

3-1

Square Roots

Main IDEA

Find square roots of perfect squares.



Reinforcement of TEKS 7.1 The student represents and uses numbers in a variety of equivalent forms. **(C) Represent squares and square roots using geometric models.**

NEW Vocabulary

perfect square
square root
radical sign

READING in the Content Area

For strategies in reading this lesson, visit tx.msmath3.com.

MINI Lab

Concepts in Motion
Interactive Lab tx.msmath3.com

Continue the pattern of square tiles until you reach 5 tiles on each side.



- Copy and complete the following table.

Tiles on a Side	1	2	3	4	5
Total Number of Tiles in the Square Arrangement	1	4			

- Suppose a square arrangement has 36 tiles. How many tiles are on a side?
- What is the relationship between the number of tiles on a side and the number of tiles in the arrangement?

Numbers such as 1, 4, 9, 16, and 25 are called **perfect squares** because they are squares of integers. The opposite of squaring a number is finding a square root. A **square root** of a number is one of its two equal factors. The symbol $\sqrt{\quad}$, called a **radical sign**, is used to indicate a square root. Every positive number has *both* a positive and a negative square root.

EXAMPLES Find Square Roots

Find each square root.

1 $\sqrt{64}$

$\sqrt{64}$ indicates the *positive* square root. Since $8^2 = 64$, $\sqrt{64} = 8$.

2 $-\sqrt{\frac{25}{36}}$

$-\sqrt{\frac{25}{36}}$ indicates the *negative* square root of $\frac{25}{36}$.

Since $\left(\frac{5}{6}\right)^2 = \frac{25}{36}$, $-\sqrt{\frac{25}{36}} = -\frac{5}{6}$.

3 $\pm\sqrt{1.21}$

$\pm\sqrt{1.21}$ indicates *both* the positive and negative square roots of 1.21. Since $1.1^2 = 1.21$ and $(-1.1)^2 = 1.21$, $\pm\sqrt{1.21} = \pm 1.1$, or 1.1 and -1.1.

CHECK Your Progress Find each square root.

a. $\sqrt{\frac{9}{16}}$

b. $-\sqrt{49}$

c. $\pm\sqrt{0.81}$

By the definition of square roots, if $n^2 = a$, then $n = \pm\sqrt{a}$. You can use this relationship to solve equations that involve squares.

EXAMPLE Use Square Roots to Solve an Equation

- 4 **ALGEBRA** Solve $t^2 = 169$. Check your solution(s).

$$t^2 = 169$$

Write the equation.

$$t = \pm\sqrt{169}$$

Definition of square root

$$t = 13 \text{ and } -13 \quad \text{Check } 13 \cdot 13 = 169 \text{ and } (-13)(-13) = 169 \checkmark$$

The equation has two solutions, 13 and -13 .

CHECK Your Progress

Solve each equation. Check your solution(s).

d. $289 = a^2$

e. $m^2 = 0.09$

f. $y^2 = \frac{4}{25}$

In most real-world situations, a negative square root does not make sense. In these cases, only the positive or *principal* square root is considered.

Real-World EXAMPLE

- 5 **HISTORY** The base of the Great Pyramid originally covered an area of 571,536 square feet. Determine the length of each side of the Great Pyramid's base.

Words

Area is equal to the square of the length of a side.

Variable

Let s represent the length of a side.

Equation

$$571,536 = s^2$$

$$571,536 = s^2$$

Write the equation.

$$\pm\sqrt{571,536} = s$$

Definition of square root

$$\boxed{2nd} \quad \boxed{\sqrt{\quad}} \quad 571536 \quad \boxed{ENTER}$$

Use a calculator to find $\sqrt{571,536}$.

$$756 = s$$

Since distance cannot be negative, the length of each side is 756 feet.

CHECK Your Progress

- g. **CONCERTS** A concert crew needs to set up 900 chairs on the floor level. If the chairs are placed in a square arrangement, how many should be in each row?

 **Online** Personal Tutor at tx.msmath3.com



CHECK Your Understanding

Examples 1–3 Find each square root.

(p. 144)

1. $\sqrt{25}$

2. $\sqrt{0.64}$

3. $-\sqrt{1.69}$

4. $-\sqrt{\frac{16}{81}}$

5. $\pm\sqrt{100}$

6. $\pm\sqrt{\frac{49}{144}}$

Example 4 **ALGEBRA** Solve each equation. Check your solution(s).

(p. 145)

7. $p^2 = 36$

8. $t^2 = \frac{1}{9}$

9. $6.25 = r^2$

Example 5

(p. 145)

10. **GAMES** A checkerboard is a large square that is made up of 32 small red squares and 32 small black squares. How many small squares are along one side of a checkerboard?

Exercises

HOMEWORK HELP

For Exercises	See Examples
11–14	1
15–18	2
19–22	3
23–30	4
31, 32	5

Find each square root.

11. $\sqrt{16}$

12. $-\sqrt{81}$

13. $-\sqrt{484}$

14. $\pm\sqrt{36}$

15. $\sqrt{\frac{121}{324}}$

16. $-\sqrt{\frac{64}{225}}$

17. $\pm\sqrt{\frac{9}{49}}$

18. $-\sqrt{\frac{16}{25}}$

19. $-\sqrt{2.56}$

20. $\pm\sqrt{1.44}$

21. $\sqrt{0.25}$

22. $\pm\sqrt{0.0196}$

ALGEBRA Solve each equation. Check your solution(s).

23. $v^2 = 81$

24. $b^2 = 100$

25. $144 = s^2$

26. $225 = y^2$

27. $w^2 = \frac{36}{100}$

28. $\frac{9}{64} = c^2$

29. $0.0169 = d^2$

30. $a^2 = 1.21$

31. **PHOTOGRAPHY** A group of 169 students needs to be seated in a square formation for a yearbook photo. How many students should be in each row?

32. **MARCHING BAND** A marching band wants to form a square in the middle of the field. If there are 81 members in the band, how many should be in each row?

ALGEBRA Solve each equation. Check your solution(s).

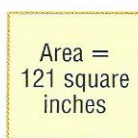
33. $\sqrt{x} = 5$

34. $\sqrt{y} = 20$

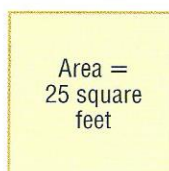
35. $\sqrt{z} = 10.5$

GEOMETRY The formula for the perimeter of a square is $P = 4s$, where s is the length of a side. Find the perimeter of each square.

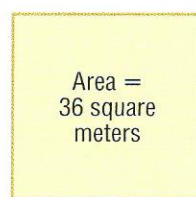
36.



37.



38.



EXTRAPRACTICE

See pages 700, 730.

Math online

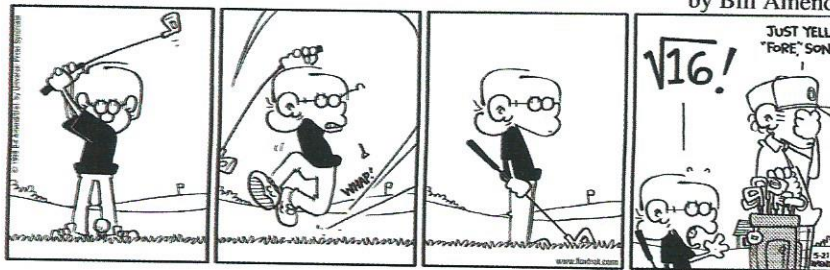
Self-Check Quiz at tx.msmath3.com

I. Problems

39. **OPEN ENDED** Create an equation that can be solved by finding the square root of a perfect square.
40. **CHALLENGE** Find each value.
 a. $(\sqrt{36})^2$ b. $(\sqrt{\frac{25}{81}})^2$ c. $(\sqrt{1.99})^2$ d. $(\sqrt{x})^2$
41. **NUMBER SENSE** Under what condition is $\sqrt{x} > \sqrt{25}$?
42. **WRITING IN MATH** Analyze the cartoon. Create a cartoon of your own that uses the square root of a perfect square.

FoxTrot

by Bill Amend

**TEST PRACTICE**

43. The area of each square is 4 square units.



Find the perimeter of the figure.

- A 8 units C 20 units
 B 16 units D 24 units

44. Mr Freeman's farm has a square cornfield. Find the area of the cornfield if the sides are measured in whole numbers.

- F 164,000 ft²
 G 170,150 ft²
 H 170,586 ft²
 J 174,724 ft²

Spiral Review

45. **SPACE** The Alpha Centauri stars are about 2.5×10^{13} miles from Earth. Write this distance in standard form. (Lesson 2-10)

Write each expression using exponents. (Lesson 2-9)

46. $6 \cdot 6 \cdot 6$ 47. $2 \cdot 3 \cdot 3 \cdot 2 \cdot 2 \cdot 2$ 48. $s \cdot t \cdot t \cdot s \cdot s \cdot t \cdot s$

49. What is the absolute value of -18 ? (Lesson 1-3)

GET READY for the Next Lesson

PREREQUISITE SKILL Between which two perfect squares does each number lie? (Lesson 2-2)

50. 57 51. 68 52. 33 53. 40