10-1 Think About a Plan
The Pythagorean Theorem

Construction  A construction worker is cutting along the diagonal of a rectangular board 15 ft long and 8 ft wide. What will be the length of the cut?

KNOW
1. The board measures □ ft long by □ ft wide.

2. The board is in the shape of a __________, which has 4 __________ angles.

3. A diagonal cut divides the board into 2 equal __________ triangles.

4. The Pythagorean Theorem states __________________________.

NEED
5. To solve the problem I need to find __________________________

______________________________

PLAN
6. What drawing can you make to show what you are given and what you are trying to find?

7. What equation can you use to find the length of the cut?

8. Solve the equation.


______________________________

______________________________

______________________________
The Pythagorean Theorem

Use the triangle at the right. Find the length of the missing side. If necessary, round to the nearest tenth.

1. $a = 9, \quad b = 12$

2. $a = 7, \quad c = 25$

3. $b = 12, \quad c = 13$

4. $a = \frac{3}{5}, \quad b = \frac{4}{5}$

5. $b = 2, \quad c = 2.5$

6. $a = 12, \quad c = 37$

7. $a = 20, \quad b = 21$

8. $a = 3.2, \quad c = 13$

9. $a = 1.8, \quad c = 8.2$

10. $b = 20, \quad c = 25$

11. $a = \frac{6}{5}, \quad b = \frac{8}{5}$

12. $a = 0.8, \quad b = 1.5$

13. A quilter is cutting along the diagonal of a rectangular piece of fabric \(\frac{3}{4}\) yard wide by 1 yard long. What will be the length of the cut?

14. How long is the diagonal of a 12 mm-by-16 mm face of a rectangular prism?

15. A pilot flies a plane south and then 600 miles west, where she lands the plane. How far south did the pilot fly the plane if she lands 610 miles from her starting point?

16. A builder divides a rectangular plot of land in half along the diagonal. If the plot is \(\frac{1}{2}\)-mile wide and the diagonal measures \(1\frac{3}{10}\)-miles long, what is the length of the plot?
Determine whether the given lengths can be side lengths of a right triangle.

17. 16 cm, 30 cm, 34 cm
18. 0.8 m, 1.5 m, 1.7 m
19. 60 in., 91 in., 110 in.
20. 10 ft, 24 ft, 26 ft
21. 12 cm, 36 cm, 37 cm
22. 18 mi, 81 mi, 82 mi
23. 2.0 km, 2.1 km, 2.9 km
24. $\frac{1}{3}$ yd, $\frac{1}{4}$ yd, $\frac{1}{5}$ yd

Any set of three positive integers that satisfies the equation $a^2 + b^2 = c^2$ is a Pythagorean triple. Determine whether each set of numbers is a Pythagorean triple.

25. 36, 77, 85
26. 40, 96, 104
27. 9, 16, 25
28. 54, 72, 85
29. 70, 240, 250
30. 12, 60, 61

31. A landscaper attaches a guy wire 10 ft up the trunk of a newly planted sapling. He stakes the wire between 20 and 25 feet from the tree. What could be the length of the guy wire if it forms a right triangle with the tree?

32. Writing Summarize the method for finding the measure of the hypotenuse of a right triangle if you are given the measure of both legs.

33. The area of a square is 625 cm$^2$. What is the measure of the diagonal to the nearest tenth?

34. Open-Ended Draw a right triangle with side lengths that are whole numbers. What equation can you use to prove that you have drawn a right triangle? What theorem will you use to help make your proof?
10-1 Standardized Test Prep
The Pythagorean Theorem

Multiple Choice

For Exercises 1–6, choose the correct letter.

1. What is the length of the missing side?
   A. 21.8
   B. 26
   C. 28
   D. 34

2. What is the length of the missing side?
   F. 16 mm
   G. 28 mm
   H. 42 mm
   I. 69.5 mm

3. Which set of lengths could be the side lengths of a right triangle?
   A. 20 cm, 22 cm, 29 cm
   B. 10 ft, 12 ft, 15 ft
   C. 7 km, 24 km, 28 km
   D. 13 in., 84 in., 85 in.

4. A right triangle has a side length that measures 4 m and a hypotenuse that measures 8.5 m. What is the measure of the other side of the triangle?
   F. 7.5 m
   G. 8.1 m
   H. 9.4 m
   I. 9.8 m

5. How long is the diagonal of a 12 ft-by-16 ft rectangular garden?
   A. 6 ft
   B. 14 ft
   C. 18 ft
   D. 20 ft

6. You want to divide a square piece of paper into two equivalent triangles. If the square measures 20 cm on each side, what will the third side of each triangle measure?
   F. 8.9 cm
   G. 20 cm
   H. 28.3 cm
   I. 40 cm

Short Response

7. Joe is cutting three risers for a set of stairs. Each riser is a right triangle with legs $7 \frac{1}{2}$ in. and 10 in.
   a. What equation could you use to find the length of the third side of a riser?
   b. How long will the staircase measure when the 3 risers are installed?
      Explain. ______________________________

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Sports The bases in a softball diamond are located at the corners of a 3600 ft$^2$ square. How far is a throw from second base to home plate?

Understanding the Problem

1. What is the area of the softball diamond? _________________________________

2. Where are second base and home plate located? ____________________________

3. What is the problem asking you to determine? ______________________________

Planning the Solution

4. What equation can be used to determine the side length of the softball diamond? ________________________________

5. What equation can be used to determine the length of the throw from second base to home plate? ________________

6. How many steps will it take to solve this problem?

Getting an Answer

7. What is the first step in finding the solution? What is the solution of the first step? What is the second step in finding the solution? What is the solution?
10-2 Practice

Simplifying Radicals

Simplify each radical expression.

1. \( \sqrt{169} \)  
2. \( \sqrt{200} \)  
3. \( \sqrt{125} \)

4. \(-5\sqrt{112} \)  
5. \( \sqrt{68} \)  
6. \( 3\sqrt{121} \)

7. \( \sqrt{63t^4} \)  
8. \( \sqrt{48n^3} \)  
9. \( -\sqrt{60m^7} \)

10. \( x\sqrt{150x^5} \)  
11. \( -3\sqrt{45y^3} \)  
12. \( -2b\sqrt{136b^2} \)

Simplify each product.

13. \( \sqrt{6} \cdot \sqrt{30} \)  
14. \( \sqrt{5} \cdot \sqrt{70} \)  
15. \( 2\sqrt{3} \cdot \sqrt{96} \)

16. \( -4\sqrt{7} \cdot \sqrt{42} \)  
17. \( \sqrt{4a} \cdot \sqrt{12a^5} \)  
18. \( \sqrt{2n^3} \cdot \sqrt{30n} \)

19. \( -3\sqrt{40x} \cdot 2\sqrt{56x^5} \)  
20. \( \frac{3}{4}\sqrt{12t^3} \cdot \sqrt{20t^3} \)  
21. \( 4\sqrt{14d^2} \cdot \frac{1}{2}\sqrt{28d^3} \)

22. A pool is shaped like a rectangle with a length 4 times its width \( w \). What is an expression for the distance between opposite corners of the pool?

23. Evelyn rode her horse along a triangular path. The distance she traveled south was five times the distance she traveled east. Then she rode directly back to her starting point. What is an expression for the total distance she rode?
Simplify each radical expression.

24. \( \sqrt{\frac{36}{49}} \)  
25. \( \sqrt{\frac{81}{16}} \)  
26. \( \sqrt{\frac{100}{225}} \)

27. \( \sqrt{\frac{18y}{36y^2}} \)  
28. \( \sqrt{\frac{49x^5}{25x}} \)  
29. \( \sqrt{\frac{16a^2}{4b^4}} \)

30. \( \frac{\sqrt{5}}{\sqrt{2}} \)  
31. \( \frac{\sqrt{12}}{\sqrt{15}} \)  
32. \( \sqrt{\frac{72}{40}} \)

33. \( \sqrt{\frac{25b}{5b^3}} \)  
34. \( \sqrt{\frac{24}{3n}} \)  
35. \( \sqrt{\frac{8}{30m^2}} \)

36. You are making a mosaic design on a square table top. You have already covered half of the table top with 150 1-inch square tile pieces.
   a. What are the dimensions of the table top?
   b. What is the measure of the diagonal from one corner to the opposite corner of the table top?

37. The equation \( r = \sqrt{\frac{SA}{4\pi}} \) gives the radius \( r \) of a sphere with surface area \( SA \). What is the radius of a sphere with the given surface area? Write your answer as a simplified radical and as a decimal rounded to the nearest hundredth. Use 3.14 for \( \pi \).
   a. 1256 in\(^2\)  
   b. 200.96 cm\(^2\)  
   c. 379.94 ft\(^2\)

38. Open-Ended What are three radical expressions that simplify to \( 2\sqrt{3} \)?
10-2 Standardized Test Prep
Simplifying Radicals

Multiple Choice

For Exercises 1–5, choose the correct letter.

1. What is the simplified form of $\sqrt{140}$?
   A. $4\sqrt{35}$  
   B. $10\sqrt{14}$  
   C. $2\sqrt{70}$  
   D. $2\sqrt{35}$

2. What is the simplified form of $\sqrt{48n^9}$?
   F. $4n^3\sqrt{3}$  
   G. $4n^4\sqrt{3n}$  
   H. $3n\sqrt{4n^8}$  
   I. $4\sqrt{3n^9}$

3. What is the simplified form of $3\sqrt{5c} \cdot \sqrt{15c^3}$?
   A. $15c^2\sqrt{3}$  
   B. $6c^2\sqrt{5}$  
   C. $5c^2\sqrt{3}$  
   D. $12c^4\sqrt{5}$

4. Which radical expression is in simplified form?
   F. $\frac{11y}{\sqrt{3}}$  
   G. $\frac{\sqrt{6}}{5y}$  
   H. $\frac{\sqrt{17}}{\sqrt{4}}$  
   I. $\sqrt{\frac{25}{81}}$

5. A gardener is mowing a 20 yd-by-40 yd rectangular pasture using a diagonal pattern. He mows from one corner of the pasture to the corner diagonally opposite. What is the length of this pass with the mower? Give your answer in simplified form.
   A. $10\sqrt{20}$  
   B. $20\sqrt{2}$  
   C. $400\sqrt{5}$  
   D. $20\sqrt{5}$

Short Response

6. Suppose the height of the freight elevator in your building is half its width $w$ when the doors are all the way open.
   a. What is an expression for the maximum side length of a sheet of metal that will fit through the elevator doors?

   b. If the height of the elevator is 3 meters, what is the maximum length that will fit through the doors?
10-3 Think About a Plan
Operations with Radical Expressions

Chemistry The ratio of the diffusion rates of two gases is given by the formula \( r_1 \div r_2 = \frac{\sqrt{m_2}}{\sqrt{m_1}} \), where \( m_1 \) and \( m_2 \) are the masses of the molecules of the gases. Find \( r_1 \div r_2 \) if \( m_1 = 12 \) units and \( m_2 = 30 \) units. Write your answer in simplified radical form.

Understanding the Problem

1. How many gases are involved in the problem? __________________________

2. What variables represent the masses of the molecules of the two gases? ________________

3. What are the masses (in units) of the molecules of the two gases? ________________

Planning the Solution

4. What ratio can you simplify to find the ratio \( r_1 \div r_2 \)? __________________________

5. What values can you substitute for \( m_1 \) and \( m_2 \)? __________________________

6. How can you simplify the radical expression that results when you substitute values for \( m_1 \) and \( m_2 \)? __________________________

Getting an Answer

7. Simplify the radical expression. What is the ratio of diffusion rates between the two gases?

8. Is diffusion faster or slower for the molecule with less mass? __________________________

9. Is the solution reasonable? Explain. __________________________
Simplify each sum or difference.

1. \(3\sqrt{7} + 5\sqrt{7}\)  
2. \(8\sqrt{3} + \sqrt{3}\)  
3. \(11\sqrt{5} - 4\sqrt{5}\)

4. \(2\sqrt{11} - 6\sqrt{11}\)  
5. \(4\sqrt{13} + 4\sqrt{13}\)  
6. \(\sqrt{7} - 4\sqrt{7}\)

7. \(4\sqrt{7} - \sqrt{63}\)  
8. \(8\sqrt{3} + 2\sqrt{48}\)  
9. \(6\sqrt{8} - 2\sqrt{50}\)

10. \(3\sqrt{20} - 2\sqrt{45}\)  
11. \(5\sqrt{18} + 4\sqrt{32}\)  
12. \(\sqrt{12} - 7\sqrt{75}\)

Simplify each product.

13. \(\sqrt{3} (\sqrt{12} + 4)\)  
14. \(\sqrt{8} (\sqrt{3} + 3)\)

15. \(\sqrt{7} (\sqrt{7} - 2)\)  
16. \((\sqrt{3} - 4)^2\)

17. \((2\sqrt{3} + \sqrt{5})(6\sqrt{5} - 4\sqrt{3})\)  
18. \((7 + 3\sqrt{5})(7 - 3\sqrt{5})\)

Simplify each quotient.

19. \(\frac{12}{\sqrt{11} - \sqrt{7}}\)  
20. \(\frac{8}{\sqrt{3} + 1}\)  
21. \(\frac{32}{\sqrt{7} - \sqrt{3}}\)

22. \(\frac{-2}{\sqrt{15} - \sqrt{7}}\)  
23. \(\frac{30}{\sqrt{5} + \sqrt{2}}\)  
24. \(\frac{128}{\sqrt{37} + \sqrt{5}}\)
25. A painting is shaped like a golden rectangle. Its length is 24 cm. What is the painting’s width to the nearest tenth of a cm?

26. A tomato fits into a 10-in.-long golden rectangle. What is the tomato’s width to the nearest tenth of an inch?

27. The length of a golden rectangle is $4 + 4 \sqrt{5}$. Use the ratio of length to width $(1 + \sqrt{5}) : 2$ to find the width of the golden rectangle.

28. **Error Analysis** A student multiplied the radical expressions shown at the right. What mistake did the student make? What is the simplified form of the radical?

\[
\sqrt{3} \left( \sqrt{3} + \sqrt{5} \right) \\
= \sqrt{9} + \sqrt{15} \\
= 3 \sqrt{2}
\]

29. **Writing** What is the conjugate of $8 \sqrt{3} - \sqrt{7}$? What is the product of the conjugates? Show your work to explain your answer.

30. Find the length of the hypotenuse of the right triangle to the right. Write your answer in simplified radical form.

31. **Open-Ended** Make up three differences that are greater than or equal to 10. Use the square roots of 2, 3, 5, or 7 and whole numbers less than or equal to 10. For example, $10 \sqrt{3} - 2 \sqrt{7} \geq 10$.

32. A large park is designed as two 10-km squares connected at the corner and with diagonals aligned. If Riley jogs along the diagonal from one end of the park to the other end, how many total kilometers will he jog? Give your answer as a simplified radical and to the nearest tenth of a kilometer.
10-3 Standardized Test Prep
Operations with Radical Expressions

Multiple Choice
For Exercises 1–6, choose the correct letter.

1. What is the simplified form of $8\sqrt{5} + 5\sqrt{5}$?
   A. $3\sqrt{5}$      B. $13\sqrt{5}$      C. $40\sqrt{5}$      D. 200

2. What is the simplified form of $\sqrt{2} - 11\sqrt{2}$?
   F. $-10\sqrt{2}$   G. $-11\sqrt{2}$   H. $-12\sqrt{2}$   I. $-22$

3. What is the simplified form of $4\sqrt{3} - \sqrt{27}$?
   A. $-5\sqrt{3}$   B. $-7\sqrt{3}$   C. $\sqrt{3}$   D. $-\sqrt{9}$

4. What is the simplified form of $\sqrt{8}(\sqrt{5} + 4)$?
   F. $16\sqrt{10}$   G. $2\sqrt{10} + 4\sqrt{2}$   H. $4\sqrt{10} + 4\sqrt{2}$   I. $2\sqrt{10} + 8\sqrt{2}$

5. What is the simplified form of $\frac{40}{\sqrt{11} + \sqrt{7}}$?
   A. $10\sqrt{11} - 10\sqrt{7}$   B. $\frac{20\sqrt{11} - 20\sqrt{7}}{9}$   C. $30\sqrt{2}$   D. $10\sqrt{11} + 10\sqrt{7}$

6. A golden rectangle is 32 cm long. The ratio of length to width is $(1 + \sqrt{5}) : 2$.
   What is the width of the rectangle in simplest radical form?
   F. $16\sqrt{5} + 16$   G. $8\sqrt{5} - 8$   H. $16\sqrt{5} - 16$   I. $\frac{32\sqrt{5} - 32}{3}$

Short Response
7. The diagram to the right shows the design of the 12-in. quilt block that a quilter is sewing.
   a. What are the dimensions of each triangle in the quilt block?
      Give your answers as simplified radicals.

   b. What are the dimensions of each triangle to the nearest tenth of an inch?
Packaging

The radius \( r \) of a cylindrical can with volume \( V \) and height \( h \) is given by

\[
r = \sqrt[3]{\frac{V}{\pi h}}.
\]

What is the height of a can with a radius of 2 in. and a volume of 75 in.\(^3\)?

**KNOW**

1. What equation can you use to find the height of a cylindrical can?

2. What known values will you substitute into the equation?

3. What is the meaning of the symbol \( \pi \)?

**NEED**

4. Which variable represents the height of the can?

**PLAN**

5. What equation do you get after substituting the known values?

6. Can you solve this equation by squaring both sides?

7. How can you isolate the remaining variable?

8. Are there any extraneous solutions? If so, what are they?

9. What is the height of the can?

10. Is the solution reasonable? Explain.
Solve each radical equation. Check your solution.

1. \( \sqrt{x} + 4 = 7 \)
2. \( \sqrt{2t} - 3 = 11 \)
3. \( 4 - \sqrt{2s} = -6 \)
4. \( \sqrt{6c} + 4 = 8 \)
5. \( \sqrt{3t} - 2 = 5 \)
6. \( 2 = \sqrt{-3y} - 5 \)
7. \( \sqrt{5n} - 4 = 6 \)
8. \( \sqrt{\frac{b^4}{16}} = 16 \)
9. \( \sqrt{\frac{a}{2}} - 3 = -32 \)

10. You decide to install a rope swing at the bend in the river. The time \( t \) in seconds for the rope swing to make one swing is given by \( 2\sqrt{\frac{T}{3,333}} \), where \( l \) is the length of the rope swing in feet. If one swing takes 3.5 seconds, how long is the rope swing? Round your answer to the nearest tenth of a foot.

11. The radius \( r \) of a sphere is given by \( r = \sqrt[4]{\frac{SA}{\pi}} \), where \( SA \) represents the sphere's surface area. If a sphere has a surface area of 531 in.\(^2 \), what is the length of its radius? Use \( \pi = 3.14 \). Round to the nearest hundredth of an inch.

12. The speed \( V \) in feet per second that an acorn falls from a tree is given by \( V = \sqrt{64d} \), where \( d \) is the distance in feet that the acorn has fallen. An acorn hits the ground at a speed of 28 feet per second. How far did the acorn fall?

13. Harrison bought a 10-foot ramp to load his dirt bike into the back of his truck. The ramp hooks to the 3-foot-high tailgate. How far away from the tailgate does the ramp sit on the ground? Round your answer to the nearest tenth of a foot.
Solve each radical equation. Check your solution.

14. \(\sqrt{4d} + 3 = \sqrt{7d} - 3\)  
15. \(\sqrt{x} + 7 = \sqrt{15 - x}\)  
16. \(\sqrt{48 - 3y} = \sqrt{3y} - 6\)

17. \(\sqrt{a^2 + 20} = \sqrt{9a}\)  
18. \(\sqrt{2x^2 + 17} = \sqrt{(x + 3)^2}\)  
19. \(\sqrt{d + 7} = 3\sqrt{4d}\)

20. \(11 = \sqrt{12b - 59}\)  
21. \(\frac{f}{3} = \sqrt{f - 2}\)  
22. \(\frac{t}{4} = \sqrt{\frac{7t - 10}{16}}\)

Solve each radical equation. Check your solution. If there is no solution, write *no solution*.

23. \(x = \sqrt{2x} + 8\)  
24. \(m = \sqrt{-6m + 7}\)  
25. \(-n = \sqrt{4n + 12}\)

26. \(x = \sqrt{3x} + 28\)  
27. \(\frac{-y}{2} = \sqrt{\frac{-5y + 24}{4}}\)  
28. \(-f = \sqrt{-f + 56}\)

29. **Error Analysis** A student solved the equation \(-t = \sqrt{5t} + 14\) and found the solutions 7 and \(-2\). Describe and correct the error.

30. The distance \(d\) in feet that it takes an automobile to stop if it is traveling \(S\) miles per hour is given by \(S = \sqrt{21d}\). Find the distance it would take an automobile traveling 60 miles per hour to stop. Round your answer to the nearest tenth of a foot.

31. **Open-Ended** Write two radical equations that have no solutions. Explain why all the solutions are extraneous.
10-4 Standardized Test Prep
Solving Radical Equations

Multiple Choice

For Exercises 1–6, choose the correct letter.

1. What is the solution of the radical equation $\sqrt{t} + 9 = 16$?
   A. 5  B. 7  C. 25  D. 49

2. What is the solution of $\sqrt{6g - 23} = \sqrt{12 - g}$?
   F. 5  G. 7  H. 11  I. 35

3. What are the solutions of $\sqrt{d^2} - 11 = 5$?
   A. 4, −4  B. 5, −5  C. 5, 6  D. 6, −6

4. Which is the extraneous solution of $-x = \sqrt{2x + 15}$?
   F. −5  G. −3  H. 3  I. 5

5. The pendulum of a cuckoo clock completes one full swing every $t$ seconds.
   The variable $t$ is determined by the function $t = 2\sqrt{\frac{T}{3.3}}$ where $l$ is the length in meters of the pendulum. Each swing takes 0.5 seconds. How many centimeters long is the pendulum?
   A. 20.625 cm  B. 41.25 cm  C. 82.5 cm  D. 330 cm

6. A company invests $15,000 in an account that compounds interest annually. After two years, the account is worth $16,099.44. Use the function $A = P(1 + r)^2$, where $r$ is the annual interest rate, $P$ is the principal, and $A$ is the amount of money after $t$ years. What is the interest rate of the account?
   F. 1.04%  G. 3.6%  H. 5.4%  I. 7.3%

Extended Response

7. The radius of Earth is about 6378 kilometers. The escape velocity $V_e$ is determined by the function $V_e = \sqrt{2gR}$ where $g$ is acceleration due to gravity in m/s$^2$ and $R$ is the radius of Earth in meters. If $g$ for Earth is 9.8 m/s$^2$, what is the escape velocity of Earth? Show your work.
10-5 Think About a Plan
Graphing Square Root Functions

Firefighting  When firefighters are trying to put out a fire, the rate at which they can spray water on the fire depends on the nozzle pressure. You can find the flow rate \( f \) in gallons per minute using the function \( f = 120 \sqrt{p} \); where \( p \) is the nozzle pressure in pounds per square inch.

a. Graph the function.

b. What nozzle pressure gives a flow rate of 800 gal/min?

1. What are the independent and dependent variables for this function?

2. What are the domain and range of the function?
   - Domain: \( p \geq \)
   - Range: \( f \geq \)

3. Use the function to complete the table of values for nozzle pressure and flow rate.

<table>
<thead>
<tr>
<th>( p )</th>
<th>( f )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td></td>
</tr>
<tr>
<td></td>
<td>600</td>
</tr>
</tbody>
</table>

4. Graph the function.

5. Which nozzle pressure on the graph corresponds to a flow rate of 800 gal/min?

Find the domain of each function.

1. \( y = 2x\sqrt{x} \)  
2. \( y = \frac{1}{4}\sqrt{x} \)  
3. \( y = \sqrt{x} + 3 \)  
4. \( y = 4\sqrt{2x + 10} \)  
5. \( y = \sqrt{x - 9} \)  
6. \( y = 4\sqrt[4]{x} \)  
7. \( y = 4.3\sqrt{x} + 5 \)  
8. \( y = \sqrt{3x - 18} \)  
9. \( \sqrt[4]{4(x - 7)} \)  
10. \( y = \frac{1}{2}\sqrt{12 - x} \)  
11. \( y = \sqrt{2x + 7} - 3 \)  
12. \( y = 3\sqrt{5x - 4} \)

Make a table of values and graph each function.

13. \( y = \sqrt{x} + 2 \)  
14. \( y = 3\sqrt{x} \)  
15. \( y = \sqrt{x} - 3 + 1 \)  
16. \( y = 5\sqrt{x} - 5 \); \( y \geq 30 \)  
17. \( y = 2\sqrt{x + 3} + 6 \)  
18. \( y = 7\sqrt{4x + 12} - 3 \)

19. The distance \( d \) a car skids in feet on dry asphalt is modeled by 
   \( S = \sqrt{21d} \), where \( S \) is the speed of the car in miles per hour upon sudden braking. What are the domain and range of the function? Graph the function. What braking distance will indicate a speed equal to or greater than 56 miles per hour?
Graph each function by translating the graph of $y = \sqrt{x}$.

20. $y = \sqrt{x} + 2$  
21. $y = \sqrt{x} - 2$  
22. $y = \sqrt{x} + 5$

23. $y = \sqrt{x} - 4$  
24. $y = \sqrt{x} + 1 - 2$  
25. $y = 4\sqrt{x} - 6$

26. The distance $d$ in miles that you can see to the horizon when looking out at the ocean is modeled by the function $d = \sqrt{1.5a}$, where $a$ is your altitude in feet. Graph the function. At what altitude can you see 15 miles? 100 miles? Round to the nearest foot.

27. Stacey is designing a soup can. It must hold 32 cubic inches of soup and the radius must be approximately half the height. The function $r = \frac{32}{\pi h}$ shows the radius of the can as a function of its height. What are the domain and range of the function? Graph the function. What height should Stacey design the can?

28. Error Analysis A student graphed the function $y = 6\sqrt{x} - 3 + 4$ at the right. What mistake(s) did the student make? Draw the correct graph.

29. Writing Describe the steps for graphing a function of the form $y = a\sqrt{x - h} + k$. 

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Multiple Choice

For Exercises 1–5, choose the correct letter.

1. What is the domain of the function \( y = 3\sqrt{6x + 42} \)?
   A. \( x \geq 0 \)  
   B. \( x \leq 7 \)  
   C. \( x \geq -6 \)  
   D. \( x \geq -7 \)

2. What are the domain and range of the function \( y = 2\sqrt{3x + 4} - 5 \)?
   F. \( x \geq -\frac{4}{3}; y \geq -5 \)  
   G. \( x \geq \frac{4}{3}; y \geq -5 \)  
   H. \( x \leq -\frac{4}{3}; y \leq -5 \)  
   I. \( x \geq \frac{4}{3}; y \leq -5 \)

3. When will the dependent variable in the equation \( y = \sqrt{x + 4} - 3 \) equal or exceed 4?
   A. \( x \geq -0.17 \)  
   B. \( x \geq 45 \)  
   C. \( x \geq 48 \)  
   D. \( x \geq 53 \)

4. Which function is shown on the graph to the right?
   F. \( y = \sqrt{2x - 6} - 1 \)  
   G. \( y = \sqrt{2x + 6} + 1 \)  
   H. \( y = \sqrt{2x - 6} + 1 \)  
   I. \( y = \sqrt{2x + 6} - 1 \)

5. The function \( t = \frac{\sqrt{d}}{16} \) models the time \( t \) in seconds that an object has been falling after the object has fallen \( d \) feet. When will the time be more than 1 minute?
   A. \( d \geq 16 \text{ ft} \)  
   B. \( d \geq 225 \text{ ft} \)  
   C. \( d \geq 3600 \text{ ft} \)  
   D. \( d \geq 57,600 \text{ ft} \)

Short Response

6. An amusement park ride is a spinning cylinder. At a certain speed the riders are pinned against the walls by the force of the spin and the floor drops out safely. The speed \( s \) in meters per second that is needed to pin the riders is given by \( s = 4.95\sqrt{r} \) where \( r \) is the radius of the cylinder in meters.
   a. Graph the function.
   b. What is an estimate for the radius of the ride if \( s = 12 \) meters per second? Round to the nearest hundredth of a meter.
**Hobbies** Suppose you are flying a kite. The kite string is 60 m long, and the angle of elevation of the string is 65° from your hand. Your hand is 1 m above the ground. How high above the ground is the kite?

**KNOW**

1. How high above the ground is the base of the triangle made by the kite string? ________

2. What is the length of the hypotenuse of the triangle made by the kite string? ________

3. What is the angle of elevation? ________

**NEED**

4. What leg of the triangle do you need to find? ________

**PLAN**

5. What diagram can you draw to help you solve the problem?

6. Which trigonometric ratio can you use to find the length of the missing leg?

7. Write and solve an equation to find the length of the missing leg.

8. Use the distance your hand is above the ground and the length of the missing leg to find how high the kite is above the ground.

10-6 Practice
Trigonometric Ratios

For $\triangle JKL$ and $\triangle RST$, find the value of each expression.

1. $\sin J$
2. $\cos J$
3. $\tan L$
4. $\cos L$
5. $\tan T$
6. $\sin T$
7. $\tan J$
8. $\cos R$
9. $\sin R$
10. $\tan R$
11. $\sin L$
12. $\cos T$

Find the value of each expression. Round to the nearest ten-thousandth.

13. $\sin 15^\circ$
14. $\tan 45^\circ$
15. $\cos 60^\circ$
16. $\tan 72^\circ$
17. $\sin 30^\circ$
18. $\cos 80^\circ$
19. $\sin 65^\circ$
20. $\cos 12^\circ$
21. $\tan 87^\circ$
22. $\tan 24^\circ$
23. $\sin 35^\circ$
24. $\cos 28^\circ$

For each triangle, find the missing side length to the nearest tenth.

25. The hypotenuse is 4 m long. How long is the side adjacent to a $40^\circ$ angle?
26. A $25^\circ$ angle has an opposite leg 6 cm long. How long is the adjacent leg?
27. A $52^\circ$ angle has an adjacent leg 10 inches long. How long is the hypotenuse?
28. The hypotenuse is 20 mm long. How long is the side adjacent to a $15^\circ$ angle?
29. A $60^\circ$ angle has an adjacent leg 5 cm long. How long is the hypotenuse?
30. The hypotenuse is 13 inches long. How long is the side opposite a $50^\circ$ angle?
31. A $5^\circ$ angle has an opposite leg 2 ft long. How long is the adjacent leg?
32. The hypotenuse is 25 mm long. How long is the side adjacent a $70^\circ$ angle?
10-6 Practice (continued)

Form G

Trigonometric Ratios

For each right triangle described, find all three angles to the nearest tenth.

33. The hypotenuse is 8 ft long. The adjacent side is 5 ft long.

34. The opposite side is 12 cm long. The adjacent side is 15 cm long.

35. The hypotenuse is 6 inches long. The opposite side is 3 inches long.

36. The adjacent side is 1 m long. The opposite side is 4 m long.

37. The hypotenuse is 5 inches long. The opposite side is 2 inches long.

38. The adjacent side is 16 mm long. The hypotenuse is 22 mm long.

39. The hypotenuse is 4 m long. The opposite side is 2.5 m long.

40. The opposite side is 7 inches long. The adjacent side is 11 inches long.

41. Gayle stood at the edge of a 120-ft deep canyon. She is approximately 5 ft tall and when she looked across the canyon to the far corner, her line of sight made a 22° angle of depression. How wide was the canyon?

42. A parallelogram has a height of 5 cm and side measures of 8 cm and 12 cm. What are the measures of the angles?

43. Error Analysis A student was finding the measure of an angle. The opposite side measured 6 cm and the hypotenuse measured 13 cm. His work is shown in the box to the right. Describe and correct the student’s error.
Solve each exercise and enter your answer on the grid provided.

1. For $\triangle ABC$, what is the value of $\cos C$?

2. A right triangle’s hypotenuse is 20 cm long. What is the length of the side opposite a $60^\circ$ angle? Give your answer to the nearest tenth of an inch.

3. A right triangle’s legs are 3 and 4 meters long. What is the measure of the angle adjacent to the 4-meter leg to the nearest tenth of a degree?

4. For $\triangle XYZ$, what is the measure of the smallest angle to the nearest tenth of a degree?

5. Suppose that you are watching the tree warden trim branches from a large tree in your yard. He has climbed up 15 meters and his assistant is holding a rope that will be used to guide the branch when it falls. To the nearest meter, how long is the rope?