

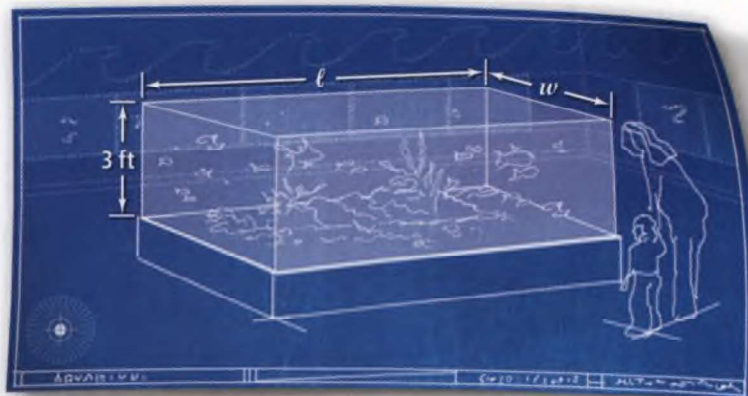
You can solve some quadratic equations that model real-world problems by finding square roots. In many cases, the negative square root may not be a reasonable solution.



### Problem 3 Choosing a Reasonable Solution

GRIDDED RESPONSE

**Aquarium** An aquarium is designing a new exhibit to showcase tropical fish. The exhibit will include a tank that is a rectangular prism with a length  $\ell$  that is twice the width  $w$ . The volume of the tank is  $420 \text{ ft}^3$ . What is the width of the tank to the nearest tenth of a foot?



### Plan

How can you write the length of the tank?

The length  $\ell$  is twice the width  $w$ , so write the length as  $2w$ .

$$V = \ell wh$$

$$420 = (2w)w(3)$$

$$420 = 6w^2$$

$$70 = w^2$$

$$\pm \sqrt{70} = w$$

$$\pm 8.366600265 \approx w$$

Use the formula for volume of a rectangular prism.

Substitute 420 for  $V$ ,  $2w$  for  $\ell$ , and 3 for  $h$ .

Simplify.

Divide each side by 6.

Find the square roots of each side.

Use a calculator.



A tank cannot have a negative width, so only the positive square root makes sense. The tank will have a width of about 8.4 ft.



- Got It?** 3. a. Suppose the tank in Problem 3 will have a height of 4 ft and a volume of  $500 \text{ ft}^3$ . What is the width of the tank to the nearest tenth of a foot?  
b. **Reasoning** What are the disadvantages of using a graph to approximate the solution to Problem 3? Explain.



### Lesson Check

#### Do you know HOW?

Solve each equation by graphing the related function or by finding square roots.

- $x^2 - 25 = 0$
- $2x^2 - 8 = 0$
- $t^2 = 144$
- $y^2 - 225 = 0$

#### Do you UNDERSTAND?



MATHEMATICAL PRACTICES

- Vocabulary** What are the zeros of a function? Give an example of a quadratic function and its zeros.
- Compare and Contrast** When is it easier to solve a quadratic equation of the form  $ax^2 + c = 0$  using square roots than to solve it using a graph?
- Reasoning** Consider the equation  $ax^2 + c = 0$ , where  $a \neq 0$ . What is true of  $a$  and  $c$  if the equation has two solutions? Only one solution? No solutions?



## Practice and Problem-Solving Exercises



MATHEMATICAL  
PRACTICES



### Practice

Solve each equation by graphing the related function. If the equation has no real-number solution, write *no solution*.

➡ See Problem 1.

- |                              |                      |                              |
|------------------------------|----------------------|------------------------------|
| 8. $x^2 - 9 = 0$             | 9. $x^2 + 7 = 0$     | 10. $3x^2 = 0$               |
| 11. $3x^2 - 12 = 0$          | 12. $x^2 + 4 = 0$    | 13. $\frac{1}{3}x^2 - 3 = 0$ |
| 14. $\frac{1}{2}x^2 + 1 = 0$ | 15. $x^2 + 5 = 5$    | 16. $\frac{1}{4}x^2 - 1 = 0$ |
| 17. $x^2 + 25 = 0$           | 18. $x^2 - 10 = -10$ | 19. $2x^2 - 18 = 0$          |

Solve each equation by finding square roots. If the equation has no real-number solution, write *no solution*.

➡ See Problem 2.

- |                     |                      |                     |
|---------------------|----------------------|---------------------|
| 20. $n^2 = 81$      | 21. $a^2 = 324$      | 22. $k^2 - 196 = 0$ |
| 23. $r^2 + 49 = 49$ | 24. $w^2 - 36 = -64$ | 25. $4g^2 = 25$     |
| 26. $64b^2 = 16$    | 27. $5q^2 - 20 = 0$  | 28. $144 - p^2 = 0$ |
| 29. $2r^2 - 32 = 0$ | 30. $3a^2 + 12 = 0$  | 31. $5z^2 - 45 = 0$ |

Model each problem with a quadratic equation. Then solve. If necessary, round to the nearest tenth.

➡ See Problem 3.

32. Find the length of a side of a square with an area of  $169 \text{ m}^2$ .
33. Find the length of a side of a square with an area of  $75 \text{ ft}^2$ .
34. Find the radius of a circle with an area of  $90 \text{ cm}^2$ .
35. **Painting** You have enough paint to cover an area of  $50 \text{ ft}^2$ . What is the side length of the largest square that you could paint? Round your answer to the nearest tenth of a foot.
36. **Gardening** You have enough shrubs to cover an area of  $100 \text{ ft}^2$ . What is the radius of the largest circular region you can plant with these shrubs? Round your answer to the nearest tenth of a foot.



### Apply



**Mental Math** Tell how many solutions each equation has.

- |                 |                    |                      |
|-----------------|--------------------|----------------------|
| 37. $h^2 = -49$ | 38. $c^2 - 18 = 9$ | 39. $s^2 - 35 = -35$ |
|-----------------|--------------------|----------------------|



**40. Think About a Plan** A circular above-ground pool has a height of 52 in. and a volume of  $1100 \text{ ft}^3$ . What is the radius of the pool to the nearest tenth of a foot? Use the equation  $V = \pi r^2 h$ , where  $V$  is the volume,  $r$  is the radius, and  $h$  is the height.

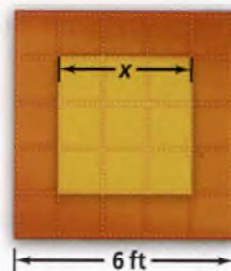
- How can drawing a diagram help you solve this problem?
- Do you need to convert any of the given measurements to different units?



**41. Reasoning** For what values of  $n$  will the equation  $x^2 = n$  have two solutions? Exactly one solution? No solution?



- 42. Quilting** You are making a square quilt with the design shown at the right. Find the side length  $x$  of the inner square that would make its area equal to 50% of the total area of the quilt. Round to the nearest tenth of a foot.

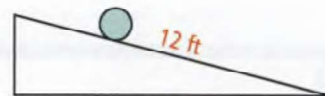


Solve each equation by finding square roots. If the equation has no real-number solution, write *no solution*. If a solution is irrational, round to the nearest tenth.

43.  $1.2z^2 - 7 = -34$       44.  $49p^2 - 16 = -7$       45.  $3m^2 - \frac{1}{12} = 0$   
 46.  $\frac{1}{2}t^2 - 4 = 0$       47.  $7y^2 + 0.12 = 1.24$       48.  $-\frac{1}{4}x^2 + 3 = 0$

49. Find the value of  $c$  such that the equation  $x^2 - c = 0$  has 12 and  $-12$  as solutions.

- STEM 50. Physics** The equation  $d = \frac{1}{2}at^2$  gives the distance  $d$  that an object starting at rest travels given acceleration  $a$  and time  $t$ . Suppose a ball rolls down the ramp shown at the right with acceleration  $a = 2 \text{ ft/s}^2$ . Find the time it will take the ball to roll from the top of the ramp to the bottom. Round to the nearest tenth of a second.

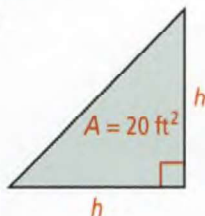


- 51. Error Analysis** Describe and correct the error made in solving the equation.  
**52. Open-Ended** Write and solve an equation in the form  $ax^2 + c = 0$ , where  $a \neq 0$ , that satisfies the given condition.  
 a. The equation has no solution.  
 b. The equation has exactly one solution.  
 c. The equation has two solutions.

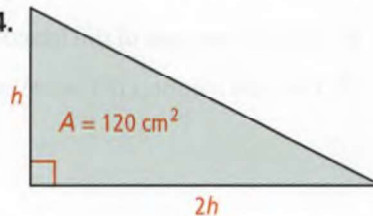
~~$x^2 + 100 = 0$~~   
 ~~$x^2 = 100$~~   
 ~~$x = \pm 10$~~

**Geometry** Find the value of  $h$  for each triangle. If necessary, round to the nearest tenth.

53.



54.



- 55.** You can use a spreadsheet like the one at the right to solve a quadratic equation.  
 a. What spreadsheet formula would you use to find the value in cell B2?  
 b. Use a spreadsheet to find the solutions of the quadratic equation  $6x^2 - 24 = 0$ . Explain how you used the spreadsheet to find the solutions.  
 c. **Reasoning** Suppose a quadratic equation has solutions that are not integers. How could you use a spreadsheet to approximate the solutions?

	A	B
1	$x$	$6x^2 - 24 = 0$
2	-3	
3	-2	
4	-1	
5	0	
6	1	
7	2	
8	3	