Chapter 7

Chapter 7 Opener

Try It Yourself (p. 287)

1. Because \( \frac{21}{10} = \frac{21}{10} \) is equal to \( 2.1 \).
   So, \( 2.10 = 2.1 \).

2. Because \( -\frac{18}{4} < -\frac{17}{4} \), \( -4.5 < -4.25 \).
   So, \( -4.5 < -4.25 \).

3. Because \( \pi \approx 3.14 \) is less than \( 3.2 \), \( \pi < 3.2 \).
   So, \( \pi < 3.2 \).

4. Sample answer: Any decimal greater than or equal to \( -0.01 \) will make the sentence true. So, three decimals are \(-0.009, -0.001, \) and \(0.01\).

5. Sample answer: Any decimal less than \( 1.75 \) will make the sentence true. So, three decimals are \(-1.75, -1.74, \) and \(1.74\).

6. Sample answer: Any decimal less than or equal to \( 0.75 \) will make the sentence true. So, three decimals are \(-0.75, 0.74, \) and \(0.75\).

7. \[ 15 \left( \frac{12}{3} \right) = 7^2 - 2 \cdot 7 = 60 - 7^2 - 2 \cdot 7 \\
   = 60 - 49 - 2 \cdot 7 \\
   = 60 - 49 - 14 \\
   = -3 \]

8. \[ 3^2 \cdot 4 + 18 + 30 \cdot 6 - 1 = 9 \cdot 4 + 18 + 30 \cdot 6 - 1 \\
   = 36 + 18 + 180 - 1 \\
   = 2 + 180 - 1 \\
   = 181 \]

9. \[ -1 + \left( \frac{4}{2} (6 - 1) \right)^2 = -1 + \left( \frac{4}{2} (5) \right)^2 \\
   = -1 + (2(5))^2 \\
   = -1 + (10)^2 \\
   = -1 + 100 \\
   = 99 \]

Section 7.1

7.1 Activity (pp. 288–289)

1. \( b. \quad s = \sqrt{81} = 9 \text{ yd} \)
   Check: \( 9 \times 9 = 81 \checkmark \)

2. \( c. \quad s = \sqrt{324} = 18 \text{ cm} \)
   Check: \( 18 \times 18 = 324 \checkmark \)

3. \( d. \quad s = \sqrt{361} = 19 \text{ mi} \)
   Check: \( 19 \times 19 = 361 \checkmark \)

4. \( e. \quad s = \sqrt{225} = 15 \text{ mi} \)
   Check: \( 15 \times 15 = 225 \checkmark \)

5. \( f. \quad s = \sqrt{2.89} = 1.7 \text{ in.} \)
   Check: \( 1.7 \times 1.7 = 2.89 \checkmark \)

6. \( g. \quad s = \sqrt{\frac{4}{9}} = \frac{2}{3} \text{ ft} \)
   Check: \( \frac{2}{3} \times \frac{2}{3} = \frac{4}{9} \checkmark \)

2. \[ A = \pi r^2 \\
   \frac{A}{\pi} = r^2 \\
   \sqrt{\frac{A}{\pi}} = r \]

a. \( r = \sqrt{\frac{36\pi}{\pi}} = \sqrt{36} = 6 \)
   The radius is 6 inches.

b. \( r = \sqrt{\frac{\pi}{\pi}} = \sqrt{1} = 1 \)
   The radius is 1 yard.

c. \( r = \sqrt{\frac{0.25\pi}{\pi}} = \sqrt{0.25} = 0.5 \)
   The radius is 0.5 foot.
Chapter 7

d. \[ r = \sqrt{\frac{9\pi}{16}} = \sqrt{\frac{9}{16}} = \frac{3}{4} \]

The radius is \( \frac{3}{4} \) meter.

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<thead>
<tr>
<th>( L )</th>
<th>( T = 1.1\sqrt{L} )</th>
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<tbody>
<tr>
<td>1.00</td>
<td>( T = 1.1\sqrt{1.00} = 1.1(1) = 1.1 )</td>
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<tr>
<td>1.96</td>
<td>( T = 1.1\sqrt{1.96} = 1.1(1.4) = 1.54 )</td>
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<tr>
<td>3.24</td>
<td>( T = 1.1\sqrt{3.24} = 1.1(1.8) = 1.98 )</td>
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<td>4.00</td>
<td>( T = 1.1\sqrt{4.00} = 1.1(2) = 2.2 )</td>
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<td>4.84</td>
<td>( T = 1.1\sqrt{4.84} = 1.1(2.2) = 2.42 )</td>
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<td>6.25</td>
<td>( T = 1.1\sqrt{6.25} = 1.1(2.5) = 2.75 )</td>
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<td>7.29</td>
<td>( T = 1.1\sqrt{7.29} = 1.1(2.7) = 2.97 )</td>
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<tr>
<td>7.84</td>
<td>( T = 1.1\sqrt{7.84} = 1.1(2.8) = 3.08 )</td>
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<tr>
<td>9.00</td>
<td>( T = 1.1\sqrt{9.00} = 1.1(3) = 3.3 )</td>
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The function is not linear because its graph is not a line.

4. The area of a square is the side length squared. So, when you are given the area of a square, find the square root of the area; that is, find a number whose square is the area.

Sample answer: The side length of a square with an area of 144 square feet is \( \sqrt{144} = 12 \) feet. You can check this by multiplying.

\[
\begin{array}{c}
\frac{12}{12} \\
\times \frac{12}{12} \\
\hline
\frac{144}{144}
\end{array}
\]

The area of a circle is \( \pi \) multiplied by the radius squared. So, when you are given the area of a circle, find the square root of the quotient of the area and \( \pi \); that is, find a number whose square times \( \pi \) is the area.

Sample answer: The radius of a circle with an area of \( 64\pi \) square inches is \( \sqrt{\frac{64\pi}{\pi}} = \sqrt{64} = 8 \) inches. You can check this by multiplying the square of the radius and \( \pi \).

\[
8^2 \times \pi = 64\pi
\]

7.1 On Your Own (pp. 390–391)

1. \( 6 \cdot 6 = 36 \)
   \((-6) \cdot (-6) = 36 \)
   So, the square roots of 36 are 6 and \(-6\).

2. \( 10 \cdot 10 = 100 \)
   \((-10) \cdot (-10) = 100 \)
   So, the square roots of 100 are 10 and \(-10\).

3. \( 11 \cdot 11 = 121 \)
   \((-11) \cdot (-11) = 121 \)
   So, the square roots of 121 are 11 and \(-11\).

4. Because \( 1^2 = 1 \), \(-\sqrt{1} = -\sqrt{1^2} = -1 \).

5. Because \( \left(\frac{2}{5}\right)^2 = \frac{4}{25} \), \( \pm \sqrt{\frac{4}{25}} = \pm \sqrt{\left(\frac{2}{5}\right)^2} = \pm \frac{2}{5} \).

6. Because \( 3.5^2 = 12.25 \), \( \sqrt{12.25} = \sqrt{3.5^2} = 3.5 \).

7. \( 12 - 3\sqrt{25} = 12 - 3(5) = 12 - 15 = -3 \)

8. \( \sqrt{\frac{28}{7}} + 2.4 = \sqrt{4} + 2.4 = 2 + 2.4 = 4.4 \)

9. \( 15 - \left(\sqrt{4}\right)^2 = 15 - (2)^2 = 15 - 4 = 11 \)
Chapter 7

10. \[ A = \pi r^2 \]
    \[ 2826 \approx 3.14 r^2 \]
    \[ 900 = r^2 \]
    \[ \sqrt{900} = \sqrt{r^2} \]
    \[ 30 = r \]

The radius of the circle is about 30 feet.

7.1 Exercises (pp. 292–293)

Vocabulary and Concept Check

1. no; The square root of 26 is not an integer.

2. no; The square of a negative integer is positive, and the square of a positive integer is positive.

3. \( \sqrt{256} \) represents the positive square root of 256 because it does not contain a negative sign or a plus/minus sign in front of the radical sign.

Practice and Problem Solving

4. \( s = \sqrt{441} = 21 \text{ cm} \)
   Check: \[
   \times \begin{array}{c}
   21 \\
   \hline
   21 \\
   \hline
   420 \\
   \hline
   441 \checkmark
   \end{array}
   \]

5. \( s = \sqrt{1.69} = 1.3 \text{ km} \)
   Check: \[
   \times \begin{array}{c}
   1.3 \\
   \hline
   39 \\
   \hline
   130 \\
   \hline
   1.69 \checkmark
   \end{array}
   \]

6. \[ r = \frac{A}{\pi} = \sqrt{\frac{64\pi^2}{\pi}} = \sqrt{64} = 8 \text{ in.} \]
   Check: \( A = \pi (8)^2 = 64\pi \checkmark \)

7. \( 3 \cdot 3 = 9 \)
   \((-3) \cdot (-3) = 9 \)
   So, the square roots of 9 are 3 and \(-3\).

8. \( 8 \cdot 8 = 64 \)
   \((-8) \cdot (-8) = 64 \)
   So, the square roots of 64 are 8 and \(-8\).

9. \( 2 \cdot 2 = 4 \)
   \((-2) \cdot (-2) = 4 \)
   So, the square roots of 4 are 2 and \(-2\).

10. \( 12 \cdot 12 = 144 \)
    \((-12) \cdot (-12) = 144 \)
    So, the square roots of 144 are 12 and \(-12\).

11. Because \( 25^2 = 625, \sqrt{625} = \sqrt{25^2} = 25 \).

12. Because \( 14^2 = 196, \pm\sqrt{196} = \pm\sqrt{14^2} = 14 \) and \(-14\).

13. Because \( \left( \frac{1}{31} \right)^2 = \frac{1}{961}, \pm\sqrt{\frac{1}{961}} = \pm\sqrt{\left( \frac{1}{31} \right)^2} = \frac{1}{31} \) and \(-\frac{1}{31}\).

14. Because \( \left( \frac{3}{10} \right)^2 = \frac{9}{100}, \sqrt{\frac{9}{100}} = \sqrt{\left( \frac{3}{10} \right)^2} = -\frac{3}{10} \).

15. Because \( 2.2^2 = 4.84, \pm\sqrt{4.84} = \pm\sqrt{2.2^2} = 2.2 \) and \(-2.2\).

16. Because \( 2.7^2 = 7.29, \sqrt{7.29} = \sqrt{2.7^2} = 2.7 \).

17. Because \( 19^2 = 361, \sqrt{361} = \sqrt{19^2} = 19 \).

18. Because \( 1.5^2 = 2.25, \sqrt{2.25} = \sqrt{1.5^2} = 1.5 \).

19. \( \sqrt{\frac{1}{4}} \) represents both the positive and negative square roots. So, \( \sqrt{\frac{1}{4}} = \sqrt{\left( \frac{1}{2} \right)^2} = \frac{1}{2} \) and \(-\frac{1}{2}\).

20. \( (\sqrt{9})^2 + 5 = (3)^2 + 5 = 9 + 5 = 14 \)

21. \( 28 - (\sqrt{144})^2 = 28 - (12)^2 = 28 - 144 = -116 \)

22. \( 3\sqrt{16} - 5 = 3(4) - 5 = 12 - 5 = 7 \)

23. \( 10 - 4\sqrt{\frac{1}{16}} = 10 - 4\left( \frac{1}{4} \right) = 10 - 1 = 9 \)

24. \( \sqrt{6.76} + 5.4 = 2.6 + 5.4 = 8 \)

25. \( 8\sqrt{8.41} + 1.8 = 8(2.9) + 1.8 = 23.2 + 1.8 = 25 \)
26. \(2 \left( \frac{80}{5} - 5 \right) = 2(\sqrt{16} - 5)\)
    \[= 2(4 - 5)\]
    \[= 2(-1)\]
    \[= -2\]

27. \(4 \left( \frac{147}{3} + 3 \right) = 4(\sqrt{49} + 3)\)
    \[= 4(7 + 3)\]
    \[= 4(10)\]
    \[= 40\]

28. Because \(1.5^2 = 2.25\), \(\sqrt{2.25} = \sqrt{1.5^2} = 1.5\).
    So, the length of one side of the base of the notepad is 1.5 inches.

29. In the context of the problem, a negative radius does not make sense. So, there is only one answer for the radius of the button.

30. \(\sqrt{81} = 9\), and \(9 \geq 8\)
    So, \(\sqrt{81} > 8\).

31. \(\sqrt{0.25} = 0.5\)
    So, \(0.5 = \sqrt{0.25}\).

32. \(\frac{25}{4} = \frac{5}{2}\), and \(\frac{3}{2} < \frac{5}{2}\)
    So, \(\frac{3}{2} < \frac{25}{4}\)

33. \(A = \frac{1}{2}bh\)
    \(40\frac{1}{2} = \frac{1}{2}h^2\)
    \(\frac{81}{2} = \frac{1}{2}h^2\)
    \(81 = h^2\)
    \(\sqrt{81} = \sqrt{h^2}\)
    \(9 = h\)
    The height of the sail is 9 feet.

34. yes; Sample answer: Consider the perfect squares, \(a^2\) and \(b^2\). Their product can be written as \(a^2b^2 = a \bullet a \bullet b \bullet b = (a \bullet b) \bullet (a \bullet b) = (a \bullet b)^2\).

35. \(K = \frac{v^2}{2}\)
    \(32 = \frac{v^2}{2}\)
    \(64 = v^2\)
    \(\sqrt{64} = \sqrt{v^2}\)
    \(8 = v\)
    The apple is traveling at a rate of 8 meters per second.

36. a. The two watch faces are similar, so the ratio of their areas is equal to the square of the ratio of their corresponding radii.
    \[
    \begin{align*}
    \frac{\text{Area of small}}{\text{Area of large}} &= \left( \frac{\text{radius of small}}{\text{radius of large}} \right)^2 \\
    16 &= \left( \frac{4}{5} \right)^2 \\
    25 &= \left( \frac{5}{4} \right)^2 \\
    \sqrt{16} &= \text{radius of small} \\
    \sqrt{25} &= \text{radius of large} \\
    \frac{4}{5} &= \frac{\text{radius of small}}{\text{radius of large}}
    \end{align*}
    \]
    The ratio of the radius of the smaller watch face to the radius of the larger watch face is \(\frac{4}{5}\).

b. Let \(r\) be the radius of the smaller watch face and \(R\) be the radius of the larger watch face. Solve the proportion for \(R\).
    \[
    \frac{4}{5} = \frac{r}{R} \Rightarrow \frac{4}{5} = \frac{2}{R} \Rightarrow R = \frac{10}{4}, \text{ or } \frac{5}{2}
    \]
    The radius of the larger watch face is \(\frac{5}{2}\) or 2.5 centimeters.

37. \(C = \frac{n^2}{5} + 175\)
    \(355 = \frac{n^2}{5} + 175\)
    \(180 = \frac{n^2}{5}\)
    \(900 = n^2\)
    \(\sqrt{900} = \sqrt{n^2}\)
    \(30 = n\)
    The length in inches is 30. Convert to feet using the fact that 1 foot = 12 inches.
    \[
    \frac{30 \text{ in.} \times \frac{1 \text{ ft}}{12 \text{ in.}}}{12 \text{ in.}} = 2.5 \text{ ft}
    \]
    So, the length of the window is 2.5 feet.
Chapter 7

38. \( s = \frac{1}{2} \cdot P = \frac{1}{2} \cdot (17 + 10 + 21) = \frac{1}{2} \cdot 48 = 24 \)

\[ A = \frac{1}{2}bh \]

\[ \sqrt{s(s - 21)(s - 17)(s - 10)} = \frac{1}{2} \cdot (21)h \]

\[ \sqrt{24(24 - 21)(24 - 17)(24 - 10)} = 10.5h \]

\[ \sqrt{24(3)(7)(14)} = 10.5h \]

\[ \sqrt{7056} = 10.5h \]

\[ 84 = 10.5h \]

\[ h = \frac{84}{10.5} \]

The height of the triangle is 8 centimeters.

**Fair Game Review**

39. \( m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{13 - 4}{5 - 2} = \frac{9}{3} = 3 \)

\[ y - y_1 = m(x - x_1) \]

\[ y - 4 = 3(x - 2) \]

\[ y - 4 = 3x - 6 \]

\[ y = 3x - 2 \]

40. \( m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-1 - 7}{3 - (-1)} = \frac{-8}{4} = -2 \)

\[ y - y_1 = m(x - x_1) \]

\[ y - 7 = -2(x + 1) \]

\[ y - 7 = -2x - 2 \]

\[ y = -2x + 5 \]

41. \( m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{4 - (-2)}{5 - (-5)} = \frac{6}{10} = \frac{3}{5} \)

\[ y - y_1 = m(x - x_1) \]

\[ y - (-2) = \frac{3}{5}(x + 5) \]

\[ y + 2 = \frac{3}{5}x + 3 \]

\[ y = \frac{3}{5}x + 1 \]

42. B: \( x + (x + 8) + 84 = 180 \)

\[ 2x + 92 = 180 \]

\[ 2x = 88 \]

\[ x = 44 \]

**Section 7.2**

### 7.2 Activity (pp. 294–295)

1. b. \( s = \sqrt{27} = \sqrt[3]{3^3} = 3 \text{ ft} \)

\[ \text{Check: } 3 \cdot 3 \cdot 3 = 9 \cdot 3 \]

\[ = 27 \]

2. b. \( s = \sqrt[3]{125} = \sqrt[3]{5^3} = 5 \text{ m} \)

\[ \text{Check: } 5 \cdot 5 \cdot 5 = 25 \cdot 5 \]

\[ = 125 \]

c. \( s = \sqrt[3]{0.001} = \sqrt[3]{0.1^3} = 0.1 \text{ cm} \)

\[ \text{Check: } 0.1 \cdot 0.1 \cdot 0.1 = 0.01 \cdot 0.1 \]

\[ = 0.001 \]

d. \( s = \sqrt[3]{\frac{1}{8}} = \sqrt[3]{\left(\frac{1}{2}\right)^3} = \frac{1}{2} \text{ yd} \)

\[ \text{Check: } \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} = \frac{1}{8} \]

2. a. \( 216 = 3 \cdot 2 \cdot 3 \cdot 3 \cdot 2 \cdot 2 \)

\[ = (3 \cdot 2) \cdot (3 \cdot 2) \cdot (3 \cdot 2) \]

\[ = 6 \cdot 6 \cdot 6 \]

The cube root of 216 is 6.

b. \( 1000 \)

\[ \sqrt[3]{1000} = \sqrt[3]{10^3} = 10 \]

\[ \sqrt[3]{1000} = 2 \cdot 2 \cdot 2 \cdot 5 \cdot 5 \cdot 5 \]

\[ = (2 \cdot 5) \cdot (2 \cdot 5) \cdot (2 \cdot 5) \]

\[ = 10 \cdot 10 \cdot 10 \]

The cube root of 1000 is 10.

c. \( 3375 \)

\[ \sqrt[3]{3375} = \sqrt[3]{15^3} = 15 \]

\[ \sqrt[3]{3375} = 3 \cdot 3 \cdot 3 \cdot 5 \cdot 5 \cdot 5 \]

\[ = (3 \cdot 5) \cdot (3 \cdot 5) \cdot (3 \cdot 5) \]

\[ = 15 \cdot 15 \cdot 15 \]

The cube root of 3375 is 15.

d. no; This procedure only works for numbers that can be written as the cubes of integers.
3. a. A positive number times a positive number is a positive number.
   b. A negative number times a negative number is a positive number.
   c. A positive number multiplied by itself twice is a positive number.
   d. A negative number multiplied by itself twice is a negative number.

4. yes; Sample answer: Multiply \(-1\) by itself twice to get 
\(-1 \cdot (-1) \cdot (-1) = 1 \cdot (-1) = -1\).

So, \(\sqrt{-1} = \sqrt[3]{-1} = -1\).

5. A square root of a number is a number that when multiplied by itself, equals the given number. A cube root of a number is a number that when multiplied by itself twice, equals the given number. Also, you can find cube roots of negative numbers. You cannot find square roots of negative numbers.

6. Sample answer: 0 or 1

7. \(\sqrt[3]{13.824} = 2.4\) m

7.2 On Your Own (pp. 296–297)

1. Because \(1^3 = 1\), \(\sqrt[3]{1} = \sqrt[3]{1^3} = 1\).

2. Because \((-7)^3 = -343\), \(\sqrt[3]{-343} = \sqrt[3]{(-7)^3} = -7\).

3. Because \((-3)^3 = -27\), \(\sqrt[3]{-27} = \sqrt[3]{(-3)^3} = -3\).

4. \(18 - 4\sqrt{8} = 18 - 4(2) = 18 - 8 = 10\)

5. \((\sqrt[3]{-64})^3 + 43 = -64 + 43 = -21\)

6. \(5\sqrt[3]{512} - 19 = 5(8) - 19 = 40 - 19 = 21\)

7. \(\sqrt[3]{8y} + y = \sqrt[3]{8} \cdot 64 + 64 = \sqrt[3]{512} + 64 = 8 + 64 = 72\)

8. \(2b - \frac{\sqrt[3]{9b}}{2} = 2(-3) - \frac{\sqrt[3]{9} \cdot -3}{2} = -6 - \frac{\sqrt[3]{27}}{} = -6 - (-3) = -3\)

9. \(V = s^3\)

\[\frac{512}{\sqrt[3]{s^3}} = \frac{8}{s}\]

\(S = 6\sqrt{s^2} = 6(8)^{\frac{2}{3}} = 384\)

So, the surface area of the music box is 384 square centimeters.

7.2 Exercises (pp. 298–299)

Vocabulary and Concept Check

1. no; there is no integer that equals 25 when cubed.

2. yes; when the integer is negative, the cube of the negative integer is negative. For example, \((-4)^3 = (-4) \cdot (-4) \cdot (-4) = -64\).

Practice and Problem Solving

3. \(s = \sqrt[3]{125,000} = \sqrt[3]{50^3} = 50\) in.

4. \(s = \sqrt[3]{\frac{1}{27}} = \sqrt[3]{\left(\frac{1}{3}\right)^3} = \frac{1}{3}\) ft

5. \(s = \sqrt[3]{0.064} = \sqrt[3]{0.4^3} = 0.4\) m

6. Because \(9^3 = 729\), \(\sqrt[3]{729} = \sqrt[3]{9^3} = 9\).

7. Because \((-5)^3 = -125\), \(\sqrt[3]{-125} = \sqrt[3]{(-5)^3} = -5\).

8. Because \((-10)^3 = -1000\), \(\sqrt[3]{-1000} = \sqrt[3]{(-10)^3} = -10\).

9. Because \(12^3 = 1728\), \(\sqrt[3]{1728} = \sqrt[3]{12^3} = 12\).

10. Because \((-7)^3 = -343\), \(\sqrt[3]{\frac{1}{512}} = \sqrt[3]{\left(\frac{1}{8}\right)^3} = \frac{1}{8}\)

11. Because \(\left(\frac{7}{4}\right)^3 = \frac{343}{64}\), \(\sqrt[3]{\frac{343}{64}} = \sqrt[3]{\left(\frac{7}{4}\right)^3} = \frac{7}{4}\)
12. \( 18 - \left( \sqrt[3]{27} \right)^3 = 18 - 27 \) 
\[ = -9 \]

13. \( \left( \sqrt[3]{\frac{1}{8}} \right) + \frac{3}{4} = \frac{1}{8} + \frac{3}{4} \) 
\[ = \frac{1}{8} + \frac{6}{8} \] 
\[ = \frac{7}{8} \]

14. \( 5\sqrt[3]{29} - 24 = 5(9) - 24 \) 
\[ = 45 - 24 \] 
\[ = 21 \]

15. \( \frac{1}{4} - 2\sqrt{\frac{1}{216}} = \frac{1}{4} - 2\left( \frac{1}{6} \right) \) 
\[ = \frac{1}{4} + \frac{2}{6} \] 
\[ = \frac{3}{12} + \frac{4}{12} \] 
\[ = \frac{7}{12} \]

16. \( 54 + \sqrt{-4096} = 54 + (-16) \) 
\[ = 38 \]

17. \( 4\sqrt{8000} - 6 = 4(20) - 6 \) 
\[ = 80 - 6 \] 
\[ = 74 \]

18. \( \sqrt[4]{\frac{n}{4}} + \frac{n}{10} = \sqrt[4]{\frac{500}{4}} + \frac{500}{10} \) 
\[ = \sqrt{125} + 50 \] 
\[ = 5 + 50 \] 
\[ = 55 \]

19. \( \sqrt[3]{6w} - w = \sqrt[3]{6(288)} - 288 \) 
\[ = \sqrt[3]{1728} - 288 \] 
\[ = 12 - 288 \] 
\[ = -276 \]

20. \( 2d + \sqrt{-45d} = 2(75) + \sqrt{-45(75)} \) 
\[ = 150 + \sqrt{-3375} \] 
\[ = 150 + (-15) \] 
\[ = 135 \]

21. \( s = \sqrt[3]{27,000} = \sqrt[3]{30^3} = 30 \) 
So, the edge length of the storage cube is 30 centimeters.

22. a. \( s = \sqrt[3]{64,000} = \sqrt[3]{40^3} = 40 \) 
So, the edge length of the cube of ice is 40 inches.

b. \( S = 6s^2 = 6(40)^2 = 6(1600) = 9600 \) 
So, the surface area of the cube of ice is 9600 square inches.

23. \( \sqrt[3]{\frac{8}{125}} = \frac{2}{5} = \frac{8}{20} \) 
\[ \frac{1}{4} = -\frac{5}{20} \] 
\[ -\frac{5}{20} > \frac{8}{20} \] 
So, \( -\frac{1}{4} > \sqrt[3]{\frac{8}{125}} \).

24. \( \sqrt[3]{0.001} = 0.1 \), and \( 0.1 > 0.01 \) 
So, \( \sqrt[3]{0.001} > 0.01 \).

25. \( \sqrt[3]{64} = 4 \) 
\( \sqrt[3]{64} = 8 \) 
4 < 8 
So, \( \sqrt[3]{64} < \sqrt[3]{64} \).

26. \( v = 2343\sqrt[3]{\frac{P}{w}} \) 
\[ = 2343\sqrt[3]{\frac{1311}{2744}} \] 
\[ = 183 \] 
So, the velocity of the car at the end of a drag race is approximately 183 miles per hour.

27. \( \sqrt[3]{-1} = -1 \), \( \sqrt[3]{0} = 0 \), \( \sqrt[3]{1} = 1 \) 
So, the three numbers that are their own cube roots are \(-1\), 0, and 1.

28. a. not true; Sample answer: \( \sqrt[3]{-125} = -5 \)

b. not true; Sample answer: 64 has only a positive cube root.
Chapter 7

29. \( V = \frac{1}{3} Bh \)
   
   \[ 972 = \frac{1}{3} (x^2) \left( \frac{1}{2} x \right) \]
   
   \[ 972 = \frac{1}{6} (x^3) \]
   
   \[ 5832 = x^3 \]
   
   \[ \sqrt[3]{5832} = x \]
   
   \[ 18 = x \]
   
   The side lengths of the base of the pyramid are 18 inches and the height of the pyramid is \( \frac{1}{2}(18) = 9 \) inches.

30. \( \frac{125}{x} = \frac{x^2}{125} \)
   
   \[ x^3 = 15,625 \]
   
   \[ \sqrt[3]{x^3} = \frac{\sqrt[3]{15,625}}{\sqrt[3]{125}} \]
   
   \[ x = 25 \]
   
   The value of \( x \) is 25.

31. \( (3x + 4)^3 = 2197 \)
   
   \[ \sqrt[3]{(3x + 4)^3} = \sqrt[3]{2197} \]
   
   \[ 3x + 4 = 13 \]
   
   \[ 3x = 9 \]
   
   \[ x = 3 \]

32. \( (8x^3 - 9)^3 = 5832 \)
   
   \[ \sqrt[3]{(8x^3 - 9)^3} = \sqrt[3]{5832} \]
   
   \[ 8x^3 - 9 = 18 \]
   
   \[ 8x^3 = 27 \]
   
   \[ x^3 = \frac{27}{8} \]
   
   \[ \sqrt[3]{x^3} = \sqrt[3]{\frac{27}{8}} \]
   
   \[ x = \frac{3}{2} \]

33. \( (5x - 16)^3 - 4 = 216,000 \)
   
   \[ \sqrt[3]{(5x - 16)^3 - 4} = \sqrt[3]{216,000} \]
   
   \[ (5x - 16)^3 - 4 = 60 \]
   
   \[ (5x - 16)^3 = 64 \]
   
   \[ \sqrt[3]{(5x - 16)^3} = \sqrt[3]{64} \]
   
   \[ 5x - 16 = 4 \]
   
   \[ 5x = 20 \]
   
   \[ x = 4 \]

Fair Game Review

34. \( 3^2 + 4^2 = 9 + 16 = 25 \)

35. \( 8^2 + 15^2 = 64 + 225 = 289 \)

36. \( 13^2 - 5^2 = 169 - 25 = 144 \)

37. \( 25^2 - 24^2 = 625 - 576 = 49 \)

38. \( C; m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{7 - 4}{2 - 1} = \frac{3}{1} = 3 \)
   
   \[ y = mx + b \]
   
   \[ 4 = 3(l) + b \]
   
   \[ 1 = b \]
   
   So, the linear function shown by the table is \( y = 3x + 1 \).

Section 7.3

7.3 Activity (pp. 300–301)

1. e. The relationship is \( a^2 + b^2 = c^2 \).

2. a. 5 cm;
   
   \[ 3^2 + 4^2 = 5^2 \]
   
   \[ 9 + 16 = 25 \]
   
   \[ 25 = 25 \checkmark \]

   b. 5.2 cm;
   
   \[ 2^2 + 4.8^2 = 5.2^2 \]
   
   \[ 4 + 23.04 = 27.04 \]
   
   \[ 27.04 = 27.04 \checkmark \]

   c. 3 1/4 in.
   
   \[ \left( \frac{5}{4} \right)^2 + 3^2 = \left( \frac{13}{4} \right)^2 \]
   
   \[ \frac{25}{16} + 9 = \frac{169}{16} \]
   
   \[ \frac{25}{16} + \frac{144}{16} = \frac{169}{16} \]
   
   \[ \frac{169}{16} = \frac{169}{16} \checkmark \]
Chapter 7

d. \(2 \frac{1}{2}\) in.
\[
\left(\frac{3}{2}\right)^2 + 2^2 = \left(\frac{5}{2}\right)^2
\]
\[
\frac{9}{4} + 4 = \frac{25}{4}
\]
\[
\frac{9}{4} + \frac{16}{4} = \frac{25}{4}
\]
\[
\frac{25}{4} = \frac{25}{4} \checkmark
\]

3. a. First envision the right triangle formed by the pole, ground, and wire. Measure the distance from the base of the pole to where the wire meets the ground. Use that length and the distance up the pole in the Pythagorean Theorem. Solve to find the wire length.

b. \(a^2 + b^2 = c^2\)
\[
24^2 + 10^2 = c^2
\]
576 + 100 = \(c^2\)
\[
676 = c^2
\]
\[
\sqrt{676} = \sqrt{c^2}
\]
26 = \(c\)
The length of the wire is 26 feet.

4. In a right triangle the sum of the squares of the lengths of the legs is equal to the square of the length of the hypotenuse.

Sample answer:

![Right Triangle](image)

\[
6^2 + 8^2 = 10^2
\]
36 + 64 = 100
100 = 100 \(\checkmark\)

7.3 On Your Own (pp. 302–303)

1. \(a^2 + b^2 = c^2\)
\[
8^2 + 15^2 = c^2
\]
64 + 225 = \(c^2\)
\[
289 = c^2
\]
\[
\sqrt{289} = \sqrt{c^2}
\]
17 = \(c\)
The length of the hypotenuse is 17 feet.

2. \(a^2 + b^2 = c^2\)
\[
\left(\frac{2}{5}\right)^2 + \left(\frac{3}{10}\right)^2 = c^2
\]
\[
\frac{4}{25} + \frac{9}{100} = c^2
\]
\[
\frac{16}{100} + \frac{9}{100} = c^2
\]
\[
\frac{25}{100} = c^2
\]
\[
\sqrt{\frac{25}{100}} = \sqrt{c^2}
\]
\[
\frac{5}{10} = c
\]
\[
\frac{1}{2} = c
\]
The length of the hypotenuse is \(\frac{1}{2}\) inch.

3. \(a^2 + b^2 = c^2\)
\[
16^2 + b^2 = 34^2
\]
256 + \(b^2\) = 1156
\[
b^2 = 900
\]
\[
\sqrt{b^2} = \sqrt{900}
\]
\[
b = 30
\]
The length of the leg is 30 yards.

4. \(a^2 + b^2 = c^2\)
\[
a^2 + 9.6^2 = 10.4^2
\]
\[
a^2 + 92.16 = 108.16
\]
\[
a^2 = 16
\]
\[
\sqrt{a^2} = \sqrt{16}
\]
\[
a = 4
\]
The length of the leg is 4 meters.

5. Use the graph in the book to find the legs. The lengths of the legs are 60 and 80.
\[
a^2 + b^2 = c^2
\]
\[
60^2 + 80^2 = c^2
\]
3600 + 6400 = \(c^2\)
\[
10,000 = c^2
\]
\[
\sqrt{10,000} = \sqrt{c^2}
\]
100 = \(c\)
So, the distance between the two bases is 100 yards.
Chapter 7

7.3 Exercises (pp. 304–305)

Vocabulary and Concept Check

1. The legs of a right triangle are the two sides that form the right angle. The hypotenuse is the side opposite the right angle. Also, the hypotenuse is the longest side and the legs are the other two sides.

2. The third question is different because it asks which side is a leg, whereas the other three questions all ask which side is the hypotenuse. \(a\) and \(b\) are the legs, and \(c\) is the hypotenuse.

Practice and Problem Solving

3. \(a^2 + b^2 = c^2\)
   
   \[
   \begin{align*}
   21^2 + 20^2 &= c^2 \\
   441 + 400 &= c^2 \\
   841 &= c^2 \\
   \sqrt{841} &= \sqrt{c^2} \\
   29 &= c
   \end{align*}
   \]

   The length of the hypotenuse is 29 kilometers.

4. \(a^2 + b^2 = c^2\)
   
   \[
   \begin{align*}
   7.2^2 + 9.6^2 &= c^2 \\
   51.84 + 92.16 &= c^2 \\
   144 &= c^2 \\
   \sqrt{144} &= \sqrt{c^2} \\
   12 &= c
   \end{align*}
   \]

   The length of the hypotenuse is 12 feet.

5. \(a^2 + b^2 = c^2\)
   
   \[
   \begin{align*}
   a^2 + 5.6^2 &= 10.6^2 \\
   a^2 + 31.36 &= 112.36 \\
   a^2 &= 81 \\
   \sqrt{a^2} &= \sqrt{81} \\
   a &= 9
   \end{align*}
   \]

   The length of the leg is 9 inches.

6. \(a^2 + b^2 = c^2\)
   
   \[
   \begin{align*}
   9^2 + b^2 &= 15^2 \\
   81 + b^2 &= 225 \\
   b^2 &= 144 \\
   \sqrt{b^2} &= \sqrt{144} \\
   b &= 12
   \end{align*}
   \]

   The length of the leg is 12 millimeters.

7. \(a^2 + b^2 = c^2\)
   
   \[
   \begin{align*}
   10^2 + b^2 &= 26^2 \\
   100 + b^2 &= 676 \\
   b^2 &= 576 \\
   \sqrt{b^2} &= \sqrt{576} \\
   b &= 24
   \end{align*}
   \]

   The length of the leg is 24 centimeters.

8. \(a^2 + b^2 = c^2\)
   
   \[
   \begin{align*}
   a^2 + 4^2 &= \left(\frac{12}{3}\right)^2 \\
   a^2 + 16 &= \left(\frac{3}{3}\right)^2 \\
   a^2 + 16 &= \frac{1369}{9} \\
   a^2 &= \frac{1225}{9} \\
   \sqrt{a^2} &= \sqrt{\frac{1225}{9}} \\
   a &= \frac{35}{3}, \text{ or } 11\frac{2}{3}
   \end{align*}
   \]

   The length of the leg is 11\frac{2}{3} yards.

9. The length of the hypotenuse was substituted for the wrong variable.

   \[
   \begin{align*}
   a^2 + b^2 &= c^2 \\
   7^2 + b^2 &= 25^2 \\
   49 + b^2 &= 625 \\
   b^2 &= 576 \\
   \sqrt{b^2} &= \sqrt{576} \\
   b &= 24
   \end{align*}
   \]

   The length of the leg is 24 feet.

10. \(a^2 + b^2 = c^2\)
    
    \[
    \begin{align*}
    5.6^2 + 3.3^2 &= c^2 \\
    31.36 + 10.89 &= c^2 \\
    42.25 &= c^2 \\
    \sqrt{42.25} &= \sqrt{c^2} \\
    6.5 &= c
    \end{align*}
    \]

    The wire is 6.5 feet long.
11. \(a^2 + b^2 = c^2\)
    
7\(2^2 + x^2 = 20^2\)
    
144 + \(x^2\) = 400
    
\(x^2\) = 256
    
\(\sqrt{x^2} = \sqrt{256}\)
    
x = 16
    
So, \(x = 16\) centimeters.

12. \(a^2 + b^2 = c^2\)
    
\(a^2 + 5^2 = 13^2\)
    
\(a^2 + 25 = 169\)
    
\(a^2 = 144\)
    
\(\sqrt{a^2} = \sqrt{144}\)
    
a = 12
    
\(a^2 + b^2 = c^2\)
    
\(12^2 + 35^2 = x^2\)
    
144 + 1225 = \(x^2\)
    
1369 = \(x^2\)
    
\(\sqrt{1369} = \sqrt{x^2}\)
    
x = 37
    
So, \(x = 37\) millimeters.

13. \(a^2 + b^2 = c^2\)
    
\(x^2 + 180^2 = 181^2\)
    
\(x^2 + 32,400 = 32,761\)
    
\(x^2 = 361\)
    
\(\sqrt{x^2} = \sqrt{361}\)
    
x = 19
    
The ball is 19 yards from the hole. Use the fact that 1 yard = 3 feet to convert to feet.
    
19 \(\text{yd} \cdot \frac{3 \text{ ft}}{1 \text{yd}} = 57 \text{ ft}\)
    
So, the ball is 57 feet from the hole.

14. \(a^2 + b^2 = c^2\)
    
\(24^2 + (12 - 5)^2 = c^2\)
    
\(24^2 + 7^2 = c^2\)
    
576 + 49 = \(c^2\)
    
625 = \(c^2\)
    
\(\sqrt{625} = \sqrt{c^2}\)
    
25 = \(c\)
    
Yes, the distance between the tennis player’s mouth and the referee’s ear is 25 feet.

15. \(a^2 + b^2 = c^2\)
    
width\(^2\) + length\(^2\) = \((BC)^2\)
    
48\(^2\) + 20\(^2\) = \((BC)^2\)
    
2304 + 400 = \((BC)^2\)
    
2704 = \((BC)^2\)
    
\(\sqrt{2704} = \sqrt{(BC)^2}\)
    
52 = \(BC\)

Then find \(AB\).
    
\(a^2 + b^2 = c^2\)
    
\((AC)^2 + (BC)^2 = (AB)^2\)
    
10\(^2\) + 52\(^2\) = \((AB)^2\)
    
100 + 2704 = \((AB)^2\)
    
2804 = \((AB)^2\)
    
\(\sqrt{2804} = \sqrt{(AB)^2}\)
    
53 = \(AB\)

So, the length of \(BC\) is 52 feet and the length of \(AB\) is approximately 53 feet.

16. \(a^2 + b^2 = c^2\)
    
28\(^2\) + 21\(^2\) = \((5x)^2\)
    
784 + 441 = 25\(x^2\)
    
1225 = 25\(x^2\)
    
49 = \(x^2\)
    
\(\sqrt{49} = \sqrt{x^2}\)
    
\(7 = x\)
    
So, \(x = 7\).

17. a. Sample answer:
Chapter 7

b. \(a^2 + b^2 = c^2\)
\[15^2 + 20^2 = c^2\]
\[225 + 400 = c^2\]
\[625 = c^2\]
\[\sqrt{625} = \sqrt{c^2}\]
\[25 = c\]
\[a^2 + b^2 = c^2\]
\[12^2 + 16^2 = c^2\]
\[144 + 256 = c^2\]
\[400 = c^2\]
\[\sqrt{400} = \sqrt{c^2}\]
\[20 = c\]

The length of your friend’s throw is represented by \(c_1 + c_2\). So, the length is \(25 + 20 = 45\) feet.

18. First find the distance across the bottom rectangle.
\[a^2 + b^2 = c^2\]
width\(^2 + \) length\(^2 = c^2\]
\[8^2 + 6^2 = c^2\]
\[64 + 36 = c^2\]
\[100 = c^2\]
\[\sqrt{100} = \sqrt{c^2}\]
\[10 = c\]

Use the above answer to find the diagonal length of the box.
\[a^2 + b^2 = c^2\]
height\(^2 + \) length\(^2 = c^2\]
\[24^2 + 10^2 = c^2\]
\[576 + 100 = c^2\]
\[676 = c^2\]
\[\sqrt{676} = \sqrt{c^2}\]
\[26 = c\]

Convert centimeters to inches.
\[63.5 \text{ cm} \cdot \frac{1 \text{ in.}}{2.54 \text{ cm}} = 25 \text{ in.}\]

Yes, the rod is 25 inches long and the diagonal from a top corner to the opposite bottom corner is 26 inches long.

**Fair Game Review**

19. Because \(6^2 = 36\), \(\pm\sqrt{36} = \pm6\) and \(-6\).

20. Because \(11^2 = 121\), \(-\sqrt{121} = -\sqrt{11^2} = -11\).

21. Because \(13^2 = 169\), \(\sqrt{169} = \sqrt{13^2} = 13\).

22. Because \(15^2 = 225\), \(-\sqrt{225} = -\sqrt{15^2} = -15\).

23. C; \(y = 4x + 1\)
\[2x + y = 13\]
\[2x + (4x + 1) = 13\]
\[6x + 1 = 13\]
\[6x = 12\]
\[x = 2\]
\[y = 4(2) + 1\]
\[y = 8 + 1\]
\[y = 9\]
So, the solution of the system is \(x = 2\) and \(y = 9\).

**Study Help**
Available at BigIdeasMath.com.

**Quiz 7.1–7.3**

1. Because \(2^2 = 4\), \(-\sqrt{4} = -\sqrt{2^2} = -2\).

2. Because \(\left(\frac{4}{5}\right)^2 = \frac{16}{25}\), \(\sqrt{\frac{16}{25}} = \sqrt{\frac{4}{5}} = \frac{4}{5}\).

3. Because \(2.5^2 = 6.25\), \(\pm\sqrt{6.25} = \pm\sqrt{2.5^2} = 2.5\) and \(-2.5\).

4. Because \(4^3 = 64\), \(\sqrt[3]{64} = \sqrt[3]{4^3} = 4\).

5. Because \((-6)^3 = -216\), \(\sqrt[3]{-216} = \sqrt[3]{(-6)^3} = -6\).

6. Because \(\left(-\frac{7}{10}\right)^3 = -\frac{343}{1000}\)

7. \(3\sqrt{49} + 5 = 3(7) + 5\)
\[= 21 + 5\]
\[= 26\]

8. \(10 - 4\sqrt{16} = 10 - 4(4) = 10 - 16 = -6\)
Chapter 7

9. \( \frac{1}{4} + \sqrt{\frac{100}{4}} = \frac{1}{4} + \sqrt{25} \)
   \[ \frac{1}{4} + 5 \]
   \[ \frac{1}{4} + 20 \]
   \[ = 21 \]
   \[ = 5 \frac{1}{4} \]

10. \( (\sqrt[3]{-27})^4 + 61 = -27 + 61 \)
    \[ = 34 \]

11. \( 15 + 3\sqrt{125} = 15 + 3(5) \)
    \[ = 15 + 15 \]
    \[ = 30 \]

12. \( 2\sqrt[2]{-729} - 5 = 2(-9) - 5 \)
    \[ = -18 - 5 \]
    \[ = -23 \]

13. \( a^2 + b^2 = c^2 \)
    \( 9^2 + 40^2 = c^2 \)
    \[ 81 + 1600 = c^2 \]
    \[ 1681 = c^2 \]
    \[ \sqrt{1681} = \sqrt{c^2} \]
    \[ 41 = c \]

   The length of the hypotenuse is 41 feet.

14. \( a^2 + b^2 = c^2 \)
    \( a^2 + 45^2 = 53^2 \)
    \( a^2 + 2025 = 2809 \)
    \[ a^2 = 784 \]
    \[ \sqrt{a^2} = \sqrt{784} \]
    \[ a = 28 \]

   The length of the leg is 28 inches.

15. \( a^2 + b^2 = c^2 \)
    \( 1.6^2 + b^2 = 6.5^2 \)
    \( 2.56 + b^2 = 42.25 \)
    \[ b^2 = 39.69 \]
    \[ \sqrt{b^2} = \sqrt{39.69} \]
    \[ b = 6.3 \]

   The length of the leg is 6.3 centimeters.

16. \( a^2 + b^2 = c^2 \)
    \( \left( \frac{3}{10} \right)^2 + \left( \frac{2}{5} \right)^2 = c^2 \)
    \[ \frac{9}{100} + \frac{4}{25} = c^2 \]
    \[ \frac{9}{100} + \frac{16}{100} = c^2 \]
    \[ \frac{25}{100} = c^2 \]
    \[ \sqrt{\frac{25}{100}} = \sqrt{c^2} \]
    \[ \frac{5}{10} = c \]
    \[ \frac{1}{2} = c \]

   The length of the hypotenuse is \( \frac{1}{2} \) yard.

17. \( A = \pi r^2 \)
    \( 314 = 3.14r^2 \)
    \[ 100 = r^2 \]
    \[ \sqrt{100} = \sqrt{r^2} \]
    \[ 10 = r \]

   The diameter of the pool cover is \( 2 \cdot 10 = 20 \) feet.

18. \( s = \sqrt{5832} = \sqrt{18^2} = 18 \) in.

   So, the edge length of the package is 18 inches.

19. \( \sqrt{\frac{1}{4}} \text{ yd} \)

   Use the fact that 1 yard = 3 feet and 1 foot = 12 inches
to convert \( \frac{1}{4} \) yards to inches.

   \( \frac{1}{4} \text{ yd} = \frac{5}{4} \text{ yd} \cdot \frac{3 \text{ ft}}{1 \text{ yd}} \cdot \frac{12 \text{ in.}}{1 \text{ ft}} \)
   \[ = \frac{5}{4} \cdot 3 \cdot 12 \text{ in.} \]
   \[ = 45 \text{ in.} \]

   \( a^2 + b^2 = c^2 \)
   \( 28^2 + 45^2 = c^2 \)
   \[ 784 + 2025 = c^2 \]
   \[ 2809 = c^2 \]
   \[ \sqrt{2809} = \sqrt{c^2} \]
   \[ 53 = c \]

   The length of the diagonal is 53 inches.
Chapter 7
Section 7.4
7.4 Activity (pp. 308–309)

1. a. no; \( \sqrt{3} \) is not a rational number, and \( \frac{265}{153} \) and \( \frac{1351}{780} \) are rational numbers.
b. no; The number given by the calculator is an approximation.
c. 1 and 2
d. For 1.7 and 1.8: yes; You can truncate the decimal expansion of \( \sqrt{2} \) as 1.73. 1.73 is between 1.7 and 1.8.
   For 1.72 and 1.73: no; You can truncate the decimal expansion of \( \sqrt{2} \) as 1.732. 1.732 is greater than 1.73,
   For 1.731 and 1.732: no; You can truncate the decimal expansion of \( \sqrt{2} \) as 1.73205. 1.73205 is greater than 1.732.

2. a. \( a^2 + b^2 = c^2 \)
   \( 1^2 + 1^2 = c^2 \)
   \( 2 = c^2 \)
   \( \sqrt{2} = c \)

So, the length of the diagonal of the square is \( \sqrt{2} \) units.
b. Sample answer: The diagonal is approximately 1.4 units in length.
c. Sample answer: The length of 1.4 units is an approximation of \( \sqrt{2} \) units.

3. d. \((AC)^2 + (BC)^2 = (AB)^2\)
   \( 1^2 + (BC)^2 = 2^2 \)
   \( 1 + (BC)^2 = 4 \)
   \( (BC)^2 = 3 \)
   \( \sqrt{(BC)^2} = \sqrt{3} \)
   \( BC = \sqrt{3} \approx 1.7 \)

e. The length of segment \( BC \) is about 17 grid squares, or about 1.7 units. So, \( \sqrt{3} \approx 1.7 \).

4. Sample answer: The approximations are about the same.

5. \[(AC)^2 + (BC)^2 = (AB)^2\]
\( 2^2 + (BC)^2 = 3^2 \)
\( 4 + (BC)^2 = 9 \)
\( (BC)^2 = 5 \)
\( \sqrt{(BC)^2} = \sqrt{5} \)
\( BC = \sqrt{5} \approx 2.2 \)

6. To find decimal approximations of square roots that are not rational, you can use geometry, as done in Activities 2 and 3.

7.4 On Your Own (pp. 310–312)

1. The number 0.121221222 … neither terminates nor repeats. So, it is irrational.

2. Because \( -\sqrt{\frac{196}{14}} = -14 \), 196 is a perfect square.
   So, \( -\sqrt{196} \) is an integer and rational.

3. The number 2 is not a cube root. So, \( \sqrt{2} \) is irrational.

4. a. Make a table of numbers whose squares are close to the radicand, 8.

<table>
<thead>
<tr>
<th>Number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square of Number</td>
<td>1</td>
<td>4</td>
<td>9</td>
<td>16</td>
</tr>
</tbody>
</table>

The table shows that 8 is not a perfect square. It is between the perfect squares 4 and 9. Because 8 is closer to 9 than to 4, \( \sqrt{8} \) is closer to 3 than to 2.

\[ \sqrt{1} \quad \sqrt{4} \quad \sqrt{9} \quad \sqrt{16} \]
\[ \sqrt{2} \quad \sqrt{3} \quad \sqrt{4} \]

So, \( \sqrt{8} \approx 3 \).
Chapter 7

b. Make a table of numbers between 2 and 3 whose squares are close to 8.

<table>
<thead>
<tr>
<th>Number</th>
<th>2.6</th>
<th>2.7</th>
<th>2.8</th>
<th>2.9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square of Number</td>
<td>6.76</td>
<td>7.29</td>
<td>7.84</td>
<td>8.41</td>
</tr>
</tbody>
</table>

Because 8 is closer to 7.84 than to 8.41, \( \sqrt{8} \) is closer to 2.8 than to 2.9.

So, \( \sqrt{8} \approx 2.8 \).

5. a. Make a table of numbers whose squares are close to the radicand, 13.

<table>
<thead>
<tr>
<th>Number</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square of Number</td>
<td>4</td>
<td>9</td>
<td>16</td>
<td>25</td>
</tr>
</tbody>
</table>

The table shows that 13 is not a perfect square. It is between the perfect squares 9 and 16. Because 13 is closer to 16 than to 9, \( \sqrt{13} \) is closer to 4 than to 3.

So, \( -\sqrt{13} = -4 \).

b. Make a table of numbers between 3 and 4 whose squares are close to 13.

<table>
<thead>
<tr>
<th>Number</th>
<th>3.5</th>
<th>3.6</th>
<th>3.7</th>
<th>3.8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square of Number</td>
<td>12.25</td>
<td>12.96</td>
<td>13.69</td>
<td>14.44</td>
</tr>
</tbody>
</table>

Because 13 is closer to 12.96 than to 13.69, \( \sqrt{13} \) is closer to 3.6 than to 3.7.

So, \( -\sqrt{13} \approx -3.6 \).

6. a. Make a table of numbers whose squares are close to the radicand, 24.

<table>
<thead>
<tr>
<th>Number</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square of Number</td>
<td>9</td>
<td>16</td>
<td>25</td>
<td>36</td>
</tr>
</tbody>
</table>

The table shows that 24 is not a perfect square. It is between the perfect squares 16 and 25. Because 24 is closer to 25 than to 16, \( \sqrt{24} \) is closer to 5 than to 4.

So, \( -\sqrt{24} \approx -5 \).

b. Make a table of numbers between 4 and 5 whose squares are close to 24.

<table>
<thead>
<tr>
<th>Number</th>
<th>4.6</th>
<th>4.7</th>
<th>4.8</th>
<th>4.9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square of Number</td>
<td>21.16</td>
<td>22.09</td>
<td>23.04</td>
<td>24.01</td>
</tr>
</tbody>
</table>

Because 24 is closer to 24.01 than to 23.04, \( \sqrt{24} \) is closer to 4.9 than to 4.8.

So, \( -\sqrt{24} \approx -4.9 \).

7. a. Make a table of numbers whose squares are close to the radicand, 110.

<table>
<thead>
<tr>
<th>Number</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square of Number</td>
<td>81</td>
<td>100</td>
<td>121</td>
<td>144</td>
</tr>
</tbody>
</table>

The table shows that 110 is not a perfect square. It is between the perfect squares 100 and 121. Because 110 is closer to 100 than to 121, \( \sqrt{110} \) is closer to 10 than to 11.

So, \( \sqrt{110} \approx 10 \).

b. Make a table of numbers between 10 and 11 whose squares are close to 110.

<table>
<thead>
<tr>
<th>Number</th>
<th>10.3</th>
<th>10.4</th>
<th>10.5</th>
<th>10.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square of Number</td>
<td>106.09</td>
<td>108.16</td>
<td>110.25</td>
<td>112.36</td>
</tr>
</tbody>
</table>

Because 110 is closer to 110.25 than to 108.16, \( \sqrt{110} \) is closer to 10.5 than to 10.4.

So, \( \sqrt{110} \approx 10.5 \).

8. \( \sqrt{23} \) is to the right of \( \frac{41}{3} \). So, \( \sqrt{23} \) is greater.

9. \( \sqrt{10} \) is to the right of \( -\sqrt{5} \) because \( \sqrt{10} \) is positive and \( -\sqrt{5} \) is negative. So, \( \sqrt{10} \) is greater.
Chapter 7

10. $-\sqrt{2}$ is to the right of $-2$. So, $-\sqrt{2}$ is greater.

11. $\sqrt{\frac{4}{3}} = \sqrt{\frac{64}{36}} = \sqrt{\frac{215}{3}}$

Because $\frac{215}{3}$ is closer to 25 than to 16, $\sqrt{\frac{215}{3}}$ is closer to $\frac{5}{2}$ than to 4. So, the radius is about 5 inches.

7.4 Exercises (pp. 313–315)

Vocabulary and Concept Check
1. A rational number is a number that can be written as the ratio of two integers. An irrational number cannot be written as the ratio of two integers.

2. Because 32 is between the perfect squares 25 and 36, but is closer to 36, $\sqrt{32} = 6$.

3. Real numbers are the set of rational and irrational numbers. Sample answer: $-2$, $\frac{1}{8}$, and $\sqrt{7}$ are real numbers.

4. $\sqrt{8}$ does not belong because it is an irrational number. The other three numbers are rational numbers.

Practice and Problem Solving
5. yes; Using a calculator, $\frac{559}{250} = 2.236$ and $\sqrt{5} = 2.236067977$. So, the rational number is a reasonable approximation of the square root.

6. no; Using a calculator, $\frac{3021}{250} = 12.084$ and $\sqrt{11} = 3.31662479$. So, the rational number is not a reasonable approximation of the square root.

7. no; Using a calculator, $\frac{678}{250} = 2.712$ and $\sqrt{28} = 5.291502622$. So, the rational number is not a reasonable approximation of the square root.

8. yes; Using a calculator, $\frac{1677}{250} = 6.708$ and $\sqrt{45} = 6.708203932$. So, the rational number is a reasonable approximation of the square root.

9. The number 0 is a whole number, an integer, and a rational number.

10. Because $\sqrt{343} = 7$, the number $\sqrt{343}$ is a natural number, a whole number, an integer, and a rational number.

11. The number $\frac{\pi}{6} = 0.523$… neither terminates nor repeats. So, it is irrational.

12. Because $-\sqrt{81} = -9$, the number $-\sqrt{81}$ is an integer and a rational number.

13. The number $-1.125$ terminates. So, it is rational.

14. Because $\frac{52}{13} = 4$, the number $\frac{52}{13}$ is a natural number, a whole number, an integer, and a rational number.

15. The number $-49$ is not a perfect cube. So, $\sqrt{-49}$ is irrational.

16. The number 15 is not a perfect square. So, $\sqrt{15}$ is irrational.

17. Because $\sqrt{144} = 12$, the number 144 is a perfect square. So, $\sqrt{144}$ is rational.

18. no; $a^2 + b^2 = c^2$

$4^2 + 6^2 = 52$

$16 + 36 = c^2$

$52 = c^2$

$\sqrt{52} = \sqrt{c^2}$

$\sqrt{52} = c$

The length of the hypotenuse is $\sqrt{52}$ inches. Because 52 is not a perfect square, the length of the hypotenuse is not a rational number.

19. a. If the last digit of your phone number is 0, it is a whole number. Otherwise it is a natural number.

b. Because a prime number is divisible only by 1 and itself, it is not a perfect square. So, the square root of a prime number is irrational.

c. $\frac{\text{circumference}}{\text{diameter}} = \frac{\pi d}{d} = \pi$

Because $\pi$ neither terminates nor repeats, the ratio of the circumference of a circle to its diameter is irrational.
Chapter 7

20. a. Make a table of numbers whose squares are close to the radicand, 46.

<table>
<thead>
<tr>
<th>Number</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square of Number</td>
<td>25</td>
<td>36</td>
<td>49</td>
<td>64</td>
</tr>
</tbody>
</table>

The table shows that 46 is not a perfect square. It is between the perfect squares 25 and 49. Because 46 is closer to 49 than to 36, \( \sqrt{46} \) is closer to 7 than to 6.

\[
\frac{\sqrt{25}}{5} \quad \frac{\sqrt{36}}{6} \quad \frac{\sqrt{49}}{7} \quad \frac{\sqrt{64}}{8}
\]

So, \( \sqrt{46} \approx 7 \).

b. Make a table of numbers between 6 and 7 whose squares are close to 46.

<table>
<thead>
<tr>
<th>Number</th>
<th>6.5</th>
<th>6.6</th>
<th>6.7</th>
<th>6.8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square of Number</td>
<td>42.25</td>
<td>43.56</td>
<td>44.89</td>
<td>46.24</td>
</tr>
</tbody>
</table>

Because 46 is closer to 46.24 than to 44.89, \( \sqrt{46} \) is closer to 6.8 than to 6.7.

\[
\frac{\sqrt{42.25}}{6.5} \quad \frac{\sqrt{43.56}}{6.6} \quad \frac{\sqrt{44.89}}{6.7} \quad \frac{\sqrt{46.24}}{6.8}
\]

So, \( \sqrt{46} \approx 6.8 \).

21. a. Make a table of numbers whose squares are close to the radicand, 685.

<table>
<thead>
<tr>
<th>Number</th>
<th>25</th>
<th>26</th>
<th>27</th>
<th>28</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square of Number</td>
<td>625</td>
<td>676</td>
<td>729</td>
<td>784</td>
</tr>
</tbody>
</table>

The table shows that 685 is not a perfect square. It is between the perfect squares 676 and 729. Because 685 is closer to 676 than to 729, \( \sqrt{685} \) is closer to 26 than to 27.

\[
\frac{\sqrt{625}}{25} \quad \frac{\sqrt{676}}{26} \quad \frac{\sqrt{729}}{27} \quad \frac{\sqrt{784}}{28}
\]

So, \( \sqrt{685} \approx 26 \).

b. Make a table of numbers between 26 and 27 whose squares are close to 685.

<table>
<thead>
<tr>
<th>Number</th>
<th>26.0</th>
<th>26.1</th>
<th>26.2</th>
<th>26.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square of Number</td>
<td>676</td>
<td>681.21</td>
<td>686.44</td>
<td>691.69</td>
</tr>
</tbody>
</table>

Because 685 is closer to 686.44 than to 681.21, \( \sqrt{685} \) is closer to 26.2 than to 26.1.

\[
\frac{\sqrt{676}}{26} \quad \frac{\sqrt{681.21}}{26.1} \quad \frac{\sqrt{686.44}}{26.2} \quad \frac{\sqrt{691.69}}{26.3}
\]

So, \( \sqrt{685} \approx 26.2 \).

22. a. Make a table of numbers whose squares are close to the radicand, 61.

<table>
<thead>
<tr>
<th>Number</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square of Number</td>
<td>36</td>
<td>49</td>
<td>64</td>
<td>81</td>
</tr>
</tbody>
</table>

The table shows that 61 is not a perfect square. It is between the perfect squares 49 and 64. Because 61 is closer to 64 than to 49, \( \sqrt{61} \) is closer to 8 than to 7.

\[
\frac{\sqrt{36}}{6} \quad \frac{\sqrt{49}}{7} \quad \frac{\sqrt{64}}{8} \quad \frac{\sqrt{81}}{9}
\]

So, \( \sqrt{61} \approx 8 \).

b. Make a table of numbers between 7 and 8 whose squares are close to 61.

<table>
<thead>
<tr>
<th>Number</th>
<th>7.7</th>
<th>7.8</th>
<th>7.9</th>
<th>8.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square of Number</td>
<td>59.29</td>
<td>60.84</td>
<td>62.41</td>
<td>64</td>
</tr>
</tbody>
</table>

Because 61 is closer to 60.84 than to 62.41, \( \sqrt{61} \) is closer to 7.8 than to 7.9.

\[
\frac{\sqrt{59.29}}{7.7} \quad \frac{\sqrt{60.84}}{7.8} \quad \frac{\sqrt{62.41}}{7.9} \quad \frac{\sqrt{64}}{8.0}
\]

So, \( \sqrt{61} \approx 7.8 \).

23. a. Make a table of numbers whose squares are close to the radicand, 105.

<table>
<thead>
<tr>
<th>Number</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square of Number</td>
<td>81</td>
<td>100</td>
<td>121</td>
<td>144</td>
</tr>
</tbody>
</table>

The table shows that 105 is not a perfect square. It is between the perfect squares 9 and 10. Because 105 is closer to 100 than to 121, \( \sqrt{105} \) is closer to 10 than to 11.

\[
\frac{\sqrt{81}}{9} \quad \frac{\sqrt{100}}{10} \quad \frac{\sqrt{121}}{11} \quad \frac{\sqrt{144}}{12}
\]

So, \( \sqrt{105} \approx 10 \).
Chapter 7

b. Make a table of numbers between 10 and 11 whose squares are close to 105.

<table>
<thead>
<tr>
<th>Number</th>
<th>10.1</th>
<th>10.2</th>
<th>10.3</th>
<th>10.4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square of Number</td>
<td>102.01</td>
<td>104.04</td>
<td>106.09</td>
<td>108.16</td>
</tr>
</tbody>
</table>

Because 105 is closer to 104.04 than to 106.09, \( \sqrt{105} \) is closer to 10.2 than to 10.3.

\[
\sqrt{102.01} < \sqrt{104.04} < \sqrt{106.09} < \sqrt{108.16}
\]

So, \( -\sqrt{105} = -10.2 \).

24. a. Make a table of numbers whose squares are close to the radicand, \( \frac{27}{4} \).

<table>
<thead>
<tr>
<th>Number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square of Number</td>
<td>1</td>
<td>4</td>
<td>9</td>
<td>16</td>
</tr>
</tbody>
</table>

The table shows that \( \frac{27}{4} \) is not a perfect square. It is between the perfect squares 2 and 3. Because \( \frac{27}{4} = 6.75 \) is closer to 9 than to 4, \( \sqrt{\frac{27}{4}} \) is closer to 3 than to 2.

So, \( \sqrt{\frac{27}{4}} = 3 \).

b. Make a table of numbers between 2 and 3 whose squares are close to \( \frac{27}{4} \).

<table>
<thead>
<tr>
<th>Number</th>
<th>2.4</th>
<th>2.5</th>
<th>2.6</th>
<th>2.7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square of Number</td>
<td>5.76</td>
<td>6.25</td>
<td>6.76</td>
<td>7.29</td>
</tr>
</tbody>
</table>

Because \( \frac{27}{4} \) is closer to 6.76 than to 2.5, \( \sqrt{\frac{27}{4}} \) is closer to 2.6 than to 2.5.

So, \( \sqrt{\frac{27}{4}} = 2.6 \).

25. a. Make a table of numbers whose squares are close to the radicand, \( \frac{335}{2} = 167.5 \).

<table>
<thead>
<tr>
<th>Number</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square of Number</td>
<td>121</td>
<td>144</td>
<td>169</td>
<td>196</td>
</tr>
</tbody>
</table>

The table shows that \( \frac{335}{2} \) is not a perfect square. It is between the perfect squares 12 and 13. Because \( \frac{335}{2} = 167.5 \) is closer to 169 than to 144, \( \sqrt{\frac{335}{2}} \) is closer to 13 than to 12.

So, \( -\sqrt{\frac{335}{2}} = -13 \).

b. Make a table of numbers between 12.5 and 13.5 whose squares are close to \( \frac{335}{2} \).

<table>
<thead>
<tr>
<th>Number</th>
<th>12.8</th>
<th>12.9</th>
<th>13.0</th>
<th>13.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square of Number</td>
<td>163.84</td>
<td>166.41</td>
<td>169</td>
<td>171.61</td>
</tr>
</tbody>
</table>

Because \( \frac{335}{2} = 167.5 \) is closer to 166.41 than to 169, \( \sqrt{\frac{335}{2}} \) is closer to 12.9 than to 13.0.

So, \( -\sqrt{\frac{335}{2}} = -12.9 \).

26. \( \sqrt{20} \)

10 is to the right of \( \sqrt{20} \). So, 10 is greater.

27. \( -\sqrt{15} \)

\( \sqrt{15} \) is to the right of \( -3.5 \) because \( \sqrt{15} \) is positive and \( -3.5 \) is negative. So, \( -\sqrt{15} \) is greater.

28. \( \sqrt{\frac{133}{4}} \)

\( \sqrt{\frac{133}{4}} \) is to the right of \( 10 \frac{3}{4} \). So, \( \sqrt{\frac{133}{4}} \) is greater.
Chapter 7

29. \( \frac{\sqrt{16}}{81} = \frac{4}{9}, \frac{2}{3} = \sqrt{\frac{4}{9}} = \frac{2}{3} \)

\( \frac{2}{3} \) is to the right of \( \frac{\sqrt{16}}{81} \). So, \( \frac{2}{3} \) is greater.

30. \(-\sqrt{0.25} = -0.5, -0.25, 0 \)

\(-0.25 \) is to the right of \(-\sqrt{0.25} \). So, \(-0.25 \) is greater.

31. \(-\sqrt{192} = -14, \sqrt{182} = 13.9 \)

\(-\sqrt{182} \) is to the right of \(-\sqrt{192} \). So, \(-\sqrt{182} \) is greater.

32. false; To the nearest tenth, \( \sqrt{10} \approx 3.2 \).

33. true

34. false; \( \sqrt{10} \) is greater than 3.16.

35. \( A = s^2 \)

\( 66 = s^2 \)

\( \sqrt{66} = \sqrt{s^2} = s \)

Because 66 is closer to 65.61 than to 67.24, \( \sqrt{66} \) is closer to 8.1 than to 8.2. So, one of the sides of the court is about 8.1 feet.

36. \( A = s^2 \)

\( 14 = s^2 \)

\( \sqrt{14} = \sqrt{s^2} = s \)

Because 14 is closer to 13.69 than to 14.44, \( \sqrt{14} \) is closer to 3.7 than to 3.8. So, \( \sqrt{14} \approx 3.7 \) and \( s \approx 3.7 \).

The side length of a square on the checkerboard is about 3.7 centimeters. The sides of the checkerboard contain 8 squares each. So, the length of a side of the checkerboard is \( x \approx 8(3.7) = 29.6 \) centimeters.

\( P = 4x = 4(29.6) = 118.4 \)

The perimeter of the checkerboard is about 118.4 centimeters.

37. \( a^2 + b^2 = c^2 \)

\( 6^2 + 6^2 = c^2 \)

\( 36 + 36 = c^2 \)

\( 72 = c^2 \)

\( \sqrt{72} = \sqrt{c^2} \)

\( 8.5 \approx c \)

So, the approximate length of the diagonal is 8.5 feet.

38. \( a^2 + b^2 = c^2 \)

\( 4^2 + 8^2 = c^2 \)

\( 16 + 64 = c^2 \)

\( 80 = c^2 \)

\( \sqrt{80} = \sqrt{c^2} \)

\( 8.9 \approx c \)

So, the approximate length of the diagonal is 8.9 centimeters.

39. \( a^2 + b^2 = c^2 \)

\( 10^2 + 18^2 = c^2 \)

\( 100 + 324 = c^2 \)

\( 424 = c^2 \)

\( \sqrt{424} = \sqrt{c^2} \)

\( 20.6 \approx c \)

So, the approximate length of the diagonal is 20.6 inches.

40. To estimate \( \sqrt{71} \) to the nearest hundredth, create a table of numbers between 8.4 and 8.5 whose squares are close to 71, and then determine which square is closest to 71.
41. To estimate a cube root to the nearest tenth, create a table of integers whose cubes are close to the radicand. Determine which two integers the cube root is between. Then create another table of numbers between those two integers whose cubes are close to the radicand. Determine which cube is closest to the radicand. Make a table of numbers whose cubes are close to the radicand, 14.

<table>
<thead>
<tr>
<th>Number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cube of Number</td>
<td>1</td>
<td>8</td>
<td>27</td>
<td>64</td>
</tr>
</tbody>
</table>

The table shows that 14 is not a perfect cube. It is between the perfect cubes 2 and 3. Make a table of numbers between 2 and 3 whose cubes are close to 14.

<table>
<thead>
<tr>
<th>Number</th>
<th>2.3</th>
<th>2.4</th>
<th>2.5</th>
<th>2.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cube of Number</td>
<td>12.167</td>
<td>13.824</td>
<td>15.625</td>
<td>17.576</td>
</tr>
</tbody>
</table>

Because 14 is closer to 13.824 than to 15.625, \( \sqrt[3]{14} \) is closer to 2.4 than to 2.5. So, \( \sqrt[3]{14} \approx 2.4 \).

42. \( x = 1.23 \sqrt{h} = 1.23 \sqrt{22,000} = 182.4 \)

The maximum distance is about 182.4 nautical miles.

43. Sample answer: Because \( \sqrt{81} = 9 \) and \( \sqrt{100} = 10 \), and \( b > a \). So, one answer is \( a = 82 \) and \( b = 97 \).

44. \( \sqrt[3]{0.39} \)

Because 0.39 is closer to 0.36 than to 0.49, \( \sqrt[3]{0.39} \approx 0.6 \).

45. \( \sqrt{1.19} \)

Because 1.19 is closer to 1.21 than to 1, \( \sqrt{1.19} \approx 1.1 \).

46. \( \sqrt[3]{1.52} \)

Because 1.52 is closer to 1.44 than to 1.69, \( \sqrt[3]{1.52} \approx 1.2 \).

47. \( s = 3 \sqrt{6r} = 3 \sqrt{6(16.764)} = 3 \sqrt{100.584} \approx 30.1 \)

The speed of a car going around the loop is about 30.1 meters per second.

48. yes; Because \( \left( \frac{1}{2} \right)^2 = \frac{1}{4} \), \( \frac{1}{4} \) is a perfect square. So, \( \sqrt[3]{\frac{1}{4}} \) is a rational number.

no; Because \( \frac{3}{16} \) is not a perfect square, \( \sqrt[3]{\frac{3}{16}} \) is not a rational number.

49. \( t = \sqrt[3]{\frac{d}{4.9}} = \sqrt[3]{\frac{14}{4.9}} = 1.7 \)

It takes the balloon about 1.7 seconds to fall to the ground.

50. a. always; The product of two rational numbers can be written as the ratio of two integers. So, the product is rational.

Sample answer: \( \frac{3}{4} \cdot \frac{1}{5} = \frac{3}{20} \)

b. sometimes; The product of a nonzero rational number and an irrational number cannot be written as the ratio of two integers. However, the product of 0 and an irrational number is 0, which is rational.

Sample answer: \( 3 \cdot \pi = 3\pi \) is irrational, but \( 0 \cdot \pi = 0 \) is rational.

c. sometimes; The product of two irrational numbers can be written or cannot be written as the ratio of two integers.

Sample answer: \( \frac{\pi}{3} \cdot \frac{\pi}{2} = \frac{\pi^2}{6} \) is irrational.

51. \( a^2 + b^2 = c^2 \)
    \( 24^2 + 32^2 = c^2 \)
    \( 576 + 1024 = c^2 \)
    \( 1600 = c^2 \)
    \( \sqrt{1600} = \sqrt{c^2} \)
    \( 40 = c \)

The length of the hypotenuse is 40 meters.

52. \( a^2 + b^2 = c^2 \)
    \( 10^2 + b^2 = 26^2 \)
    \( 100 + b^2 = 676 \)
    \( b^2 = 576 \)
    \( \sqrt{b^2} = \sqrt{576} \)
    \( b = 24 \)

The length of the leg is 24 inches.
53. \[a^2 + b^2 = c^2\]
\[a^2 + 12^2 = 15^2\]
\[a^2 + 144 = 225\]
\[a^2 = 81\]
\[\sqrt{a^2} = \sqrt{81}\]
\[a = 9\]
The length of the leg is 9 centimeters.

54. D: side length of red triangle
side length of blue triangle = \[\frac{4}{10} = \frac{2}{5}\]
The ratio is 2 : 5.

**7.4 Extension**

1. Let \(x = 0.\overline{1}\).
   \[x = 0.1\]
   \[10 \cdot x = 10 \cdot 0.1\]
   \[- (x = 0.1)\]
   \[9x = 1\]
   \[x = \frac{1}{9}\]
   So, \(0.\overline{1} = \frac{1}{9}\).

2. Let \(x = -0.\overline{5}\).
   \[x = -0.5\]
   \[10 \cdot x = 10 \cdot (-0.5)\]
   \[- (x = -0.5)\]
   \[9x = -5\]
   \[x = -\frac{5}{9}\]
   So, \(-0.\overline{5} = -\frac{5}{9}\).

3. Let \(x = -1.\overline{2}\).
   \[x = -1.2\]
   \[10 \cdot x = 10 \cdot (-1.2)\]
   \[- (x = -1.2)\]
   \[9x = -11\]
   \[x = -\frac{11}{9} \text{ or } -1\frac{2}{9}\]
   So, \(-1.\overline{2} = -1\frac{2}{9}\).

4. Let \(x = 5\overline{8}\).
   \[x = 5\overline{8}\]
   \[10 \cdot x = 10 \cdot 5\overline{8}\]
   \[10x = 58\overline{8}\]
   \[- (x = 5\overline{8})\]
   \[9x = 53\]
   \[x = \frac{53}{9} = \frac{58}{9}\]
   So, \(5\overline{8} = \frac{58}{9}\).

5. Because the solution does not change when adding/subtracting two equivalent equations; Multiply by 10 so that when you subtract the original equation, the repeating part is removed.

6. Write the digit that repeats in the numerator and use 9 in the denominator.

7. Let \(x = -0.4\overline{3}\).
   \[x = -0.4\overline{3}\]
   \[10 \cdot x = 10 \cdot (-0.4\overline{3})\]
   \[- (x = -0.4\overline{3})\]
   \[9x = -3.9\]
   \[x = -\frac{3.9}{9}\]
   So, \(0.4\overline{3} = \frac{3.9}{9} = \frac{39}{90} = -\frac{13}{30}\).

8. Let \(x = 2.0\overline{6}\).
   \[x = 2.0\overline{6}\]
   \[10 \cdot x = 10 \cdot 2.0\overline{6}\]
   \[- (x = 2.0\overline{6})\]
   \[9x = 18.6\]
   \[x = \frac{18.6}{9}\]
   So, \(2.0\overline{6} = \frac{18.6}{9} = \frac{186}{90} = \frac{26}{15} = \frac{2\frac{1}{15}}{15}\).
Chapter 7

9. Let \( x = 0.27 \).

\[
x = 0.27 \\
100 \cdot x = 100 \cdot 0.27 \\
100x = 27.27 \\
- (x = 0.27) \\
99x = 27 \\
x = 27 \div 99 \\
So, \ 0.27 = \frac{27}{99} = \frac{3}{11}
\]

10. Let \( x = -4.50 \).

\[
x = -4.50 \\
100 \cdot x = 100 \cdot (-4.50) \\
100x = -450.50 \\
- (x = -4.50) \\
99x = -446 \\
x = -446 \div 99 \\
So, \ -4.50 = \frac{-446}{99} = -\frac{450}{99}
\]

11. Pattern: Digits that repeat are in the numerator and 99 is in the denominator; Use 9 as the integer part, 4 as the numerator, and 99 as the denominator of the fractional part.

Section 7.5

7.5 Activity (pp. 318–319)

1. a. Converse: If \( a^2 = b^2 \), then \( a = b \). The converse is false. A counterexample is \( a = -2 \) and \( b = 2 \).

b. Converse: If \( a^3 = b^3 \), then \( a = b \). The converse is true because a number and its cube have the same sign. Take the cube root of each side to see \( \sqrt[3]{a^3} = \sqrt[3]{b^3} \), or \( a = b \).

c. Converse: If two figures are congruent, then one is a translation of the other figure. The converse is false. 

Sample answer:

\[
\text{Pattern: Digits that repeat are in the numerator and 99 is in the denominator; Use 9 as the integer part, 4 as the numerator, and 99 as the denominator of the fractional part.}
\]

2. a. The converse of the Pythagorean Theorem is true. You must prove a triangle is a right triangle solely from the fact that \( a^2 + b^2 = c^2 \) is true for the triangle.

b. \( \triangle JKL \) is a right triangle, so \( a^2 + b^2 = x^2 \).

\[
a^2 + b^2 = c^2 \text{ and } a^2 + b^2 = x^2, \text{ so } c = x.
\]
\[
a = a, b = b, \text{ and } c = x, \text{ so } \triangle DEF \cong \triangle JKL.
\]
\[
\triangle DEF \cong \triangle JKL, \text{ so } \angle E = \angle K. \angle K = 90^\circ, \text{ so } \angle E = 90^\circ.
\]
\[
\angle E = 90^\circ, \text{ so } \triangle DEF \text{ is a right triangle.}
\]

3. Sample answer:

\[
\text{The hypotenuse is the distance between the two points.}
\]

4. The Pythagorean Theorem can be used to show that a triangle is a right triangle and to find the distance between two points in a plane.

5. The converse of the Pythagorean Theorem can help solve real-life problems where two lines intersect and it needs to be determined whether they form a right angle.

7.5 On Your Own (pp. 320–321)

1. \( a^2 + b^2 = c^2 \)

\[
21^2 + 20^2 = 28^2 \\
441 + 400 = 784 \\
841 \neq 784 \times
\]

It is not a right triangle.

2. \( a^2 + b^2 = c^2 \)

\[
1^2 + (0.75)^2 = (125)^2 \\
1 + 0.5625 = 1.5625 \\
1.5625 = 1.5625 \checkmark
\]

It is a right triangle.
Chapter 7

3. Let \((x_1, y_1) = (0, 0)\) and \((x_2, y_2) = (4, 5)\).
   \[
d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}
   = \sqrt{(4 - 0)^2 + (5 - 0)^2}
   = \sqrt{16 + 25}
   = \sqrt{41}
   \]

4. Let \((x_1, y_1) = (7, -3)\) and \((x_2, y_2) = (9, 6)\).
   \[
d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}
   = \sqrt{(9 - 7)^2 + [6 - (-3)]^2}
   = \sqrt{4^2 + 9^2}
   = \sqrt{16 + 81}
   = \sqrt{95}
   \]

5. Let \((x_1, y_1) = (-2, -3)\) and \((x_2, y_2) = (-5, 1)\).
   \[
d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}
   = \sqrt{(-5 - (-2))^2 + [1 - (-3)]^2}
   = \sqrt{(-3)^2 + 4^2}
   = \sqrt{9 + 16}
   = \sqrt{25}
   = 5
   \]

6. \(d_1\): Let \((x_1, y_1) = (60, 50)\) and \((x_2, y_2) = (20, 10)\).
   \[
d_1 = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}
   = \sqrt{(20 - 60)^2 + (10 - 50)^2}
   = \sqrt{1600 + 1600}
   = \sqrt{3200}\ \text{feet}
   \]
\[
d_2: \text{Let } (x_1, y_1) = (20, 10) \text{ and } (x_2, y_2) = (80, -30).
   \[
d_2 = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}
   = \sqrt{(80 - 20)^2 + (-30 - 10)^2}
   = \sqrt{3600 + 1600}
   = \sqrt{5200}\ \text{feet}
   \]
From Example 3, you know that \(d_1 = \sqrt{6800}\ \text{feet.}
\[
(\sqrt{3200})^2 + (\sqrt{5200})^2 = (\sqrt{6800})^2
\]
\[
3200 + 5200 = 6800
\]
\[
8400 \neq 6800 \times
\]
No, your friend did not make a 90° turn.

7.5 Exercises (pp. 322–323)

Vocabulary and Concept Check

1. One method is to use the Pythagorean Theorem. Another, is to use the Distance Formula.
   \[
a^2 + b^2 = c^2
   \]
   \[
3^2 + 6^2 = 8^2
   6^2 + 8^2 = 10^2
   9 + 36 = 64
   36 + 64 = 100
   45 \neq 64 \times
   100 = 100 \checkmark
   \]
   \[
a^2 + b^2 = c^2
   \]
   \[
5^2 + 12^2 = 13^2
   7^2 + 24^2 = 25^2
   25 + 144 = 169
   49 + 576 = 625
   169 = 169 \checkmark
   625 = 625 \checkmark
   \]

Practice and Problem Solving

3. Converse: If \(a^2\) is odd, then \(a\) is an odd number. The converse is true when \(a\) is an integer because a product of two integers is odd only when each integer is odd.

4. Converse: If \(ABCD\) is a parallelogram, then \(ABCD\) is a square. The converse is false. A counterexample is any parallelogram that does not have right angles.

5. \(a^2 + b^2 = c^2\)
   \[
15^2 + 8^2 = 17^2
225 + 64 = 289
289 = 289 \checkmark
\]
The triangle is a right triangle.

6. \(a^2 + b^2 = c^2\)
   \[
36^2 + 27^2 = 45^2
1296 + 729 = 2025
2025 = 2025 \checkmark
\]
The triangle is a right triangle.

7. \(a^2 + b^2 = c^2\)
   \[
8^2 + (8.5)^2 = (11.5)^2
64 + 72.25 = 132.25
136.25 \neq 132.25 \times
\]
The triangle is not a right triangle.
Chapter 7

8. \( a^2 + b^2 = c^2 \)
   
   \[ 14^2 + 19^2 = 23^2 \]
   
   \[ 196 + 361 = 529 \]
   
   \[ 557 \neq 529 \times \]
   
   The triangle is not a right triangle.

9. \( a^2 + b^2 = c^2 \)
   
   \[ \left( \frac{9}{10} \right)^2 + \left( \frac{1}{5} \right)^2 = \left( \frac{1}{2} \right)^2 \]
   
   \[ \frac{81}{100} + \frac{1}{25} = \frac{2}{4} \]
   
   \[ \frac{21}{4} = \frac{2}{4} \checkmark \]
   
   The triangle is a right triangle.

10. \( a^2 + b^2 = c^2 \)
    
    \[ 1.4^2 + 4.8^2 = 5^2 \]
    
    \[ 1.96 + 23.04 = 25 \]
    
    \[ 25 = 25 \checkmark \]
    
    The triangle is a right triangle.

11. Let \((x_1, y_1) = (1, 2)\) and \((x_2, y_2) = (7, 6)\).
    
    \[ d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \]
    
    \[ = \sqrt{(7 - 1)^2 + (6 - 2)^2} \]
    
    \[ = \sqrt{36 + 16} \]
    
    \[ = \sqrt{52} \]
    
    \[ = 2\sqrt{13} \]

12. Let \((x_1, y_1) = (4, -5)\) and \((x_2, y_2) = (-1, 7)\).
    
    \[ d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \]
    
    \[ = \sqrt{(-1 - 4)^2 + [7 - (-5)]^2} \]
    
    \[ = \sqrt{25 + 144} \]
    
    \[ = \sqrt{169} \]
    
    \[ = 13 \]

13. Let \((x_1, y_1) = (2, 4)\) and \((x_2, y_2) = (7, 2)\).
    
    \[ d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \]
    
    \[ = \sqrt{(7 - 2)^2 + (2 - 4)^2} \]
    
    \[ = \sqrt{5^2 + (-2)^2} \]
    
    \[ = \sqrt{25 + 4} \]
    
    \[ = \sqrt{29} \]

14. Let \((x_1, y_1) = (-1, -3)\) and \((x_2, y_2) = (1, 3)\).
    
    \[ d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \]
    
    \[ = \sqrt{[0 - (-1)]^2 + [3 - (-3)]^2} \]
    
    \[ = \sqrt{2^2 + 6^2} \]
    
    \[ = \sqrt{4 + 36} \]
    
    \[ = \sqrt{40} \]
    
    \[ = 2\sqrt{10} \]

15. Let \((x_1, y_1) = (-6, -7)\) and \((x_2, y_2) = (0, 0)\).
    
    \[ d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \]
    
    \[ = \sqrt{[0 - (-6)]^2 + [0 - (-7)]^2} \]
    
    \[ = \sqrt{6^2 + 7^2} \]
    
    \[ = \sqrt{36 + 49} \]
    
    \[ = \sqrt{85} \]

16. Let \((x_1, y_1) = (12, 5)\) and \((x_2, y_2) = (-12, -2)\).
    
    \[ d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \]
    
    \[ = \sqrt{(-12 - 12)^2 + (-2 - 5)^2} \]
    
    \[ = \sqrt{(-24)^2 + (-7)^2} \]
    
    \[ = \sqrt{576 + 49} \]
    
    \[ = \sqrt{625} \]
    
    \[ = 25 \]

17. The squared quantities under the radical should be added not subtracted.

    \[ d = \sqrt{[7 - (-3)]^2 + [4 - (-2)]^2} \]
    
    \[ = \sqrt{10^2 + 6^2} \]
    
    \[ = \sqrt{100 + 36} \]
    
    \[ = \sqrt{136} \]
    
    \[ = 2\sqrt{34} \]
Chapter 7

18. \[a^2 + b^2 = c^2\]
\[15^2 + 20^2 = 225\]
\[225 + 400 = 625\]
\[625 = 625\] Yes, the Pythagorean Theorem works with the sides of the brace.

19. \[a^2 + b^2 = c^2\]
\[(\sqrt{63})^2 + 9^2 = 12^2\]
\[63 + 81 = 144\]
\[144 = 144\] The triangle is a right triangle.

20. \[a^2 + b^2 = c^2\]
\[4^2 + (\sqrt{15})^2 = 6^2\]
\[16 + 15 = 31\]
\[31 = 36\] The triangle is not a right triangle.

21. \[a^2 + b^2 = c^2\]
\[(\sqrt{18})^2 + (\sqrt{24})^2 = (\sqrt{42})^2\]
\[18 + 24 = 42\]
\[42 = 42\] The triangle is a right triangle.

22. \[d_1 = \sqrt{[4 - (-1)]^2 + (-2 - 3)^2} = \sqrt{25 + 25} = \sqrt{50}\]
\[d_2 = \sqrt{(1 - 4)^2 + [-5 - (-2)]^2} = \sqrt{9 + 9} = \sqrt{18}\]
\[d_3 = \sqrt{(-1 - 1)^2 + [3 - (-5)]^2} = \sqrt{4 + 64} = \sqrt{68}\]
\[\left(\sqrt{50}\right)^2 + \left(\sqrt{18}\right)^2 = \left(\sqrt{68}\right)^2\]
\[50 + 18 = 68\]
\[68 = 68\] Yes, the points are vertices of a right triangle.

23. \[d_4 = \sqrt{(20 - 10)^2 + (-20 - 50)^2}\]
\[= \sqrt{100 + 4900}\]
\[= \sqrt{5000}\]
\[d_2 = \sqrt{(80 - 20)^2 + [-10 - (-20)]^2}\]
\[= \sqrt{3600 + 100}\]
\[= \sqrt{3700}\]
\[d_3 = \sqrt{(10 - 80)^2 + [50 - (-10)]^2}\]
\[= \sqrt{4900 + 3600}\]
\[= \sqrt{8500}\]
\[\left(\sqrt{5000}\right)^2 + \left(\sqrt{3700}\right)^2 = \left(\sqrt{8500}\right)^2\]
\[5000 + 3700 = 8500\]
\[8700 \neq 8500\] No, the path does not form a right triangle.

24. You: Let \((x_1, y_1) = (2, 4)\) and \((x_2, y_2) = (9, 7).\)
\[d = \sqrt{(2 - 9)^2 + (4 - 7)^2}\]
\[= \sqrt{7^2 + 3^2}\]
\[= \sqrt{49 + 9}\]
\[= \sqrt{58}\]
Your friend: Let \((x_1, y_1) = (9, 7)\) and \((x_2, y_2) = (2, 4).\)
\[d = \sqrt{(2 - 9)^2 + (4 - 7)^2}\]
\[= \sqrt{(-7)^2 + (-3)^2}\]
\[= \sqrt{49 + 9}\]
\[= \sqrt{58}\]
Yes, you and your friend obtain the same result. Because you square the differences \(x_2 - x_1\) and \(y_2 - y_1\), it does not matter if the differences are positive or negative. The squares of opposite numbers are equivalent.
25. Convert feet to kilometers.

\[
20,000 \, \text{ft} \cdot \frac{1 \, \text{m}}{3.28 \, \text{ft}} \cdot \frac{1 \, \text{km}}{1000 \, \text{m}} = \frac{20,000 \, \text{km}}{3.28 \times 1000} = \frac{20,000 \, \text{km}}{3280} = 6.1 \, \text{km}
\]

\[
8000 \, \text{ft} \cdot \frac{1 \, \text{m}}{3.28 \, \text{ft}} \cdot \frac{1 \, \text{km}}{1000 \, \text{m}} = \frac{8000 \, \text{km}}{3.28 \times 1000} = \frac{8000 \, \text{km}}{3280} = 2.4 \, \text{km}
\]

Plane A:

\[
a^2 + b^2 = c^2 \\
6.1^2 + 5^2 = x^2 \\
37.21 + 25 = x^2 \\
62.21 = x^2 \\
\sqrt{62.21} = \sqrt{x^2} \\
7.9 = x
\]

Plane A is about 7.9 kilometers from the base of the tower.

Plane B:

\[
a^2 + b^2 = c^2 \\
2.4^2 + 7^2 = y^2 \\
5.76 + 49 = y^2 \\
54.76 = y^2 \\
\sqrt{54.76} = \sqrt{y^2} \\
7.4 = y
\]

Plane B is about 7.4 kilometers from the base of the tower. So, Plane B is slightly closer.

26. So, \((x_m, y_m) = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)\)

\[
dx_1 = \sqrt{\left(x_1 - \frac{x_1 + x_2}{2}\right)^2 + \left(y_1 - \frac{y_1 + y_2}{2}\right)^2} \\
= \sqrt{\left(\frac{2x_1 - (x_1 + x_2)}{2}\right)^2 + \left(\frac{2y_1 - (y_1 + y_2)}{2}\right)^2} \\
= \sqrt{\frac{(x_1 - x_2)^2}{4} + \frac{(y_1 - y_2)^2}{4}} \\
= \frac{1}{2}\sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}
\]

\[
dx_2 = \sqrt{\left(x_2 - \frac{x_1 + x_2}{2}\right)^2 + \left(y_2 - \frac{y_1 + y_2}{2}\right)^2} \\
= \sqrt{\left(\frac{x_1 + x_2 - 2x_2}{2}\right)^2 + \left(\frac{y_1 + y_2 - 2y_2}{2}\right)^2} \\
= \sqrt{\frac{(x_1 - x_2)^2}{4} + \frac{(y_1 - y_2)^2}{4}} \\
= \frac{1}{2}\sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}
\]

So, \(d_1 + d_2 = \frac{1}{2}\sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2} + \frac{1}{2}\sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2} = d.\)
Chapter 7

Fair Game Review

27. mean = \( \frac{12 + 9 + 17 + 15 + 12 + 13}{6} = \frac{78}{6} = 13 \)

The mean is 13.

The data in order is 9, 12, 12, 13, 15, 17.

median = \( \frac{12 + 13}{2} = \frac{25}{2} = 12.5 \)

The median is 12.5.

The value 12 occurs most often. So, the mode is 12.

28. mean = \( \frac{21 + 32 + 16 + 27 + 22 + 19 + 10}{7} \)

= \( \frac{147}{7} \)

= 21

The mean is 21.

The data in order is 10, 16, 19, 21, 22, 27, 32. The middle value is 21. So, the median is 21.

All data values occur once. So, there is no mode.

29. mean = \( \frac{67 + 59 + 34 + 71 + 59}{5} = \frac{290}{5} = 58 \)

The mean is 58.

The data in order is 34, 59, 59, 67, 71. The middle value is 59. So, the median is 59.

The value 59 occurs most often. So, the mode is 59.

30. B; \( S = (n - 2) \cdot 180^\circ \)

= \( (8 - 2) \cdot 180^\circ \)

= 6 \cdot 180^\circ

= 1080^\circ

The sum of the angle measures of an octagon is 1080°.

Quiz 7.4–7.5

1. Because \( -\sqrt{225} = -15 \), 225 is a perfect square.
   \( -\sqrt{225} \) is an integer and rational.

2. Because \( \frac{-1}{9} \) can be written as \( \frac{-10}{-9} \), \( -\frac{1}{9} \) is rational.

3. Because 41 is not a perfect square, \( \sqrt{41} \) is irrational.

4. Because 17 is not a perfect square, \( \sqrt{17} \) is irrational.

5. a. Make a table of numbers whose squares are close to the radicand, 38.

<table>
<thead>
<tr>
<th>Number</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square of Number</td>
<td>25</td>
<td>36</td>
<td>49</td>
<td>64</td>
</tr>
</tbody>
</table>

The table shows that 38 is not a perfect square. It is between the perfect squares 6 and 7. Because 38 is closer to 36 than to 49, \( \sqrt{38} \) is closer to 6 than to 7.

So, \( \sqrt{38} \approx 6 \).

b. Make a table of numbers between 6 and 7 whose squares are close to 38.

<table>
<thead>
<tr>
<th>Number</th>
<th>6.0</th>
<th>6.1</th>
<th>6.2</th>
<th>6.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square of Number</td>
<td>36</td>
<td>37.21</td>
<td>38.44</td>
<td>36.69</td>
</tr>
</tbody>
</table>

Because 38 is closer to 38.44 than to 37.21, \( \sqrt{38} \) is closer to 6.2 than to 6.1.

So, \( \sqrt{38} \approx 6.2 \).

6. a. Make a table of numbers whose squares are close to the radicand, 99.

<table>
<thead>
<tr>
<th>Number</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square of Number</td>
<td>81</td>
<td>100</td>
<td>121</td>
<td>144</td>
</tr>
</tbody>
</table>

The table shows that 99 is not a perfect square. It is between the perfect squares 81 and 100. Because 99 is closer to 100 than to 81, \( \sqrt{99} \) is closer to 10 than 9.

So, \( \sqrt{99} \approx -10 \).

b. Make a table of numbers between 9 and 10 whose squares are close to 99.

<table>
<thead>
<tr>
<th>Number</th>
<th>9.7</th>
<th>9.8</th>
<th>9.9</th>
<th>10.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square of Number</td>
<td>94.09</td>
<td>96.04</td>
<td>98.01</td>
<td>100</td>
</tr>
</tbody>
</table>

Because 99 is closer to 98.01 than to 100, \( \sqrt{99} \) is closer to 9.9 than to 10.

So, \( \sqrt{99} \approx 9.9 \).
7. **a.** Make a table of numbers whose squares are close to the radicand, 172.

<table>
<thead>
<tr>
<th>Number</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square of Number</td>
<td>144</td>
<td>169</td>
<td>196</td>
<td>225</td>
</tr>
</tbody>
</table>

The table shows that 172 is not a perfect square. It is between the perfect squares 13 and 14. Because 172 is closer to 169 than to 196, $\sqrt{172}$ is closer to 13 than to 14.

So, $\sqrt{172} = 13$.

**b.** Make a table of numbers between 13 and 14 whose squares are close to 172.

<table>
<thead>
<tr>
<th>Number</th>
<th>13</th>
<th>13.1</th>
<th>13.2</th>
<th>13.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square of Number</td>
<td>169</td>
<td>171.61</td>
<td>174.24</td>
<td>176.89</td>
</tr>
</tbody>
</table>

Because 172 is closer to 171.61 than to 174.24, $\sqrt{172}$ is closer to 13.1 than to 13.2.

So, $\sqrt{172} = 13.1$.

8. **a.** Make a table of numbers whose squares are close to the radicand, 115.

<table>
<thead>
<tr>
<th>Number</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square of Number</td>
<td>81</td>
<td>100</td>
<td>121</td>
<td>144</td>
</tr>
</tbody>
</table>

The table shows that 115 is not a perfect square. It is between the perfect squares 10 and 11. Because 115 is closer to 121 than to 100, $\sqrt{115}$ is closer to 11 than to 10.

So, $\sqrt{115} = 11$.

**b.** Make a table of numbers between 10 and 11 whose squares are close to 172.

<table>
<thead>
<tr>
<th>Number</th>
<th>10.6</th>
<th>10.7</th>
<th>10.8</th>
<th>10.9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square of Number</td>
<td>112.36</td>
<td>114.49</td>
<td>116.64</td>
<td>118.81</td>
</tr>
</tbody>
</table>

Because 115 is closer to 114.49 than to 116.64, $\sqrt{115}$ is closer to 10.7 than to 10.8.

So, $\sqrt{115} = 10.7$.

9.

$\sqrt{11} = 3.3$ is to the right of $\sqrt{11}$. So, $3.3$ is greater.

$\sqrt{1.44} = 1.2$ is to the right of 1.18. So, $\sqrt{1.44}$ is greater.

10. Let $x = 0.7$.

\[10 \times x = 10 \times 0.7 = 7.7\]

So, $0.7 = \frac{7}{9}$.

11. Let $x = -\sqrt{1.63}$.

\[100 \times x = 100 \times \left(-\sqrt{1.63}\right)\]

\[-\left(x = -\sqrt{1.63}\right)\]

\[99x = -162\]

\[x = -\frac{162}{99} = -\frac{162}{99} = -\frac{17}{11}\]

So, $-\sqrt{1.63} = -\frac{17}{11}$.

12. Let $x = -\sqrt{22}$.

\[100 \times x = 100 \times \left(-\sqrt{22}\right)\]

\[-\left(x = -\sqrt{22}\right)\]

\[99x = -180\]

\[x = -\frac{180}{99} = -\frac{20}{11}\]

So, $-\sqrt{22} = -\frac{20}{11}$.

13. $a^2 + b^2 = c^2$

$46^2 + 28^2 = 53^2$

$2116 + 784 = 2809$

$2900 \neq 2809$

The triangle is not a right triangle.

14. $a^2 + b^2 = c^2$

$3.5^2 + 1.2^2 = 3.7^2$

$12.25 + 1.44 = 13.69$

$13.69 = 13.69$

The triangle is a right triangle.
Chapter 7

15. Let \((x_1, y_1) = (-3, -1)\) and \((x_2, y_2) = (-1, -5)\).

\[
d = \sqrt{[-1 - (-3)]^2 + [-5 - (-1)]^2}
= \sqrt{2^2 + (-4)^2}
= \sqrt{4 + 16}
= \sqrt{20}
= 2\sqrt{5}
\]

The distance is \(2\sqrt{5}\) units.

16. Let \((x_1, y_1) = (-4, 2)\) and \((x_2, y_2) = (5, 1)\).

\[
d = \sqrt{[5 - (-4)]^2 + (1 - 2)^2}
= \sqrt{9^2 + (-1)^2}
= \sqrt{81 + 1}
= \sqrt{82}
\]

The distance is \(\sqrt{82}\) units.

17. Let \((x_1, y_1) = (1, -2)\) and \((x_2, y_2) = (4, -5)\).

\[
d = \sqrt{(4 - 1)^2 + [-5 - (-2)]^2}
= \sqrt{3^2 + (-3)^2}
= \sqrt{9 + 9}
= \sqrt{18}
= 3\sqrt{2}
\]

The distance is \(3\sqrt{2}\) units.

18. Let \((x_1, y_1) = (-1, 1)\) and \((x_2, y_2) = (7, 4)\).

\[
d = \sqrt{[7 - (-1)]^2 + (4 - 1)^2}
= \sqrt{8^2 + 3^2}
= \sqrt{64 + 9}
= \sqrt{73}
\]

The distance is \(\sqrt{73}\) units.

19. Let \((x_1, y_1) = (-6, 5)\) and \((x_2, y_2) = (-4, -6)\).

\[
d = \sqrt{[-4 - (-6)]^2 + (-6 - 5)^2}
= \sqrt{2^2 + (-11)^2}
= \sqrt{4 + 121}
= \sqrt{125}
= 5\sqrt{5}
\]

The distance is \(5\sqrt{5}\) units.

20. Let \((x_1, y_1) = (-1, 4)\) and \((x_2, y_2) = (1, 3)\).

\[
d = \sqrt{[1 - (-1)]^2 + (3 - 4)^2}
= \sqrt{2^2 + (-1)^2}
= \sqrt{4 + 1}
= \sqrt{5}
\]

The distance is \(\sqrt{5}\) units.

21. The cabin is at the point \((-3, 0)\). The peak is at the point \((0, -5)\).

\[
d = \sqrt{[0 - (-3)]^2 + (-5 - 0)^2}
= \sqrt{3^2 + (-5)^2}
= \sqrt{9 + 25}
= \sqrt{34}
\approx 5.8
\]

The cabin is about 5.8 kilometers from the peak.

22. The fire tower is at the point \((0, 7)\). The lake is at the point \((5, 0)\).

\[
d = \sqrt{(5 - 0)^2 + (0 - 7)^2}
= \sqrt{5^2 + (-7)^2}
= \sqrt{25 + 49}
= \sqrt{74}
\approx 8.6
\]

The fire tower is about 8.6 kilometers from the lake.

23. The lake is at the point \((5, 0)\). The peak is at the point \((0, -5)\).

\[
d = \sqrt{(0 - 5)^2 + (-5 - 0)^2}
= \sqrt{(-5)^2 + (-5)^2}
= \sqrt{25 + 25}
= \sqrt{50}
= 5\sqrt{2}
\approx 7.1
\]

The lake is about 7.1 kilometers from the peak.
Chapter 7

24. The lake is at the point (5, 0).

\[ d = \sqrt{(5 - (-5))^2 + (0 - (-6))^2} \]
\[ = \sqrt{10^2 + 6^2} \]
\[ = \sqrt{100 + 36} \]
\[ = \sqrt{136} \]
\[ \approx 2\sqrt{34} \]

You are about 11.7 kilometers from the lake.

Chapter 7 Review

1. Because \( t^2 = 1 \), \( \sqrt{1} = \sqrt{1^2} = 1 \).

2. Because \( \left( \frac{3}{5} \right)^2 = \frac{9}{25} \), \( \sqrt{\frac{9}{25}} = -\frac{3}{5} \).

3. Because \( 1.3^2 = 1.69 \), \( \pm \sqrt{1.69} = \pm \sqrt{1.3^2} = 1.3 \) and \(-1.3\).

4. \( 15 - 4\sqrt{36} = 15 - 4(6) = 15 - 24 = -9 \)

5. \( \sqrt{\frac{54}{6} + \frac{2}{3}} = \sqrt{\frac{9}{2} + \frac{2}{3}} = 3 + \frac{2}{3} = 3\frac{2}{3} \) or \( \frac{11}{3} \).

6. \( 10(\sqrt{81} - 12) = 10(9 - 12) = 10(-3) = -30 \)

7. Because \( 9^3 = 729 \), \( \sqrt[3]{729} = \sqrt[3]{9^3} = 9 \).

8. Because \( \left( \frac{4}{7} \right)^3 = \frac{64}{343} \), \( \sqrt[3]{\frac{64}{343}} = \sqrt[3]{\frac{4}{7}} = \frac{4}{7} \).

9. Because \( \left( \frac{-2}{3} \right)^3 = -\frac{8}{27} \), \( \sqrt[3]{-\frac{8}{27}} = \sqrt[3]{\frac{-2}{3}} = -\frac{2}{3} \).

10. \( \sqrt{27} - 16 = \sqrt{3^3} - 16 = 3 - 16 = -13 \)

11. \( 25 + 2\sqrt{-64} = 25 + 2\sqrt{-4^2} \)
\[ = 25 + 2(-4) \]
\[ = 25 - 8 \]
\[ = 17 \]

12. \( 3\sqrt{-125} - 27 = 3\sqrt{5^3} - 27 \)
\[ = 3(-5) - 27 \]
\[ = -15 - 27 \]
\[ = -42 \]

13. \( a^2 + b^2 = c^2 \)
\[ 12^2 + 35^2 = c^2 \]
\[ 144 + 1225 = c^2 \]
\[ 1369 = c^2 \]
\[ \sqrt{1369} = \sqrt{c^2} \]
\[ 37 = c \]

The length of the hypotenuse is 37 inches.

14. \( a^2 + b^2 = c^2 \)
\[ 0.3^2 + b^2 = 0.5^2 \]
\[ 0.09 + b^2 = 0.25 \]
\[ b^2 = 0.16 \]
\[ \sqrt{b^2} = \sqrt{0.16} \]
\[ b = 0.4 \]

The length of the leg is 0.4 centimeter.

15. The number 0.81\(\overline{5} \) is a repeating decimal, so it is rational.

16. The number \( \sqrt{101} \) is irrational because 101 is not a perfect square.

17. Because \( \sqrt{4} = 2 \), the number is a natural number, a whole number, an integer, and a rational number.

18. a. Make a table of numbers whose squares are close to the radicand, 14.

<table>
<thead>
<tr>
<th>Number</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square of Number</td>
<td>4</td>
<td>9</td>
<td>16</td>
<td>25</td>
</tr>
</tbody>
</table>

The table shows that 14 is not a perfect square. It is between the perfect squares 3 and 4. Because 14 is closer to 16 than to 9, \( \sqrt{14} \) is closer to 4 than to 3.

So, \( \sqrt{14} \approx 4 \).

b. Make a table of numbers between 3 and 4 whose squares are close to 14.

<table>
<thead>
<tr>
<th>Number</th>
<th>3.6</th>
<th>3.7</th>
<th>3.8</th>
<th>3.9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square of Number</td>
<td>12.96</td>
<td>13.69</td>
<td>14.44</td>
<td>15.21</td>
</tr>
</tbody>
</table>

Because 14 is closer to 13.69 than to 14.44, \( \sqrt{14} \) is closer to 3.7 than to 3.8.

So, \( \sqrt{14} \approx 3.7 \).
Chapter 7

19. a. Make a table of numbers whose squares are close to the radicand, 90.

<table>
<thead>
<tr>
<th>Number</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square of Number</td>
<td>49</td>
<td>64</td>
<td>81</td>
<td>100</td>
</tr>
</tbody>
</table>

The table shows that 90 is not a perfect square. It is between the perfect squares 9 and 10. Because 90 is closer to 81 than to 100, \( \sqrt{90} \) is closer to 9 than to 10.

\[ \sqrt{90} \approx 9 \]

b. Make a table of numbers between 9 and 10 whose squares are close to 90.

<table>
<thead>
<tr>
<th>Number</th>
<th>9.4</th>
<th>9.5</th>
<th>9.6</th>
<th>9.7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square of Number</td>
<td>88.36</td>
<td>90.25</td>
<td>92.16</td>
<td>94.09</td>
</tr>
</tbody>
</table>

Because 90 is closer to 90.25 than to 88.36, \( \sqrt{90} \) is closer to 9.5 than to 9.4.

\[ \sqrt{90} \approx 9.5 \]

20. a. Make a table of numbers whose squares are close to the radicand, 175.

<table>
<thead>
<tr>
<th>Number</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square of Number</td>
<td>144</td>
<td>169</td>
<td>196</td>
<td>225</td>
</tr>
</tbody>
</table>

The table shows that 175 is not a perfect square. It is between the perfect squares 13 and 14. Because 175 is closer to 169 than to 196, \( \sqrt{175} \) is closer to 13 than to 14.

\[ \sqrt{175} \approx 13 \]

b. Make a table of numbers between 13 and 14 whose squares are close to 175.

<table>
<thead>
<tr>
<th>Number</th>
<th>13.1</th>
<th>13.2</th>
<th>13.3</th>
<th>13.4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square of Number</td>
<td>171.61</td>
<td>174.24</td>
<td>176.89</td>
<td>179.56</td>
</tr>
</tbody>
</table>

Because 175 is closer to 174.24 than to 176.89, \( \sqrt{175} \) is closer to 13.2 than to 13.3.

\[ \sqrt{175} \approx 13.2 \]

21. Let \( x = 0.\overline{8} \).

\[
\begin{align*}
x &= 0.\overline{8} \\
10 \cdot x &= 10 \cdot 0.\overline{8} \\
10x &= 8.\overline{8} \\
-x &= 0.\overline{8} \\
9x &= 8 \\
x &= \frac{8}{9} \\
\text{So, } 0.\overline{8} &= \frac{8}{9}
\end{align*}
\]

22. Let \( x = 0.\overline{36} \).

\[
\begin{align*}
x &= 0.\overline{36} \\
100 \cdot x &= 10 \cdot 0.\overline{36} \\
100x &= 36.\overline{36} \\
-x &= 0.\overline{36} \\
99x &= 36 \\
x &= \frac{36}{99} = \frac{4}{11} \\
\text{So, } 0.\overline{36} &= \frac{4}{11}
\end{align*}
\]

23. Let \( x = -1.\overline{6} \).

\[
\begin{align*}
x &= -1.\overline{6} \\
10 \cdot x &= 10 \cdot (-1.\overline{6}) \\
10x &= -16.\overline{6} \\
-x &= -1.\overline{6} \\
9x &= -15 \\
x &= \frac{-15}{9} = \frac{-16}{9} = -\frac{16}{9} = -\frac{16}{9} = -\frac{2}{3} \\
\text{So, } -1.\overline{6} &= -\frac{2}{3}
\end{align*}
\]

24. \( a^2 + b^2 = c^2 \)

\[
\begin{align*}
11^2 + 60^2 &= 61^2 \\
121 + 3600 &= 3721 \\
3721 &= 3721
\end{align*}
\]

The triangle is a right triangle.
Chapter 7

25. \( a^2 + b^2 = c^2 \)

\[
\begin{align*}
40^2 + 98^2 &= 104^2 \\
1600 + 9604 &= 10816 \\
11,204 &\neq 10,816 \times
\end{align*}
\]

The triangle is \textit{not} a right triangle.

26. Let \((x_1, y_1) = (-2, -5)\) and \((x_2, y_2) = (3, 5)\).

\[
\begin{align*}
d &= \sqrt{[3 - (-2)]^2 + [5 - (-5)]^2} \\
&= \sqrt{5^2 + 10^2} \\
&= \sqrt{25 + 100} \\
&= \sqrt{125} \\
&= 5\sqrt{5}
\end{align*}
\]

27. Let \((x_1, y_1) = (-4, 7)\) and \((x_2, y_2) = (4, 0)\).

\[
\begin{align*}
d &= \sqrt{[4 - (-4)]^2 + (0 - 7)^2} \\
&= \sqrt{8^2 + (-7)^2} \\
&= \sqrt{64 + 49} \\
&= \sqrt{113}
\end{align*}
\]

Chapter 7 Test

1. Because \(40^2 = 1600\), \(-\sqrt{1600} = -\sqrt{40^2} = -40\).

2. Because \(\left(\frac{5}{7}\right)^2 = \frac{25}{49}\), \(\sqrt{\frac{25}{49}} = \sqrt{\frac{5^2}{7^2}} = \frac{5}{7}\).

3. Because \(\left(\frac{10}{3}\right)^2 = \frac{100}{9}\), \(\pm \sqrt{\frac{100}{9}} = \pm \sqrt{\left(\frac{10}{3}\right)^2} = \pm \frac{10}{3}\)

and \(-\frac{10}{3}\).

4. Because \((-3)^3 = -27\), \(-\sqrt{-27} = \sqrt[3]{-3}^3 = -3\).

5. Because \(\left(\frac{2}{5}\right)^3 = \frac{8}{125}\), \(\sqrt[3]{\frac{8}{125}} = \sqrt[3]{\left(\frac{2}{5}\right)^3} = \frac{2}{5}\)

6. Because \(\left(-\frac{9}{4}\right)^3 = \frac{729}{64}\), \(\sqrt[3]{\frac{729}{64}} = \sqrt[3]{\left(-\frac{9}{4}\right)^3} = -\frac{9}{4}\)

or \(-2\frac{1}{4}\)

7. \(12 + 8\sqrt{16} = 12 + 8(4) = 12 + 32 = 44\)

8. \(\frac{1}{2} + \sqrt{\frac{72}{2}} = \frac{1}{2} + \sqrt{36} = \frac{1}{2} + 6 = \frac{13}{2}\) or \(6\frac{1}{2}\)

9. \((\sqrt{-125})^3 + 75 = -125 + 75 = -50\)

10. \(50\left(\frac{512}{1000}\right) + 14 = 50\left(\frac{8}{10}\right) + 14 = 40 + 14 = 54\)

11. \(a^2 + b^2 = c^2\)

\[a^2 + 24^2 = 26^2\]

\[a^2 + 576 = 676\]

\[a^2 = 100\]

\[\sqrt{a^2} = \sqrt{100}\]

\[a = 10\]

The length of the leg is 10 inches.

12. The decimal form of \(16\pi\) neither terminates nor repeats. So, \(16\pi\) is irrational.

13. 49 is a perfect square. So, \(-\sqrt{49}\) is an integer and rational.

14. a. Make a table of numbers whose squares are close to the radicand, 58.

<table>
<thead>
<tr>
<th>Number</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square of Number</td>
<td>36</td>
<td>49</td>
<td>64</td>
<td>81</td>
</tr>
</tbody>
</table>

The table shows that 58 is not a perfect square. It is between the perfect squares 7 and 8. Because 58 is closer to 64 than to 49, \(\sqrt{58}\) is closer to 8 than to 7.

So, \(\sqrt{58} = 8\).

b. Make a table of numbers between 7 and 8 whose squares are close to 58.

<table>
<thead>
<tr>
<th>Number</th>
<th>7.5</th>
<th>7.6</th>
<th>7.7</th>
<th>7.8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square of Number</td>
<td>56.25</td>
<td>57.76</td>
<td>59.29</td>
<td>60.84</td>
</tr>
</tbody>
</table>

Because 58 is closer to 57.76 than to 59.29, \(\sqrt{58}\) is closer to 7.6 than to 7.7.

So, \(\sqrt{58} = 7.6\).
Chapter 7

15. a. Make a table of numbers whose squares are close to the radicand, 83.

<table>
<thead>
<tr>
<th>Number</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square of Number</td>
<td>64</td>
<td>81</td>
<td>100</td>
<td>121</td>
</tr>
</tbody>
</table>

The table shows that 83 is not a perfect square. It is between the perfect squares 9 and 10. Because 83 is closer to 81 than to 100, \( \sqrt{83} \) is closer to 9 than to 10.

So, \( \sqrt{83} = 9 \).

b. Make a table of numbers between 9 and 10 whose squares are close to 83.

<table>
<thead>
<tr>
<th>Number</th>
<th>9.0</th>
<th>9.1</th>
<th>9.2</th>
<th>9.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square of Number</td>
<td>81</td>
<td>82.81</td>
<td>84.64</td>
<td>86.49</td>
</tr>
</tbody>
</table>

Because 83 is closer to 82.81 than to 84.64, \( \sqrt{83} \) is closer to 9.1 than to 9.2.

So, \( \sqrt{83} = 9.1 \).

16. Let \( x = -0.3 \).

\[
x = -0.3
\]

\[
10 \cdot x = 10 \cdot (-0.3) = -3
\]

\[
9x = -3
\]

\[
x = \frac{-3}{9} = \frac{-1}{3}
\]

So, \( -0.3 = -\frac{1}{3} \).

17. Let \( x = 1.24 \).

\[
x = 1.24
\]

\[
100 \cdot x = 100 \cdot 1.24
\]

\[
100x = 124.24
\]

\[
99x = 123
\]

\[
x = \frac{123}{99} = \frac{124}{99} = \frac{8}{33}
\]

So, \( 1.24 = \frac{8}{33} \).

18. \( a^2 + b^2 = c^2 \)

\[
39^2 + 80^2 = 89^2
\]

\[
1521 + 6400 = 7921
\]

\[
7921 = 7921 \checkmark
\]

The triangle is a right triangle.

19. Let \( (x_1, y_1) = (-2, 3) \) and \( (x_2, y_2) = (6, 9) \).

\[
d = \sqrt{(6 - (-2))^2 + (9 - 3)^2}
\]

\[
= \sqrt{8^2 + 6^2}
\]

\[
= \sqrt{64 + 36}
\]

\[
= \sqrt{100}
\]

\[
= 10
\]

The distance is 10 units.

20. Let \( (x_1, y_1) = (0, -5) \) and \( (x_2, y_2) = (4, 1) \).

\[
d = \sqrt{(4 - 0)^2 + (1 - (-5))^2}
\]

\[
= \sqrt{4^2 + 6^2}
\]

\[
= \sqrt{16 + 36}
\]

\[
= \sqrt{52}
\]

\[
= 2\sqrt{13}
\]

The distance is 2\( \sqrt{13} \) units.

21. \( a^2 + b^2 = c^2 \)

\[
x^2 + 11^2 = 61^2
\]

\[
x^2 + 121 = 3721
\]

\[
x^2 = 3600
\]

\[
\sqrt{x^2} = \sqrt{3600}
\]

\[
x = 60
\]

The altitude of the balloon is 60 + 6 = 66 feet.

Chapter 7 Standards Assessment

1. D; \( T = 1.1\sqrt{L} = 1.1\sqrt{4} = 1.1(2) = 2.2 \)

The period is 2.2 seconds.

2. H;

Ratios of corresponding side lengths:

\[
\frac{9}{6} = \frac{3}{2}
\]

\[
\frac{6}{4} = \frac{3}{2}
\]

The ratios of corresponding side lengths are equivalent, so the side lengths are proportional. Corresponding angles have the same measure. So, parallelogram \( H \) is a dilation of parallelogram \( JKL\).

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Chapter 7

3. D; Because the equation \( x + y = 1 \) is the only equation of the form \( Ax + By = C \), the equation is linear.

4. F; Find the slope using the points \((0, -5)\) and \((5, 0)\).

\[
slope = \frac{\text{rise}}{\text{run}} = \frac{5}{5} = 1
\]

The line crosses the y-axis at \((0, -5)\), so the y-intercept is \(-5\). So, the equation of the line is \( y = x - 5 \).

5. about 126.5 yd; Use the Pythagorean Theorem.

\[
a^2 + b^2 = c^2
\]
\[
40^2 + 120^2 = c^2
\]
\[
1600 + 14400 = c^2
\]
\[
16000 = c^2
\]
\[
\sqrt{16000} = \sqrt{c^2}
\]
\[
126.5 = c
\]

The distance between opposite corners is about 126.5 yards.

6. 15 h; \(40h + 50 = 650\)

\[
40h = 600
\]
\[
h = 15
\]

The consultant worked 15 hours.

7. B; \( S = 180(n - 2) \)

\[
S = 180n - 360
\]
\[
S + 360 = 180n
\]
\[
\frac{S}{180} + 2 = n
\]

8. I; To get the \( y \)-values in the table, multiply the \( x \)-value by \(-2\), then add 6. So, the linear function \( y = -2x + 6 \) relates \( y \) and \( x \) in the table.

9. 91 mi; City 1 to 2: \( d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \)

\[
= \sqrt{(33 - 0)^2 + (56 - 0)^2}
\]
\[
= \sqrt{1089 + 3136}
\]
\[
= \sqrt{4225}
\]
\[
= 65
\]

City 2 to 3: \( d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \)

\[
= \sqrt{(23 - 33)^2 + (32 - 56)^2}
\]
\[
= \sqrt{100 + 576}
\]
\[
= \sqrt{676}
\]
\[
= 26
\]

The total distance the airplane flies is \( 65 + 26 = 91 \) miles.

10. C; \( a^2 + b^2 = c^2 \)

\[
x^2 + 7^2 = 25^2
\]
\[
x^2 + 49 = 625
\]
\[
x^2 = 576
\]
\[
\sqrt{x^2} = \sqrt{576}
\]
\[
x = 24
\]

The value of \( x \) is 24 centimeters.

11. H; The lines intersect at the point \((4, 2)\), so the solution of the system is \((4, 2)\).

12. D; \( \angle 1 \) and \( \angle 8 \) are corresponding angles, so they have the same measure.

13. F; The graph of the line \( y = -2x - 2 \) has a slope of \(-2\) and passes through \((0, -2)\).