7.1 Finding Square Roots

Essential Question How can you find the dimensions of a square or a circle when you are given its area?

When you multiply a number by itself, you square the number.

Symbol for squaring is the exponent 2.

$4^2 = 4 \cdot 4$

$= 16$ 4 squared is 16.

To "undo" this, take the *square root* of the number.

Symbol for square root is a *radical sign*, $\sqrt{\ }$.

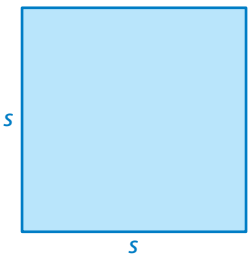
$\sqrt{16} = \sqrt{4^2} = 4$ The square root of 16 is 4.

1 ACTIVITY: Finding Square Roots

Work with a partner. Use a square root symbol to write the side length of the square. Then find the square root. Check your answer by multiplying.

a. Sample: $s = \sqrt{121} = 11$ ft

Area = 121 ft^2

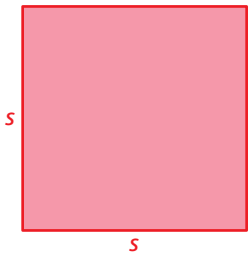


∴ The side length of the square is 11 feet.

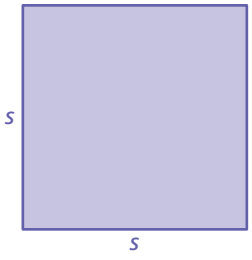
Check

$$\begin{array}{r} 11 \\ \times\ 11 \\ \hline 11 \\ 110 \\ \hline 121 \end{array}$$ ✓

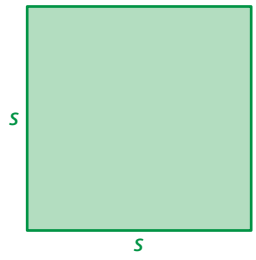
b. Area = 81 yd^2



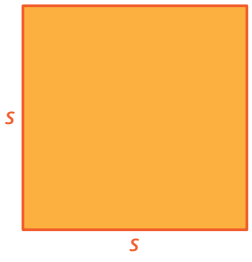
c. Area = 324 cm^2



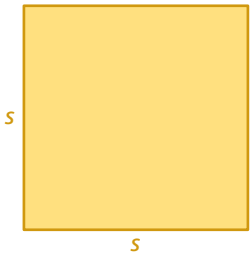
d. Area = 361 mi^2



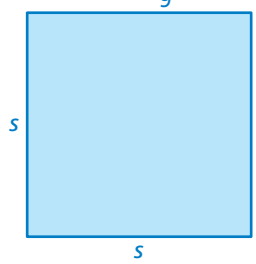
e. Area = 225 mi^2



f. Area = 2.89 in.^{2}



g. Area = $\frac{4}{9}$ ft^2



Common Core

Square Roots

In this lesson, you will

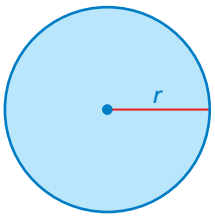
- find square roots of perfect squares.
- evaluate expressions involving square roots.
- use square roots to solve equations.

Learning Standard 8.EE.2

2 ACTIVITY: Using Square Roots

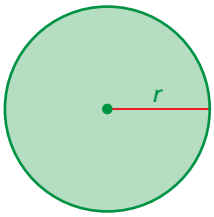
Work with a partner. Find the radius of each circle.

a.



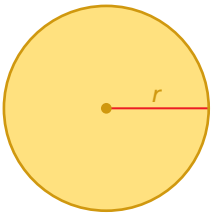
Area = 36π in.^{2}

b.



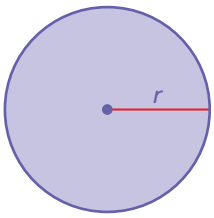
Area = π yd^2

c.



Area = 0.25π ft^2

d.



Area = $\frac{9}{16}\pi$ m^2

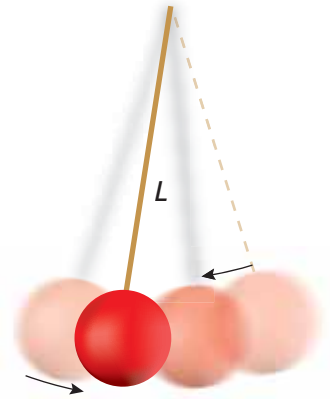
3 ACTIVITY: The Period of a Pendulum

Work with a partner.

The period of a pendulum is the time (in seconds) it takes the pendulum to swing back *and* forth.

The period T is represented by $T = 1.1\sqrt{L}$, where L is the length of the pendulum (in feet).

Copy and complete the table. Then graph the function. Is the function linear?



Math Practice 6

Calculate Accurately

How can you use the graph to help you determine whether you calculated the values of T correctly?

L	1.00	1.96	3.24	4.00	4.84	6.25	7.29	7.84	9.00
T									

What Is Your Answer?

4. **IN YOUR OWN WORDS** How can you find the dimensions of a square or a circle when you are given its area? Give an example of each. How can you check your answers?

Practice Use what you learned about finding square roots to complete Exercises 4–6 on page 292.

7.1 Lesson

Check It Out
Lesson Tutorials
BigIdeasMath.com

Key Vocabulary
square root, *p. 290*
perfect square, *p. 290*
radical sign, *p. 290*
radicand, *p. 290*

A **square root** of a number is a number that, when multiplied by itself, equals the given number. Every positive number has a positive *and* a negative square root. A **perfect square** is a number with integers as its square roots.

EXAMPLE 1 Finding Square Roots of a Perfect Square

Find the two square roots of 49.

$7 \cdot 7 = 49$ and $(-7) \cdot (-7) = 49$

∴ So, the square roots of 49 are 7 and -7.

Study Tip
Zero has one square root, which is 0.

The symbol $\sqrt{\ }$ is called a **radical sign**. It is used to represent a square root. The number under the radical sign is called the **radicand**.

Positive Square Root, $\sqrt{\ }$	Negative Square Root, $-\sqrt{\ }$	Both Square Roots, $\pm\sqrt{\ }$
$\sqrt{16} = 4$	$-\sqrt{16} = -4$	$\pm\sqrt{16} = \pm 4$

EXAMPLE 2 Finding Square Roots

Find the square root(s).

a. $\sqrt{25}$

$\sqrt{25}$ represents the *positive* square root.

∴ Because $5^2 = 25$, $\sqrt{25} = \sqrt{5^2} = 5$.

b. $-\sqrt{\frac{9}{16}}$

$-\sqrt{\frac{9}{16}}$ represents the *negative* square root.

∴ Because $\left(\frac{3}{4}\right)^2 = \frac{9}{16}$, $-\sqrt{\frac{9}{16}} = -\sqrt{\left(\frac{3}{4}\right)^2} = -\frac{3}{4}$.

c. $\pm\sqrt{2.25}$

$\pm\sqrt{2.25}$ represents both the *positive* and the *negative* square roots.

∴ Because $1.5^2 = 2.25$, $\pm\sqrt{2.25} = \pm\sqrt{1.5^2} = 1.5$ and -1.5.

On Your Own

Now You're Ready
Exercises 7–18

Find the two square roots of the number.

1. 36 **2.** 100 **3.** 121

Find the square root(s).

4. $-\sqrt{1}$ **5.** $\pm\sqrt{\frac{4}{25}}$ **6.** $\sqrt{12.25}$

Squaring a positive number and finding a square root are inverse operations. You can use this relationship to evaluate expressions and solve equations involving squares.

EXAMPLE 3 Evaluating Expressions Involving Square Roots

Evaluate each expression.

a. $5\sqrt{36} + 7 = 5(6) + 7$ Evaluate the square root.

$= 30 + 7$ Multiply.

$= 37$ Add.

b. $\frac{1}{4} + \sqrt{\frac{18}{2}} = \frac{1}{4} + \sqrt{9}$ Simplify.

$= \frac{1}{4} + 3$ Evaluate the square root.

$= 3\frac{1}{4}$ Add.

c. $(\sqrt{81})^2 - 5 = 81 - 5$ Evaluate the power using inverse operations.

$= 76$ Subtract.

EXAMPLE 4 Real-Life Application

The area of a crop circle is 45,216 square feet. What is the radius of the crop circle? Use 3.14 for π.

$A = \pi r^2$ Write the formula for the area of a circle.

$45{,}216 \approx 3.14r^2$ Substitute 45,216 for A and 3.14 for π.

$14{,}400 = r^2$ Divide each side by 3.14.

$\sqrt{14{,}400} = \sqrt{r^2}$ Take positive square root of each side.

$120 = r$ Simplify.

∴ The radius of the crop circle is about 120 feet.

On Your Own

Now You're Ready
Exercises 20–27

Evaluate the expression.

7. $12 - 3\sqrt{25}$ **8.** $\sqrt{\frac{28}{7}} + 2.4$ **9.** $15 - (\sqrt{4})^2$

10. The area of a circle is 2826 square feet. Write and solve an equation to find the radius of the circle. Use 3.14 for π.

7.1 Exercises

Check It Out
Help with Homework
BigIdeasMath.com

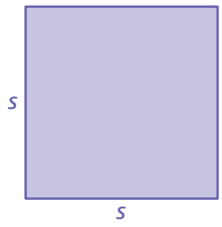
Vocabulary and Concept Check

1. **VOCABULARY** Is 26 a perfect square? Explain.
2. **REASONING** Can the square of an integer be a negative number? Explain.
3. **NUMBER SENSE** Does $\sqrt{256}$ represent the positive square root of 256, the negative square root of 256, or both? Explain.

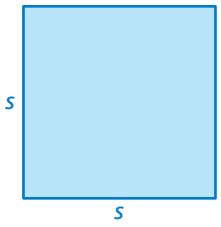
Practice and Problem Solving

Find the dimensions of the square or circle. Check your answer.

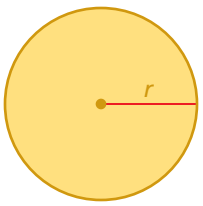
4. Area = 441 cm^2



5. Area = 1.69 km^2



6. Area = 64π in.^{2}



Find the two square roots of the number.

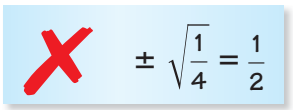
1 **7.** 9 **8.** 64 **9.** 4 **10.** 144

Find the square root(s).

2 **11.** $\sqrt{625}$ **12.** $\pm\sqrt{196}$ **13.** $\pm\sqrt{\frac{1}{961}}$ **14.** $-\sqrt{\frac{9}{100}}$

15. $\pm\sqrt{4.84}$ **16.** $\sqrt{7.29}$ **17.** $-\sqrt{361}$ **18.** $-\sqrt{2.25}$

19. ERROR ANALYSIS Describe and correct the error in finding the square roots.



Evaluate the expression.

3 **20.** $(\sqrt{9})^2 + 5$ **21.** $28 - (\sqrt{144})^2$ **22.** $3\sqrt{16} - 5$ **23.** $10 - 4\sqrt{\frac{1}{16}}$

24. $\sqrt{6.76} + 5.4$ **25.** $8\sqrt{8.41} + 1.8$ **26.** $2\left(\sqrt{\frac{80}{5}} - 5\right)$ **27.** $4\left(\sqrt{\frac{147}{3}} + 3\right)$

28. NOTEPAD The area of the base of a square notepad is 2.25 square inches. What is the length of one side of the base of the notepad?

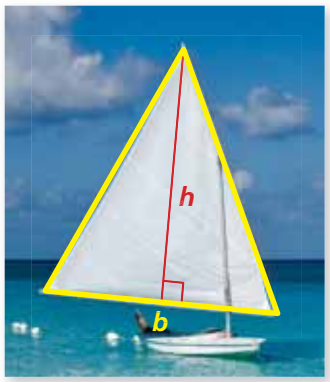
29. CRITICAL THINKING There are two square roots of 25. Why is there only one answer for the radius of the button?

$A = 25\pi$ mm^2

Copy and complete the statement with <, >, or =.

30. $\sqrt{81}$ ☐ 8 **31.** 0.5 ☐ $\sqrt{0.25}$ **32.** $\frac{3}{2}$ ☐ $\sqrt{\frac{25}{4}}$

33. SAILBOAT The area of a sail is $40\frac{1}{2}$ square feet. The base and the height of the sail are equal. What is the height of the sail (in feet)?



34. REASONING Is the product of two perfect squares always a perfect square? Explain your reasoning.

35. ENERGY The kinetic energy K (in joules) of a falling apple is represented by $K = \frac{v^2}{2}$, where v is the speed of the apple (in meters per second). How fast is the apple traveling when the kinetic energy is 32 joules?

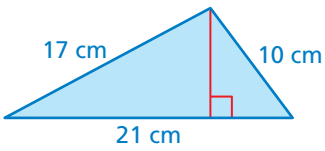
36. PRECISION The areas of the two watch faces have a ratio of 16 : 25.

a. What is the ratio of the radius of the smaller watch face to the radius of the larger watch face?

b. What is the radius of the larger watch face?

37. WINDOW The cost C (in dollars) of making a square window with a side length of n inches is represented by $C = \frac{n^2}{5} + 175$. A window costs \$355. What is the length (in feet) of the window?

38. Geometry The area of the triangle is represented by the formula $A = \sqrt{s(s-21)(s-17)(s-10)}$, where s is equal to half the perimeter. What is the height of the triangle?



Fair Game Review *What you learned in previous grades & lessons*

Write in slope-intercept form an equation of the line that passes through the given points. *(Section 4.7)*

39. (2, 4), (5, 13) **40.** (−1, 7), (3, −1) **41.** (−5, −2), (5, 4)

42. MULTIPLE CHOICE What is the value of x? *(Section 3.2)*

Ⓐ 41 Ⓑ 44

Ⓒ 88 Ⓓ 134