2\pi}{3}$

18. $r = 10.5$ in., $\theta = 150^\circ$

19. $r = 8$ m, $\theta = 210^\circ$

Evaluate the trigonometric function using a calculator if necessary. If possible, give an exact answer.

20. $\cot \frac{\pi}{3}$

21. $\tan \frac{\pi}{3}$

22. $\csc \frac{\pi}{8}$

23. $\cos \frac{2\pi}{5}$

24. $\sin \frac{7\pi}{15}$

25. $\sec \frac{3\pi}{8}$

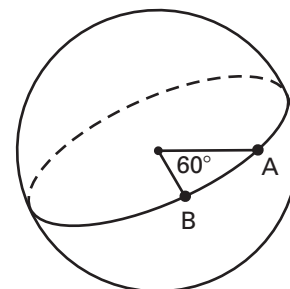
26. $\cot \frac{\pi}{6}$

27. $\csc \frac{\pi}{4}$

28. **Bicycles** A bicycle's gear ratio is the number of times the freewheel turns for every one turn of the chainwheel. The table shows the number of teeth in the freewheel and chainwheel for the first 5 gears on an 18-speed bicycle. In first gear, if the chainwheel completes 2 rotations, through what angle does the freewheel turn? Give your answer in both degrees and radians.

Gear Number	Number of teeth in freewheel	Number of teeth in chainwheel
1	32	24
2	26	24
3	22	24
4	32	40
5	19	24

29. **Earth** Assuming that Earth is a sphere of diameter 8000 miles, what is the distance between city A and city B in the figure shown if the central angle is 60° ?

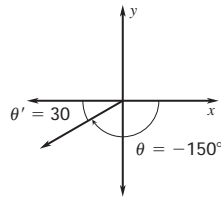


Answer Key

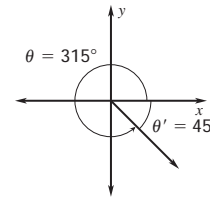
Practice A

1. $\sin \theta = -\frac{3}{5}$; $\cos \theta = -\frac{4}{5}$; $\tan \theta = \frac{3}{4}$;
 $\cot \theta = \frac{4}{3}$; $\sec \theta = -\frac{5}{4}$; $\csc \theta = -\frac{5}{3}$
2. $\sin \theta = -\frac{\sqrt{5}}{5}$; $\cos \theta = \frac{2\sqrt{5}}{5}$; $\tan \theta = -\frac{1}{2}$;
 $\cot \theta = -2$; $\sec \theta = \frac{\sqrt{5}}{2}$; $\csc \theta = -\sqrt{5}$
3. $\sin \theta = \frac{5\sqrt{106}}{106}$; $\cos \theta = -\frac{9\sqrt{106}}{106}$;
 $\tan \theta = -\frac{5}{9}$; $\cot \theta = -\frac{9}{5}$; $\sec \theta = -\frac{\sqrt{106}}{9}$;
 $\csc \theta = \frac{\sqrt{106}}{5}$
4. $\sin \theta = \frac{8\sqrt{89}}{89}$; $\cos \theta = \frac{5\sqrt{89}}{89}$; $\tan \theta = \frac{8}{5}$;
 $\cot \theta = \frac{5}{8}$; $\sec \theta = \frac{\sqrt{89}}{5}$; $\csc \theta = \frac{\sqrt{89}}{8}$
5. $\sin \theta = \frac{\sqrt{2}}{2}$; $\cos \theta = -\frac{\sqrt{2}}{2}$; $\tan \theta = -1$;
 $\cot \theta = -1$; $\sec \theta = -\sqrt{2}$; $\csc \theta = \sqrt{2}$
6. $\sin \theta = \frac{7\sqrt{58}}{58}$; $\cos \theta = \frac{3\sqrt{58}}{58}$; $\tan \theta = \frac{7}{3}$;
 $\cot \theta = \frac{3}{7}$; $\sec \theta = \frac{\sqrt{58}}{3}$; $\csc \theta = \frac{\sqrt{58}}{7}$
7. $\sin \theta = -\frac{\sqrt{26}}{26}$; $\cos \theta = -\frac{5\sqrt{26}}{26}$; $\tan \theta = \frac{1}{5}$;
 $\cot \theta = 5$; $\sec \theta = -\frac{\sqrt{26}}{5}$; $\csc \theta = -\sqrt{26}$ **8.**
 $\sin \theta = 0$; $\cos \theta = -1$; $\tan \theta = 0$;
 $\cot \theta = \text{undefined}$; $\sec \theta = -1$;
 $\sec \theta = \text{undefined}$
- 9.** $\sin \theta = -1$; $\cos \theta = 0$; $\tan \theta = \text{undefined}$;
 $\cot \theta = 0$; $\sec \theta = \text{undefined}$; $\csc \theta = -1$
- 10.** $\sin \theta = 0$; $\cos \theta = 1$; $\tan \theta = 0$;
 $\cot \theta = \text{undefined}$; $\sec \theta = 1$; $\csc \theta = \text{undefined}$

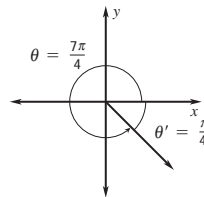
11.



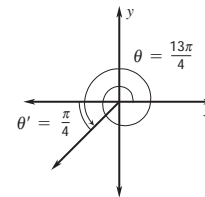
12.



13.



14.



15. $-\frac{\sqrt{3}}{2}$ **16.** $-\sqrt{2}$ **17.** $\frac{\sqrt{3}}{2}$ **18.** 1

19. $-\frac{\sqrt{3}}{2}$ **20.** $\sqrt{2}$ **21.** $-\sqrt{2}$ **22.** $-\sqrt{3}$

23. 0.9659 **24.** -0.1736 **25.** -2.4751

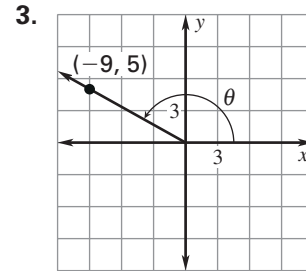
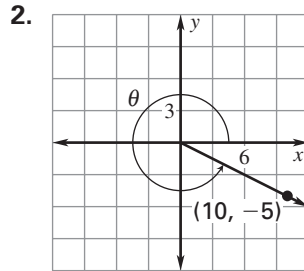
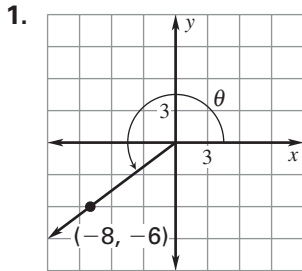
26. undefined **27.** 0.8391 **28.** -1.0101

29. -0.5774 **30.** $\frac{1}{2}$ **31.** no

Practice A

For use with pages 784–790

Use the given point on the terminal side of an angle θ in standard position. Evaluate the six trigonometric functions of θ .



4. $(5, 8)$

5. $(-4, 4)$

6. $(3, 7)$

7. $(-10, -2)$

Evaluate the six trigonometric functions of the quadrantal angle θ .

8. $\theta = 180^\circ$

9. $\theta = -90^\circ$

10. $\theta = 360^\circ$

Sketch the angle. Then find its reference angle.

11. -150°

12. 315°

13. $\frac{7\pi}{4}$

14. $\frac{13\pi}{4}$

Evaluate the function without using a calculator.

15. $\sin 300^\circ$

16. $\csc 225^\circ$

17. $\cos(-750^\circ)$

18. $\tan 405^\circ$

19. $\sin\left(-\frac{2\pi}{3}\right)$

20. $\csc \frac{11\pi}{4}$

21. $\sec \frac{5\pi}{4}$

22. $\tan \frac{17\pi}{3}$

Use a calculator to evaluate the function. Round the result to four decimal places.

23. $\sin 435^\circ$

24. $\cos(-100^\circ)$

25. $\tan 112^\circ$

26. $\sec 450^\circ$

27. $\tan \frac{2\pi}{9}$

28. $\sec 3$

29. $\cot \frac{11\pi}{3}$

30. $\cos \frac{7\pi}{3}$

31. **Baseball** You are at bat and hit a baseball so that it has an initial velocity of 80 feet per second and an angle of elevation of 40° . Assuming the ball is not caught and the fence is 305 feet away, did you hit a homerun?

Answer Key

Practice B

1. $\sin \theta = -\frac{9\sqrt{97}}{97}$; $\cos \theta = \frac{4\sqrt{97}}{97}$;

$\tan \theta = -\frac{9}{4}$; $\cot \theta = -\frac{4}{9}$; $\sec \theta = \frac{\sqrt{97}}{4}$;

$\csc \theta = -\frac{\sqrt{97}}{9}$

2. $\sin \theta = \frac{5\sqrt{41}}{41}$; $\cos \theta = -\frac{4\sqrt{41}}{41}$;

$\tan \theta = -\frac{5}{4}$; $\cot \theta = -\frac{4}{5}$; $\sec \theta = -\frac{\sqrt{41}}{4}$;

$\csc \theta = \frac{\sqrt{41}}{5}$

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

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

4. $\sin \theta = -\frac{8\sqrt{89}}{89}$; $\cos \theta = -\frac{5\sqrt{89}}{89}$;

$\tan \theta = \frac{8}{5}$; $\cot \theta = \frac{5}{8}$; $\sec \theta = -\frac{\sqrt{89}}{5}$;

$\csc \theta = -\frac{\sqrt{89}}{8}$

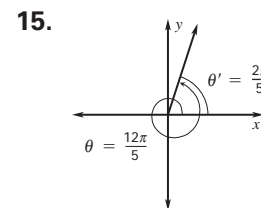
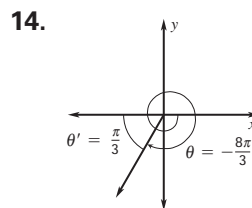
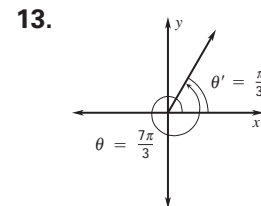
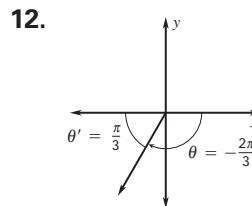
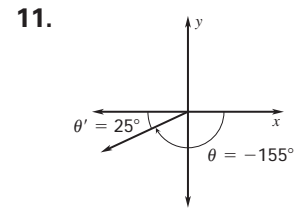
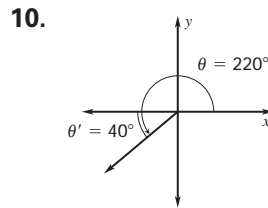
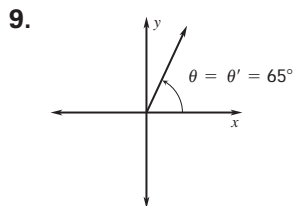
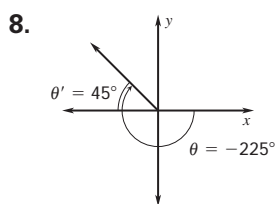
5. $\sin \theta = 1$; $\cos \theta = 0$; $\tan \theta = \text{undefined}$;
 $\cot \theta = 0$; $\sec \theta = \text{undefined}$; $\csc \theta = 1$

6. $\sin \theta = -1$; $\cos \theta = 0$; $\tan \theta = \text{undefined}$;
 $\cot \theta = 0$; $\sec \theta = \text{undefined}$; $\csc \theta = -1$

7. $\sin \theta = 0$; $\cos \theta = -1$; $\tan \theta = 0$;

$\cot \theta = \text{undefined}$;

$\sec \theta = -1$; $\csc \theta = \text{undefined}$



16. -1 17. $-\frac{\sqrt{3}}{2}$ 18. $-\frac{\sqrt{3}}{2}$ 19. $\sqrt{2}$

20. $\sqrt{3}$ 21. $\frac{2\sqrt{3}}{3}$ 22. $\sqrt{3}$ 23. $-\frac{\sqrt{2}}{2}$

24. 0.3090 25. 1.1434 26. -0.5

27. -1.0515 28. The terminal side of a 10° angle would be in the first quadrant where the sine function is positive. Your friend's calculator was in radian mode. 29. 307.75 ft; 312.5 ft; 307.75 ft

Practice B

For use with pages 784–790

Use the given point on the terminal side of an angle θ in standard position. Evaluate the six trigonometric functions of θ .

1. $(4, -9)$

2. $(-4, 5)$

3. $(8, 6)$

4. $(-5, -8)$

Evaluate the six trigonometric functions of the quadrantal angle θ .

5. $\theta = -270^\circ$

6. $\theta = -90^\circ$

7. $\theta = -180^\circ$

Sketch the angle. Then find its reference angle.

8. -225°

9. 65°

10. 220°

11. -155°

12. $-\frac{2\pi}{3}$

13. $\frac{7\pi}{3}$

14. $-\frac{8\pi}{3}$

15. $\frac{12\pi}{5}$

Evaluate the function without using a calculator.

16. $\tan 135^\circ$

17. $\sin(-60^\circ)$

18. $\cos 210^\circ$

19. $\sec(-315^\circ)$

20. $\cot \frac{7\pi}{6}$

21. $\csc \frac{2\pi}{3}$

22. $\tan \frac{7\pi}{3}$

23. $\sin\left(-\frac{3\pi}{4}\right)$

Use a calculator to evaluate the function. Round the result to four decimal places.

24. $\sin 18^\circ$

25. $\sec 29^\circ$

26. $\cos\left(-\frac{10\pi}{3}\right)$

27. $\csc \frac{18\pi}{5}$

28. **Critical Thinking** Your friend used a calculator to evaluate $\sin 10^\circ$ and obtained -0.544 . How can you tell this is incorrect? What did your friend do wrong?

29. **Baseball** You are at bat and hit the baseball so that it has an initial velocity of 100 feet per second. Approximately how far will the ball travel horizontally if the angle of elevation is 40° ? 45° ? 50° ?

Answer Key

Practice C

1. $\sin \theta = -\frac{2\sqrt{13}}{13}$; $\cos \theta = \frac{3\sqrt{13}}{13}$;

$\tan \theta = -\frac{2}{3}$; $\cot \theta = -\frac{3}{2}$; $\sec \theta = \frac{\sqrt{13}}{3}$;

$\csc \theta = -\frac{\sqrt{13}}{2}$

2. $\sin \theta = \frac{1}{2}$; $\cos \theta = -\frac{\sqrt{3}}{2}$; $\tan \theta = -\frac{\sqrt{3}}{3}$;

$\cot \theta = -\sqrt{3}$; $\sec \theta = -\frac{2\sqrt{3}}{3}$; $\csc \theta = 2$

3. $\sin \theta = -\frac{\sqrt{2}}{2}$; $\cos \theta = -\frac{\sqrt{2}}{2}$; $\tan \theta = 1$;

$\cot \theta = 1$; $\sec \theta = -\sqrt{2}$; $\csc \theta = -\sqrt{2}$

4. $\sin \theta = \frac{15}{17}$; $\cos \theta = \frac{8}{17}$; $\tan \theta = \frac{15}{8}$;

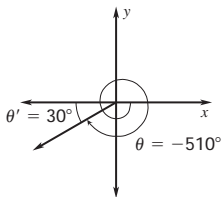
$\cot \theta = \frac{8}{15}$; $\sec \theta = \frac{17}{8}$; $\csc \theta = \frac{17}{15}$

5. $\sin \theta = -1$; $\cos \theta = 0$; $\tan \theta = \text{undefined}$;
 $\cot \theta = 0$; $\sec \theta = \text{undefined}$; $\csc \theta = -1$

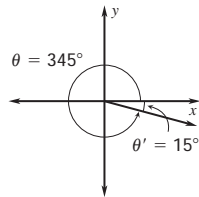
6. $\sin \theta = 0$; $\cos \theta = -1$; $\tan \theta = 0$;
 $\cot \theta = \text{undefined}$; $\sec \theta = -1$; $\csc \theta = \text{undefined}$

7. $\sin \theta = 0$; $\cos \theta = 1$; $\tan \theta = 0$;
 $\cot \theta = \text{undefined}$; $\sec \theta = 1$; $\csc \theta = \text{undefined}$

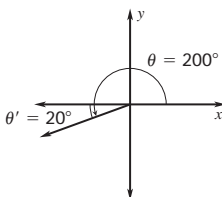
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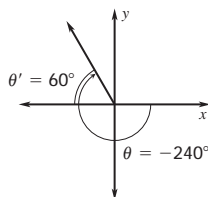
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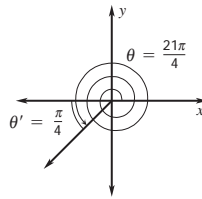
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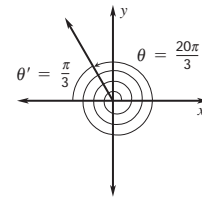
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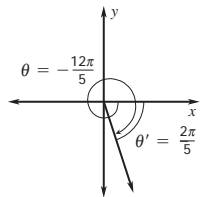
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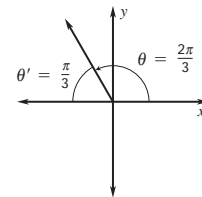
13.



14.



15.



16. $-\sqrt{2}$ 17. $-\frac{\sqrt{2}}{2}$ 18. $-\frac{2\sqrt{3}}{3}$ 19. $\sqrt{3}$

20. $\frac{\sqrt{2}}{2}$ 21. 2 22. $-\sqrt{3}$ 23. -2

24. 0.0402 25. 0.5774 26. undefined

27. -0.9511 28. about 152 ft/sec; about 722 ft

29. about 6.70 ft

Practice C

For use with pages 784–790

Use the given point on the terminal side of an angle θ in standard position. Evaluate the six trigonometric functions of θ .

1. $(3, -2)$ 2. $(-\sqrt{3}, 1)$ 3. $(-2, -2)$ 4. $(8, 15)$

Evaluate the six trigonometric functions of the quadrantal angle θ .

5. $\theta = -90^\circ$ 6. $\theta = 180^\circ$ 7. $\theta = 360^\circ$

Sketch the angle. Then find its reference angle.

8. -510° 9. 345° 10. 200° 11. -240°
 12. $\frac{21\pi}{4}$ 13. $\frac{20\pi}{3}$ 14. $-\frac{12\pi}{5}$ 15. $\frac{2\pi}{3}$

Evaluate the function without using a calculator.

16. $\sec 225^\circ$ 17. $\cos(-225^\circ)$ 18. $\csc(-120^\circ)$ 19. $\tan 240^\circ$
 20. $\cos \frac{15\pi}{4}$ 21. $\csc \frac{5\pi}{6}$ 22. $\cot \frac{11\pi}{6}$ 23. $\sec\left(-\frac{4\pi}{3}\right)$

Use a calculator to evaluate the function. Round the result to four decimal places.

24. $\tan 2.3^\circ$ 25. $\cot 420^\circ$ 26. $\sec\left(-\frac{9\pi}{2}\right)$ 27. $\sin \frac{18\pi}{5}$

28. Driving Golf Balls You and a friend are driving golf balls at a driving range. If the angle of elevation is 30° and the ball travels 625 feet horizontally, what is the initial velocity of the ball? Suppose you use the same initial velocity and hit the ball at an angle of 45° . How far would the ball travel?

29. Fishing You and a friend are fishing. Each of you casts with an initial velocity of 40 feet per second. Your cast was projected at an angle of 45° and your friend's at an angle of 60° . About how much further will your fishing tackle go than your friend's?

Answer Key

Practice A

1. π ; 180°
2. $\frac{\pi}{6}$; 30°
3. $\frac{\pi}{6}$; 30°
4. $\frac{\pi}{6}$; 30°
5. 0 ; 0°
6. $\frac{\pi}{4}$; 45°
7. $\frac{\pi}{3}$; 60°
8. $-\frac{\pi}{4}$; -45°
9. 33.7°
10. 36.9°
11. 39.8°
12. 36.9°
13. 18.4°
14. 71.6°
15. 0.644 ; 36.9°
16. 2.42 ; 139°
17. 1.35 ; 77.5°
18. 1.82 ; 104°
19. 1.47 ; 84.3°
20. -1.19 ; -68.2°
21. 1.12 ; 64.2°
22. -0.412 ; -23.6°
23. 166°
24. 214°
25. 68.2°
26. 320°
27. 35.8° ; 0.625

Practice A

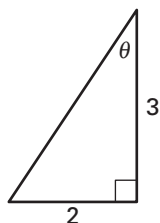
For use with pages 792–798

Evaluate the expression without using a calculator. Give your answer in both radians and degrees.

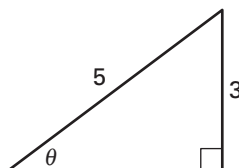
- | | | | |
|--------------------|----------------------------------|----------------------------------|----------------------------------|
| 1. $\cos^{-1}(-1)$ | 2. $\sin^{-1}\frac{1}{2}$ | 3. $\tan^{-1}\frac{\sqrt{3}}{3}$ | 4. $\cos^{-1}\frac{\sqrt{3}}{2}$ |
| 5. $\tan^{-1} 0$ | 6. $\sin^{-1}\frac{\sqrt{2}}{2}$ | 7. $\cos^{-1}\frac{1}{2}$ | 8. $\tan^{-1}(-1)$ |

Find the measure of the angle θ . Round to three significant digits.

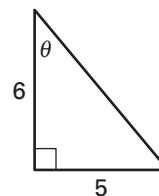
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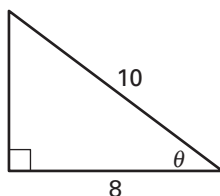
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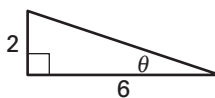
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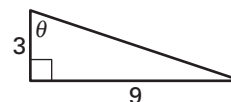
12.



13.



14.



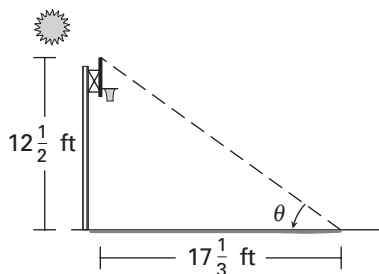
Use a calculator to evaluate the expression in both radians and degrees. Round to three significant digits.

- | | | | |
|---------------------|------------------------|---------------------|------------------------|
| 15. $\sin^{-1} 0.6$ | 16. $\cos^{-1}(-0.75)$ | 17. $\tan^{-1} 4.5$ | 18. $\cos^{-1}(-0.25)$ |
| 19. $\cos^{-1} 0.1$ | 20. $\tan^{-1}(-2.5)$ | 21. $\sin^{-1} 0.9$ | 22. $\sin^{-1}(-0.4)$ |

Solve the equation for θ . Round to three significant digits.

- | | |
|---|---|
| 23. $\sin \theta = 0.25; 90^\circ < \theta < 180^\circ$ | 24. $\cos \theta = -0.83; 180^\circ < \theta < 270^\circ$ |
| 25. $\tan \theta = 2.5; 0^\circ < \theta < 90^\circ$ | 26. $\sin \theta = -0.64; 270^\circ < \theta < 360^\circ$ |

27. **Basketball** The height of an outdoor basketball backboard is $12\frac{1}{2}$ feet, and the backboard casts a shadow $17\frac{1}{3}$ feet long, as shown below. Find the angle of elevation of the sun. Give your answer in both radians and degrees.



Answer Key

Practice B

1. $\frac{2\pi}{3}$; 120°
2. $-\frac{\pi}{4}$; -45°
3. $-\frac{\pi}{6}$; -30°
4. $\frac{\pi}{3}$; 60°
5. 36.9°
6. 25.4°
7. 18.4°
8. 1.43 ; 82.0°
9. 0.222 ; 12.7°
10. -0.644 ; -36.9°
11. -0.381 ; -21.8°
12. 259°
13. 297°
14. 127°
15. 56.8°
16. about 127°
17. about 11.5°

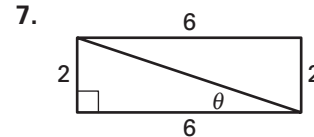
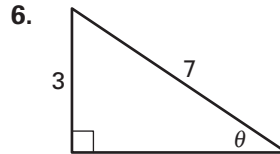
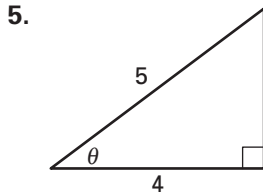
Practice B

For use with pages 792–798

Evaluate the expression without using a calculator. Give your answer in both radians and degrees.

1. $\cos^{-1}\left(-\frac{1}{2}\right)$ 2. $\sin^{-1}\left(-\frac{\sqrt{2}}{2}\right)$ 3. $\tan^{-1}\left(-\frac{\sqrt{3}}{3}\right)$ 4. $\tan^{-1}\sqrt{3}$

Find the measure of the angle θ . Round to three significant digits.



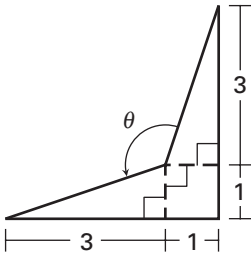
Use a calculator to evaluate the expression in both radians and degrees. Round to three significant digits.

8. $\cos^{-1} 0.14$ 9. $\sin^{-1} 0.22$ 10. $\sin^{-1}(-0.6)$ 11. $\tan^{-1}(-0.4)$

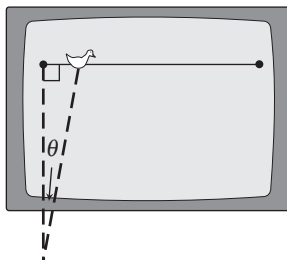
Solve the equation for θ . Round to three significant digits.

12. $\tan \theta = 5.3$; $180^\circ < \theta < 270^\circ$ 13. $\sin \theta = -0.89$; $270^\circ < \theta < 360^\circ$
 14. $\cos \theta = -0.6$; $90^\circ < \theta < 180^\circ$ 15. $\tan \theta = 1.53$; $0^\circ < \theta < 90^\circ$

16. **Geometry** Find the measure of angle θ in the diagram below. Round the result to three significant digits.



17. **Video Games** In a video game, a target appears on the left side of the television screen and moves at the rate of 2 inches per second across the screen. You fire a laser beam that travels 10 inches per second. If the player tries to hit the target as soon as it appears, at what angle should the laser beam be aimed?



Answer Key

Practice C

1. $\frac{5\pi}{6}$; 150°
2. $-\frac{\pi}{3}$; -60°
3. $\frac{\pi}{4}$; 45°
4. $-\frac{\pi}{2}$; -90°
5. 17.4°
6. 45°
7. 44.4°
8. -0.694 ; -39.8°
9. undefined
10. -0.955 ; -54.7°
11. 1.48 ; 84.6°
12. 281°
13. 164°
14. 215°
15. 221°
16. about 12°
17. about 51.3°

Practice C

For use with pages 792–798

Evaluate the expression without using a calculator. Give your answer in both radians and degrees.

1. $\cos^{-1}\left(-\frac{\sqrt{3}}{2}\right)$

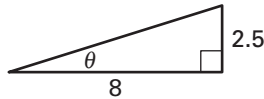
2. $\tan^{-1}(-\sqrt{3})$

3. $\cos^{-1}\frac{\sqrt{2}}{2}$

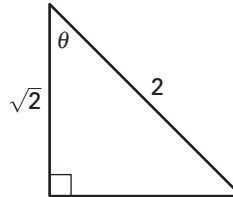
4. $\sin^{-1}(-1)$

Find the measure of the angle θ . Round to three significant digits.

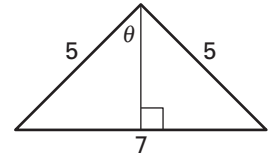
5.



6.



7.



Use a calculator to evaluate the expression in both radians and degrees. Round to three significant digits.

8. $\sin^{-1}(-0.64)$

9. $\cos^{-1} 1.3$

10. $\tan^{-1}(-\sqrt{2})$

11. $\tan^{-1} 10.5$

Solve the equation for θ . Round to three significant digits.

12. $\tan^{-1}(-5.3)$; $270^\circ < \theta < 360^\circ$

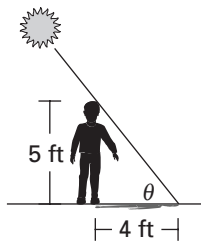
13. $\sin^{-1} 0.28$; $90^\circ < \theta < 180^\circ$

14. $\cos^{-1}(-0.82)$; $180^\circ < \theta < 270^\circ$

15. $\tan^{-1} 0.88$; $180^\circ < \theta < 270^\circ$

16. Ramp Construction A builder needs to construct a wheelchair ramp 24 feet long that rises to a height of 5 feet above level ground. Approximate the angle that the ramp should make with the ground.

17. Casting Shadows At a certain time of the day a child five feet tall casts a four foot long shadow as shown below. Approximate the angle of elevation of the sun.



Answer Key

Practice A

1. one triangle
2. one triangle
3. no triangle
4. one triangle
5. two triangles
6. one triangle
7. $C = 105^\circ$, $b \approx 14.1$, $c \approx 19.3$
8. $C = 78^\circ$, $b \approx 5.82$, $c \approx 6.58$
9. $B \approx 55.2^\circ$, $C \approx 87.8^\circ$, $c \approx 18.3$; or
 $B \approx 124.8^\circ$, $C \approx 18.2^\circ$, $c \approx 5.71$
10. $B \approx 21.6^\circ$, $C \approx 122.4^\circ$, $c \approx 11.5$
11. no solution
12. $B = 10^\circ$, $b \approx 69.5$, $c \approx 137$
13. $B \approx 70.4^\circ$, $C \approx 51.6^\circ$, $c \approx 4.16$; or
 $B \approx 109.6^\circ$, $C \approx 12.4^\circ$, $c \approx 1.14$
14. 408 units²
15. 120 units²
16. 12.0 units²
17. 2.6 units²
18. 23.8 units²
19. 361 units²
20. 24.3 units²
21. about 9.58 ft

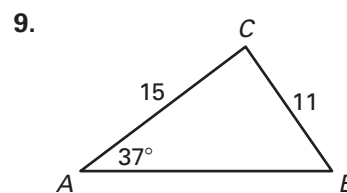
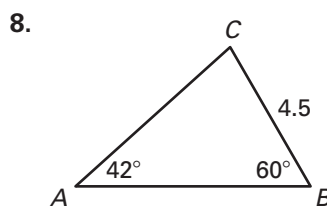
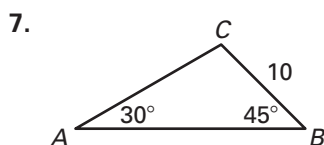
Practice A

For use with pages 799–806

Decide whether the given measurements can form exactly *one* triangle, exactly *two* triangles, or *no* triangle.

- $B = 110^\circ, C = 30^\circ, a = 15$
- $B = 35^\circ, a = 12, b = 26$
- $B = 130^\circ, a = 10, b = 8$
- $B = 60^\circ, b = 30, c = 20$
- $C = 16^\circ, b = 92, c = 32$
- $A = 10^\circ, C = 130^\circ, b = 5$

Solve $\triangle ABC$. (*Hint: Some of the “triangles” have no solution and some have two solutions.*)

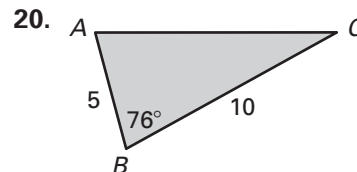
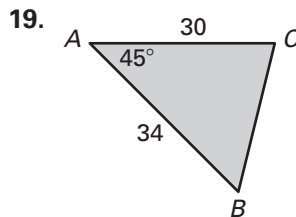
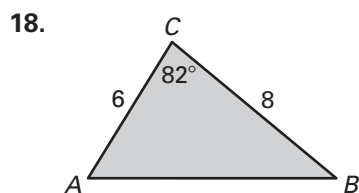


- $A = 36^\circ, a = 8, b = 5$
- $A = 150^\circ, C = 20^\circ, a = 200$
- $C = 160^\circ, c = 12, b = 15$
- $A = 58^\circ, a = 4.5, b = 5$

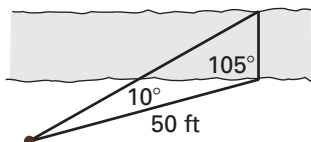
Find the area of the triangle with the given side lengths and included angle.

- $A = 70^\circ, b = 28, c = 31$
- $B = 35^\circ, a = 12, c = 35$
- $C = 95^\circ, a = 8, b = 3$
- $A = 10^\circ, b = 5, c = 6$

Find the area of $\triangle ABC$.



21. *Surveying* A surveyor wants to find the width of a narrow, deep gorge from a point on the edge. To do this, the surveyor takes measurements as shown in the figure. How wide is the gorge?



Answer Key

Practice B

1. no triangle 2. one triangle 3. two triangles
4. one triangle
5. $C = 110^\circ, b \approx 22.4, c \approx 24.4$
6. $B \approx 21.4^\circ, C \approx 116.6^\circ, c \approx 29.4$
7. $C = 35^\circ, b \approx 18.5, c \approx 10.8$
8. $A = 38^\circ, a \approx 22.0, c \approx 34.0$
9. no solution
10. $A \approx 40.9^\circ, C \approx 84.1^\circ, c \approx 30.4$
11. $B \approx 71.8^\circ, C \approx 78.2^\circ, c \approx 39.2$; or
 $B \approx 108.2^\circ, C \approx 41.8^\circ, c \approx 26.7$
12. 2290 units² 13. 10.4 units²
14. 24.3 units² 15. 23.8 units²
16. 361 units² 17. 24.3 units²
18. 1680 units² 19. about \$5,680
20. about 550 feet

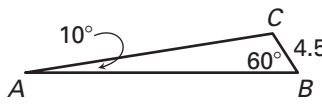
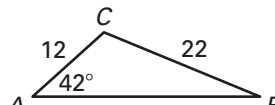
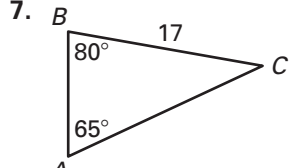
Practice B

For use with pages 799–806

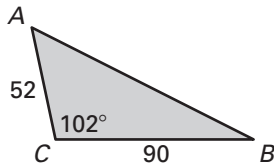
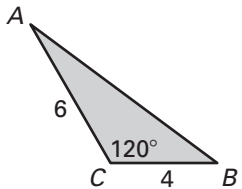
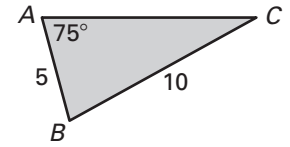
Decide whether the given measurements can form exactly *one* triangle, exactly *two* triangles, or *no* triangle.

1. $A = 63^\circ, a = 42, b = 120$
2. $B = 47^\circ, A = 60^\circ, a = 45$
3. $B = 30^\circ, b = 40, a = 60$
4. $A = 60^\circ, B = 40^\circ, c = 6$

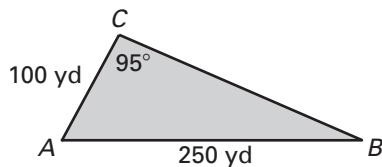
Solve $\triangle ABC$. (*Hint: Some of the “triangles” have no solution and some have two solutions.*)

5. 
6. 
7. 
8. $B = 34^\circ, C = 108^\circ, b = 20$
9. $A = 42^\circ, a = 10, b = 21$
10. $B = 55^\circ, a = 20, b = 25$
11. $A = 30^\circ, a = 20, b = 38$

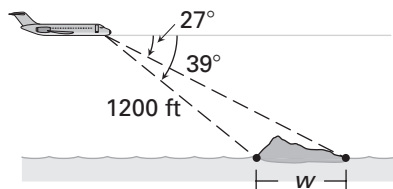
Find the area of $\triangle ABC$.

12. 
13. 
14. 
15. $C = 82^\circ, a = 8, b = 6$
16. $A = 45^\circ, b = 30, c = 34$
17. $B = 76^\circ, a = 10, c = 5$
18. $A = 43.75^\circ, b = 57, c = 85$

19. **Real Estate** You are buying the triangular piece of land shown. The price of the land is \$2500 per acre (1 acre = 4840 square yards). How much does the land cost?



20. **Measuring an Island** What is the width w of the island in the figure shown below?



Answer Key

Practice C

1. no triangle 2. two triangles
3. two triangles 4. one triangle
5. $B \approx 51.4^\circ$, $C \approx 53.6^\circ$, $b \approx 4.85$
6. $A \approx 29.3^\circ$, $C \approx 132.7^\circ$, $c \approx 28.5$; or
 $A \approx 150.7^\circ$, $C \approx 11.3^\circ$, $c \approx 7.61$
7. $C = \frac{5\pi}{12}$, $a \approx 32.2$, $b \approx 39.4$
8. $C = 100^\circ$, $a \approx 4.76$, $b \approx 10.2$
9. $C = 100^\circ$, $b \approx 25.8$, $c \approx 30.2$
10. $B \approx 55.2^\circ$, $C \approx 87.8^\circ$, $c \approx 18.3$; or
 $B \approx 124.8^\circ$, $C \approx 18.2^\circ$, $c \approx 5.7$
11. no solution 12. 1680 units²
13. 366 units² 14. 110 units² 15. 7 units²
16. 1.41 units² 17. 46.8 units² 18. 98.3 units²
19. about 2.67 miles

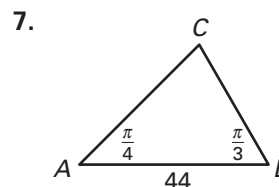
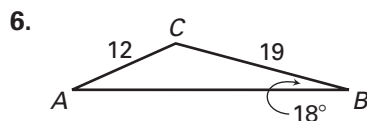
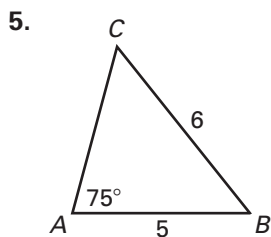
Practice C

For use with pages 799–806

Decide whether the given measurements can form exactly *one* triangle, exactly *two* triangles, or *no* triangle.

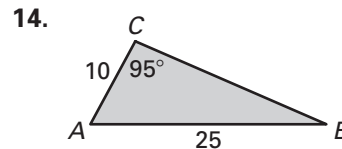
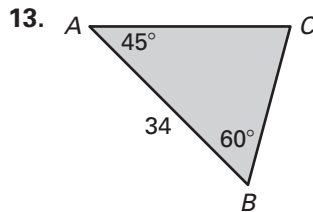
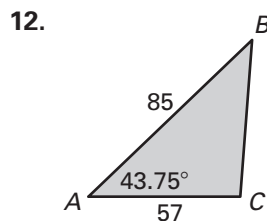
- $A = 76.4^\circ, a = 176, b = 189$
- $A = 48.2^\circ, a = 15, b = 20$
- $A = 20^\circ, a = 10, c = 11$
- $C = 95^\circ, a = 8, c = 9$

Solve $\triangle ABC$. (*Hint: Some of the “triangles” have no solution and some have two solutions.*)



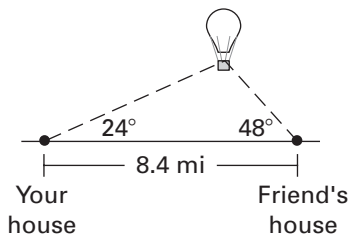
- $A = 23^\circ, B = 57^\circ, c = 12$
- $A = 23^\circ, B = 57^\circ, a = 12$
- $A = 37^\circ, a = 11, b = 15$
- $B = 130^\circ, a = 10, b = 8$

Find the area of $\triangle ABC$.



- $B = 150^\circ, a = 7, c = 4$
- $B = \frac{\pi}{4}, a = 4, c = 1$
- $A = 60^\circ, b = 9, c = 12$
- $B = 25^\circ, a = 15, c = 31$

19. **Hot Air Balloon** You and a friend live 8.4 miles apart. A hot air balloon is floating between your houses as shown in the figure. Given the angles of elevation, approximate the height of the balloon. (*Hint: The height of the balloon is the altitude of the triangle.*)



Answer Key

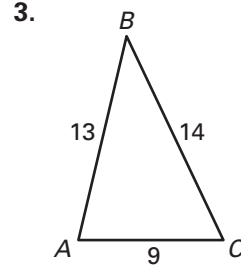
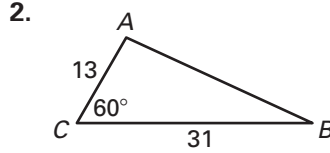
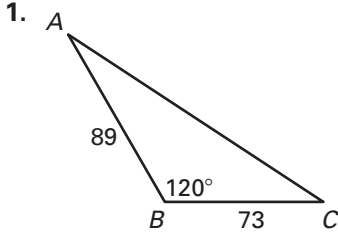
Practice A

1. $A = 26.7^\circ$, $C \approx 33.3^\circ$, $b \approx 141$
2. $A \approx 95.3^\circ$, $B \approx 24.7^\circ$, $c \approx 27.0$
3. $A \approx 76.7^\circ$, $B \approx 38.7^\circ$, $C \approx 64.6^\circ$
4. $A \approx 54.3^\circ$, $B \approx 79.7^\circ$, $c \approx 100$
5. $A \approx 57.5^\circ$, $B \approx 71.5^\circ$, $c \approx 283$
6. $A \approx 44.4^\circ$, $B \approx 44.4^\circ$, $C \approx 91.2^\circ$
7. $B \approx 74.5^\circ$, $C \approx 43.5^\circ$, $a \approx 51.3$
8. $A \approx 142.0^\circ$, $B \approx 12.8^\circ$, $C \approx 25.2^\circ$
9. $A \approx 62.9^\circ$, $B \approx 79.6^\circ$, $C \approx 37.5^\circ$
10. $A \approx 48.8^\circ$, $B \approx 65.6^\circ$, $C \approx 65.6^\circ$
11. $A \approx 122.2^\circ$, $B \approx 19.8^\circ$, $c \approx 29.1$
12. $B \approx 104.9^\circ$, $C \approx 15.1^\circ$, $b \approx 33.5$
13. 16.2 units^2
14. 41.2 units^2
15. 96.8 units^2
16. 54 units^2
17. 1350 units^2
18. 713 units^2
19. 56.9 units^2
20. 10.4 units^2
21. 6 units^2
22. $B \approx 52.6^\circ$ E of S; $C \approx 25.3^\circ$ W of S

Practice A

For use with pages 807–812

Solve $\triangle ABC$.



4. $C = 46^\circ, a = 113, b = 137$

5. $C = 51^\circ, a = 307, b = 345$

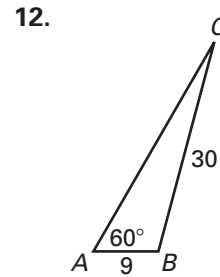
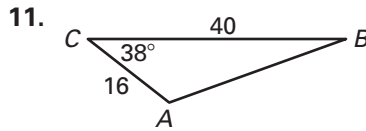
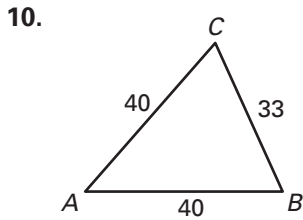
6. $a = 7, b = 7, c = 10$

7. $A = 62^\circ, b = 56, c = 40$

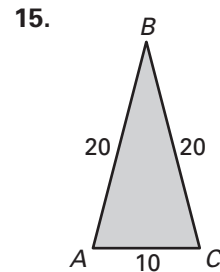
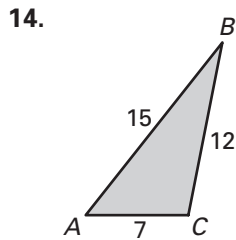
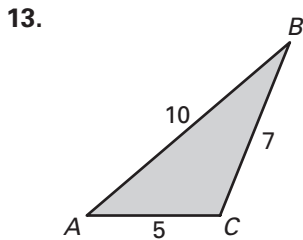
8. $a = 39, b = 14, c = 27$

9. $a = 19, b = 21, c = 13$

Use the Law of Sines, Law of Cosines, or the Pythagorean theorem to solve $\triangle ABC$.



Find the area of $\triangle ABC$.



16. $a = 9, b = 12, c = 15$

17. $a = 75.4, b = 52, c = 52$

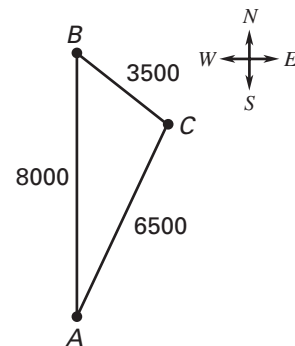
18. $a = 47, b = 36, c = 41$

19. $a = 13, b = 14, c = 9$

20. $a = 2.5, b = 10.2, c = 9$

21. $a = 3, b = 4, c = 5$

22. **Boat Race** A boat race occurs along a triangular course marked by buoys $A, B,$ and C . The race starts with the boats going 8000 feet due north. The other two sides of the course lie to the east of the first side, and their lengths are 3500 feet and 6500 feet as shown at the right. Find the bearings for the last two legs of the course.



Answer Key

Practice B

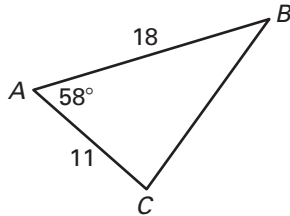
1. $B \approx 37.5^\circ, C \approx 84.5^\circ, a \approx 15.3$
2. $A \approx 82.1^\circ, B \approx 58.8^\circ, C \approx 39.1^\circ$
3. $A \approx 51.6^\circ, B \approx 27.3^\circ, C \approx 101.1^\circ$
4. $A \approx 38.0^\circ, C \approx 42^\circ, b \approx 19.2$
5. $A \approx 38.3^\circ, B \approx 99.7^\circ, c \approx 23.8$
6. $A \approx 102.2^\circ, B \approx 38.4^\circ, c \approx 81.8$
7. $A \approx 153.5^\circ, B \approx 15.5^\circ, C \approx 11.0^\circ$
8. $B = 12^\circ, a \approx 17.9, c \approx 20.8$
9. $A = 30^\circ, a \approx 29.0, c \approx 41.0$
10. $C = 105^\circ, b \approx 18.4, c \approx 35.5$
11. $A = 48.5^\circ, C \approx 69.5^\circ, b \approx 4.71$
12. $B = 79^\circ, a \approx 102, c \approx 17.7$
13. $A \approx 55.8^\circ, B \approx 8.6^\circ, C \approx 115.6^\circ$
14. 2813 units² 15. 10.4 units²
16. 56.9 units² 17. 1.62 units²
18. 0.468 units² 19. 43.3 units²
20. 9.92 units² 21. about 110 ft 22. about 4 ft

Practice B

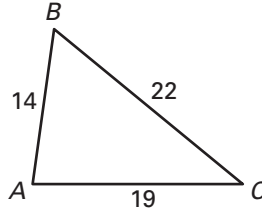
For use with pages 807–812

Solve $\triangle ABC$.

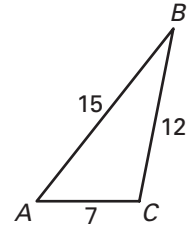
1.



2.



3.



4. $B = 100^\circ, a = 12, c = 13$

5. $C = 42^\circ, a = 22, b = 35$

6. $C = 39.4^\circ, a = 126, b = 80.1$

7. $a = 21.46, b = 12.85, c = 9.179$

Use the Law of Sines, Law of Cosines, or the Pythagorean theorem to solve $\triangle ABC$.

8. $A = 48^\circ, C = 120^\circ, b = 5$

9. $B = 15^\circ, C = 135^\circ, b = 15$

10. $A = 45^\circ, B = 30^\circ, a = 26$

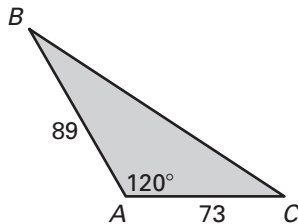
11. $B = 62^\circ, a = 4, c = 5$

12. $A = 91^\circ, C = 10^\circ, b = 100$

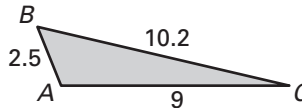
13. $a = 11, b = 2, c = 12$

Find the area of $\triangle ABC$.

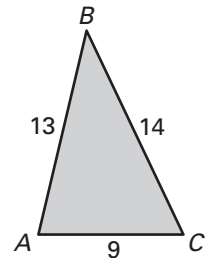
14.



15.



16.



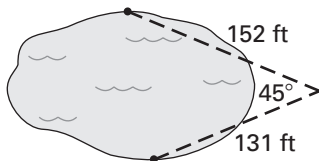
17. $a = 4.25, b = 1.55, c = 3$

18. $a = 1.42, b = 0.75, c = 1.25$

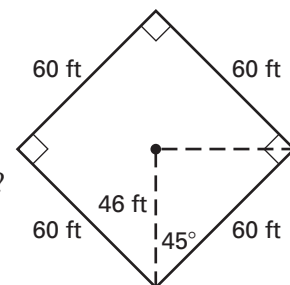
19. $a = 10, b = 10, c = 10$

20. $a = 11, b = 2, c = 12$

21. **Measuring a Pond** How wide is the pond shown in the figure below?



22. **Softball** The pitcher's mound on a softball field is 46 feet from home plate. The distance between the bases is 60 feet. How much closer is the pitcher's mound to second base than it is to first base?



Answer Key

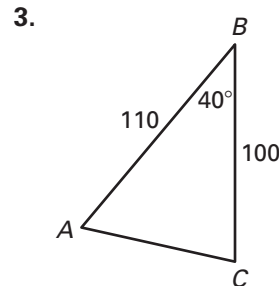
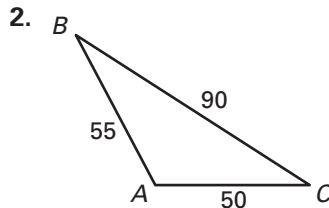
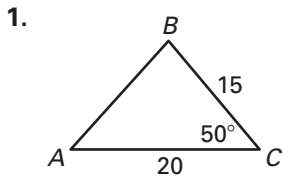
Practice C

1. $A \approx 48.0^\circ, B \approx 82.0^\circ, c \approx 15.5$
2. $A \approx 117.9^\circ, B \approx 29.4^\circ, C \approx 32.7^\circ$
3. $A \approx 62.5^\circ, C \approx 77.5^\circ, b \approx 72.4$
4. $A \approx 52.4^\circ, B \approx 82.6^\circ, c \approx 16.4$
5. $B \approx 42.1^\circ, C \approx 20.4^\circ, a \approx 9.92$
6. $A \approx 27.3^\circ, B \approx 33.7^\circ, C \approx 119^\circ$
7. $A \approx 40.9^\circ, B \approx 82.2^\circ, C \approx 56.9^\circ$
8. $B \approx 17.4^\circ, C \approx 109.6^\circ, c \approx 9.4$
9. $A \approx 50.5^\circ, C \approx 89.5^\circ, c \approx 15.6$; or
 $A \approx 129.5^\circ, C \approx 10.5^\circ, c \approx 2.83$
10. $A \approx 34.0^\circ, B \approx 122.9^\circ, C \approx 23.1^\circ$
11. $A = 15^\circ, a \approx 3.7, c \approx 12.2$
12. $C = 98^\circ, a \approx 9.68, c \approx 18.1$
13. $A \approx 70.5^\circ, B \approx 86.6^\circ, C \approx 22.9^\circ$
14. 0.496 units^2 15. 159 units^2 16. 116 units^2
17. 43.2 units^2 18. 20.4 units^2 19. 62.0 units^2
20. 0.959 units^2 21. about 2.01 acres
22. about 92 ft

Practice C

For use with pages 807–812

Solve $\triangle ABC$.



4. $C = 45^\circ, a = 13\sqrt{2}, b = 23$

5. $A = 117.5^\circ, b = 7.5, c = 3.9$

6. $a = 4.3, b = 5.2, c = 8.2$

7. $a = 20.1, b = 30.4, c = 25.7$

Use the Law of Sines, Law of Cosines, or the Pythagorean theorem to solve $\triangle ABC$.

8. $A = 53^\circ, a = 8, b = 3$

9. $B = 40^\circ, a = 12, b = 10$

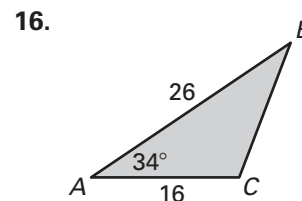
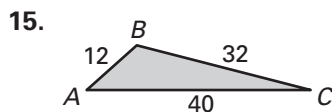
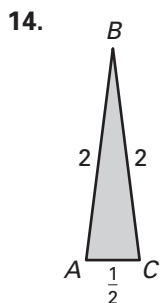
10. $a = 10, b = 15, c = 7$

11. $B = 45^\circ, C = 120^\circ, b = 10$

12. $A = 32^\circ, B = 50^\circ, b = 14$

13. $a = 17, b = 18, c = 7$

Find the area of $\triangle ABC$.



17. $a = 4, b = 24, c = 26$

18. $a = 12, b = 9, c = 5$

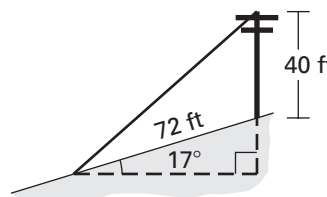
19. $a = 21.5, b = 14.3, c = 10.2$

20. $a = 2.32, b = 5.76, c = 3.48$

21. **Farming** A farmer has a triangular field with sides of lengths 125 yards, 160 yards, and 225 yards. Find the number of acres in the field. (1 acre = 4840 square yards)



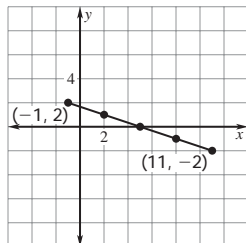
22. **Guy Wire** A vertical telephone pole 40 feet tall stands on the side of a hill as shown in the figure to the right. Find the length of the wire that will reach from the top of the pole to a point 72 feet downhill from the pole.



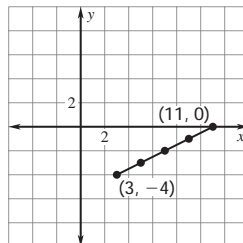
Answer Key

Practice A

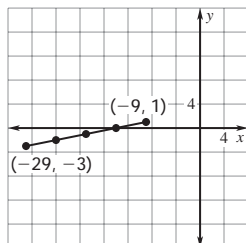
1.



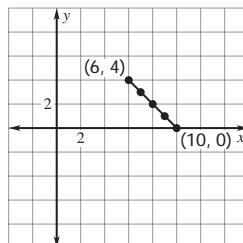
2.



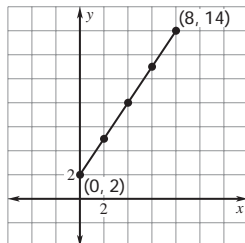
3.



4.



5.



6. $y = -2x; 0 \leq x \leq 12$
7. $y = \frac{1}{2}x; 0 \leq x \leq 8$
8. $y = \frac{1}{3}x - 4; 6 \leq x \leq 18$
9. $y = \frac{1}{2}x + 1; -4 \leq x \leq 4$
10. $y = -\frac{1}{2}x + 1; -2 \leq x \leq 6$
11. $x = (8.06 \cos 65.6^\circ)t$ or $x = 3.33t$;
 $y = (8.06 \sin 65.6^\circ)t$ or $y = 7.33t$
12. $x = (9.13 \cos 61.2^\circ)t + 2$ or $x = 4.40t + 2$;
 $y = (9.13 \sin 61.2^\circ)t + 5$ or $y = 8.00t + 5$
13. $x = (8.72 \cos 83.4^\circ)t + 9$ or $x = 1.00t + 9$;
 $y = (8.72 \sin 83.4^\circ)t - 24$ or $y = 8.67t - 24$
14. $x = (18 \cos 15^\circ)t$ or $x = 17.4t$;
 $y = -4.9t^2 + (18 \sin 15^\circ)t + 2$ or
 $y = -4.9t^2 + 4.66t + 2$
15. about 22.1 m

Practice A

For use with pages 813–819

Graph the parametric equations.

1. $x = 3t - 1$ and $y = -t + 2$ for $0 \leq t \leq 4$
2. $x = 2t + 3$ and $y = t - 4$ for $0 \leq t \leq 4$
3. $x = 1 - 5t$ and $y = -t + 3$ for $2 \leq t \leq 6$
4. $x = t + 5$ and $y = 5 - t$ for $1 \leq t \leq 5$
5. $x = 2t$ and $y = 3t + 2$ for $0 \leq t \leq 4$

Write an xy -equation for the parametric equations. State the domain.

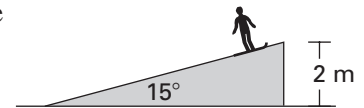
6. $x = 3t$ and $y = -6t$ for $0 \leq t \leq 4$
7. $x = 2t$ and $y = t$ for $0 \leq t \leq 4$
8. $x = 3t + 3$ and $y = t - 3$ for $1 \leq t \leq 5$
9. $x = 2t - 8$ and $y = t - 3$ for $2 \leq t \leq 6$
10. $x = 2t - 2$ and $y = -t + 2$ for $0 \leq t \leq 4$

Use the given information to write parametric equations describing the linear motion.

11. An object is at $(0, 0)$ at time $t = 0$ and then at $(10, 22)$ at time $t = 3$.
12. An object is at $(2, 5)$ at time $t = 0$ and then at $(24, 45)$ at time $t = 5$.
13. An object is at $(12, 2)$ at time $t = 3$ and then at $(15, 28)$ at time $t = 6$.

Snowboarding In Exercises 14 and 15, use the following information.

A snowboarder jumps off a ramp at a speed of 18 meters per second. The ramp's angle of elevation is 15° , and the height of the end of the ramp above level ground is 2 meters.

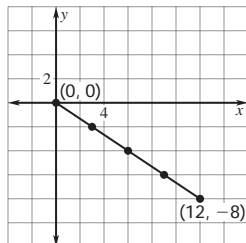


14. Write a set of parametric equations for the snowboarder's jump.
15. Use the equation to determine how far from the ramp the snowboarder landed.

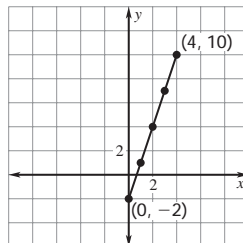
Answer Key

Practice B

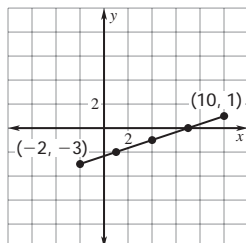
1.



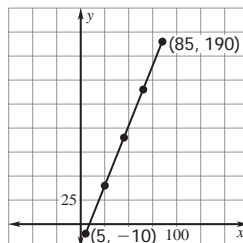
2.



3.



4.



5. $y = \frac{3}{2}x + 1; 0 \leq x \leq 8$
6. $y = -x + 10; 7 \leq x \leq 11$
7. $y = \frac{1}{5}x + 2; -20 \leq x \leq 0$
8. $y = 2x - 13; 6 \leq x \leq 46$
9. $x = (19.5 \cos 62.6^\circ)t$ or $x = 9.00t$;
 $y = (19.5 \sin 62.6^\circ)t$ or $y = 17.3t$
10. $x = (21.4 \cos 46.1^\circ)t + 6$ or $x = 14.8t + 6$;
 $y = (21.4 \sin 46.1^\circ)t + 15$ or $y = 15.4t + 15$
11. $x = (7.35 \cos 54.7^\circ)t + 1$ or $x = 4.25t + 1$;
 $y = (7.35 \sin 54.7^\circ)t + 7$ or $y = 6.00t + 7$
12. $x = (6.43 \cos 66.2^\circ)t + 5$ or $x = 2.60t + 5$;
 $y = (6.43 \sin 66.2^\circ)t + 6$ or $y = 5.88t + 6$
13. $x = (140 \cos 22.5^\circ)t$ or $x = 129t$;
 $y = -16t^2 + (140 \cos 22.5^\circ)t + 10$ or
 $y = -16t^2 + 53.6t + 10$
14. about 456 ft 15. about 3.53 seconds

Practice B

For use with pages 813–819

Graph the parametric equations.

- $x = 3t$ and $y = -2t$ for $0 \leq t \leq 4$
- $x = t$ and $y = 3t - 2$ for $0 \leq t \leq 4$
- $x = 3t + 1$ and $y = t - 2$ for $-1 \leq t \leq 3$
- $x = 20t + 5$ and $y = 50t - 10$ for $0 \leq t \leq 4$

Write an xy -equation for the parametric equations. State the domain.

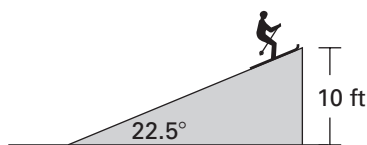
- $x = 2t$ and $y = 3t + 1$ for $0 \leq t \leq 4$
- $x = t + 5$ and $y = 5 - t$ for $2 \leq t \leq 6$
- $x = 5 - 5t$ and $y = -t + 3$ for $1 \leq t \leq 5$
- $x = 2t + 6$ and $y = 4t - 1$ for $0 \leq t \leq 20$

Use the given information to write parametric equations describing the linear motion.

- An object is at $(0, 0)$ at time $t = 0$ and then at $(27, 52)$ at time $t = 3$.
- An object is at $(6, 15)$ at time $t = 0$ and then at $(80, 92)$ at time $t = 5$.
- An object is at $(1, 7)$ at time $t = 2$ and then at $(18, 31)$ at time $t = 6$.
- An object is at $(5, 6)$ at time $t = 4$ and then at $(20.6, 41.3)$ at time $t = 10$.

Snow Skiing In Exercises 13–15, use the following information.

A snow skier jumps off a ramp at a speed of 140 feet per second. The ramp's angle of elevation is 22.5° , and the height of the end of the ramp above level ground is 10 feet.

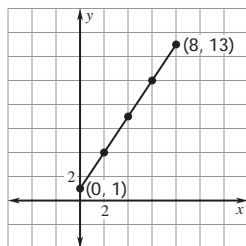


- Write a set of parametric equations for the snow skier's jump.
- Use the equation to determine how far from the ramp the skier landed.
- Determine how many seconds the snow skier is in the air.

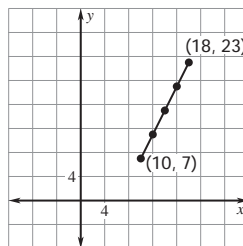
Answer Key

Practice C

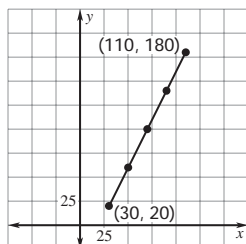
1.



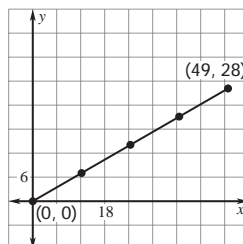
2.



3.



4.



5. $y = -x + 19; 7 \leq x \leq 12$
6. $y = 3x - 10; 4 \leq x \leq 20$
7. $y = 1.04x; 0 \leq x \leq 148$
8. $y = 2.20x; 0 \leq x \leq 50$
9. $x = (29.2 \cos 69.3^\circ)t$ or $x = 10.3t$;
 $y = (29.2 \sin 69.3^\circ)t$ or $y = 27.3t$
10. $x = (4.75 \cos 14.6^\circ)t + 4$ or $x = 4.60t + 4$;
 $y = (4.75 \sin 14.6^\circ)t + 1$ or $y = 1.20t + 1$
11. $x = (2.49 \cos 23.6^\circ)t - 2$ or $x = 2.29t - 2$;
 $y = (2.49 \sin 23.6^\circ)t$ or $y = 1.00t$
12. $x = (10.0 \cos 39.8^\circ)t + 2$ or $x = 7.71t + 2$;
 $y = (10.0 \sin 39.8^\circ)t - 3$ or $y = 6.43t - 3$
13. about 29.7 ft 14. $x = (6.1 \cos 125^\circ)t + 3.5$ or
 $x = -3.5t + 3.5$; $y = (6.1 \sin 125^\circ)t$ or $y = 5.0t$

Practice C

For use with pages 813–819

Graph the parametric equations.

- $x = 2t$ and $y = 3t + 1$ for $0 \leq t \leq 4$
- $x = 2t + 6$ and $y = 4t - 1$ for $2 \leq t \leq 6$
- $x = 20t + 10$ and $y = 40t - 20$ for $1 \leq t \leq 5$
- $x = (14.1 \cos 30^\circ)t$ and $y = (14.1 \sin 30^\circ)t$ for $0 \leq t \leq 4$

Write an xy -equation for the parametric equations. State the domain.

- $x = t + 7$ and $y = 12 - t$ for $0 \leq t \leq 5$
- $x = 2t + 4$ and $y = 6t + 2$ for $0 \leq t \leq 8$
- $x = (21.4 \cos 46.1^\circ)t$ and $y = (21.4 \sin 46.1^\circ)t$ for $0 \leq t \leq 10$
- $x = (8.1 \cos 65.6^\circ)t$ and $y = (8.1 \sin 65.6^\circ)t$ for $0 \leq t \leq 15$

Use the given information to write parametric equations describing the linear motion.

- An object is at $(0, 0)$ at time $t = 0$ and then at $(31, 82)$ at time $t = 3$.
- An object is at $(4, 1)$ at time $t = 0$ and then at $(27, 7)$ at time $t = 5$.
- An object is at $(-2, 0)$ at time $t = 1$ and then at $(14, 7)$ at time $t = 8$.
- An object is at $(2, -3)$ at time $t = 5$ and then at $(56, 42)$ at time $t = 12$.
- Soccer** You are a goalie in a soccer game. You save the ball and then drop kick it as far as you can down the field. Your kick has an initial speed of 30 feet per second and starts at a height of 2.5 feet. If you kick the ball at an angle of 50° , how far down the field does the ball hit the ground?
- Bike Path** A bike trail connects State and Peach Streets as shown. You enter the trail 3.5 miles from the intersection of the streets and pedal at a speed of 12 miles per hour. You reach Peach Street 5 miles from the intersection. Write a set of parametric equations to describe your path.

