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9.3 Solving Quadratic Equations Using Square Roots

For use with Exploration 9.3

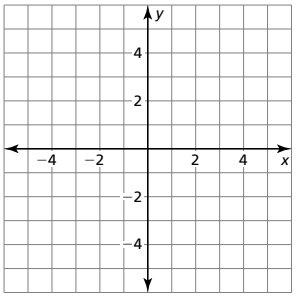
Essential Question How can you determine the number of solutions of a quadratic equation of the form $ax^2 + c = 0$?

1 EXPLORATION: The Number of Solutions of $ax^2 + c = 0$

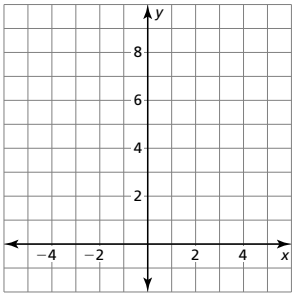
Go to *BigIdeasMath.com* for an interactive tool to investigate this exploration.

Work with a partner. Solve each equation by graphing. Explain how the number of solutions of $ax^2 + c = 0$ relates to the graph of $y = ax^2 + c$.

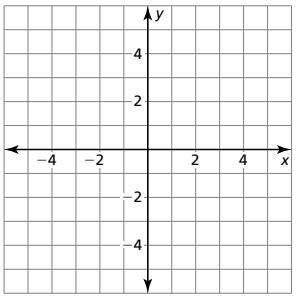
a. $x^2 - 4 = 0$



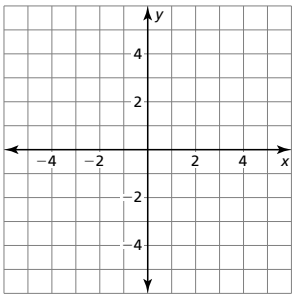
b. $2x^2 + 5 = 0$



c. $x^2 = 0$



d. $x^2 - 5 = 0$



2 EXPLORATION: Estimating Solutions

Work with a partner. Complete each table. Use the completed tables to estimate the solutions of $x^2 - 5 = 0$. Explain your reasoning.

a.

x	$x^2 - 5$
2.21	
2.22	
2.23	
2.24	
2.25	
2.26	

b.

x	$x^2 - 5$
–2.21	
–2.22	
–2.23	
–2.24	
–2.25	
–2.26	

9.3 Solving Quadratic Equations Using Square Roots (continued)

3 EXPLORATION: Using Technology to Estimate Solutions

Work with a partner. Two equations are equivalent when they have the same solutions.

a. Are the equations $x^2 - 5 = 0$ and $x^2 = 5$ equivalent? Explain your reasoning.

b. Use the square root key on a calculator to estimate the solutions of $x^2 - 5 = 0$. Describe the accuracy of your estimates in Exploration 2.

c. Write the exact solutions of $x^2 - 5 = 0$.

Communicate Your Answer

4. How can you determine the number of solutions of a quadratic equation of the form $ax^2 + c = 0$?

5. Write the exact solutions of each equation. Then use a calculator to estimate the solutions.

a. $x^2 - 2 = 0$

b. $3x^2 - 18 = 0$

c. $x^2 = 8$

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9.3 Practice
For use after Lesson 9.3

Core Concepts

Solutions of $x^2 = d$

- When $d > 0, x^2 = d$ has two real solutions, $x = \pm\sqrt{d}$.
- When $d = 0, x^2 = d$ has one real solution, $x = 0$.
- When $d < 0, x^2 = d$ has no real solutions.

Notes:

Worked-Out Examples

Example #1

Determine the number of real solutions of the equation. Then solve the equation using square roots.

$x^2 = -36$

Because $d = -36 < 0$, $x^2 = -36$ has no real solutions.

Example #2

Solve the equation using square roots.

$$4x^2 + 10 = 11$$
$$\underline{-10} \quad \underline{-10}$$
$$4x^2 = 1$$
$$\frac{4x^2}{4} = \frac{1}{4}$$
$$x^2 = \frac{1}{4}$$
$$\sqrt{x^2} = \sqrt{\frac{1}{4}}$$
$$x = \pm\frac{1}{2}$$

The solutions are $x = \frac{1}{2}$ and $x = -\frac{1}{2}$.

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9.3 **Practice (continued)**

Practice A

In Exercises 1–18, solve the equation using square roots.

1. $x^2 + 49 = 0$

2. $x^2 - 25 = 0$

3. $x^2 + 6 = 6$

4. $2x^2 + 84 = 0$

5. $2x^2 - 72 = 0$

6. $-x^2 - 12 = -12$

7. $8x^2 - 49 = 151$

8. $-3x^2 + 16 = -11$

9. $81x^2 - 49 = -24$

10. $16x^2 - 1 = 0$

11. $25x^2 + 9 = 0$

12. $16 - 2x^2 = 16$

13. $(x - 4)^2 = 0$

14. $(x + 2)^2 = 196$

15. $(2x + 7)^2 = 49$

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9.3 Practice (continued)

16. $16(x - 3)^2 = 25$ **17.** $81(3x + 1)^2 = 49$ **18.** $(4x - 3)^2 = 64$

In Exercises 19–24, solve the equation using square roots. Round your solutions to the nearest hundredth.

19. $x^2 + 6 = 8$ **20.** $x^2 - 12 = 3$ **21.** $x^2 + 25 = 49$

22. $3x^2 - 4 = 14$ **23.** $6x^2 + 5 = 20$ **24.** $20 - 4x^2 = 18$

25. A ball is dropped from a window at a height of 81 feet. The function $h = -16x^2 + 81$ represents the height (in feet) of the ball after x seconds. How long does it take for the ball to hit the ground?

26. The volume of a cone with height h and radius r is given by the formula $V = \frac{1}{3}\pi r^2 h$. Solve the formula for r. Then find the radius of a cone with volume 27π cubic inches and height 4 inches.

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Practice B

In Exercises 1–3, determine the number of real solutions of the equation. Then solve the equation using square roots.

1. $x^2 = 121$ **2.** $x^2 = -15$ **3.** $x^2 = 196$

In Exercises 4–12, solve the equation using square roots.

4. $x^2 + 9 = 0$ **5.** $4x^2 - 16 = 0$ **6.** $-2x^2 + 10 = 10$

7. $5x^2 - 21 = 24$ **8.** $9x^2 + 7 = 8$ **9.** $4x^2 - 38 = 43$

10. $(x + 5)^2 = 49$ **11.** $(4x - 3)^2 = 25$ **12.** $25(x - 1)^2 = 49$

In Exercises 13–15, solve the equation using square roots. Round your solutions to the nearest hundredth.

13. $2x^2 + 7 = 21$ **14.** $-16 = 8 - 3x^2$ **15.** $5 = 9x^2 - 6$

16. Describe and correct the error in solving the equation $x^2 + 25 = 9$ using square roots.

$$\begin{aligned} x^2 + 25 &= 9 \\ x^2 &= -16 \\ x &= \pm 4 \end{aligned}$$

17. A can of juice has a height of 10 inches and a volume of 160π cubic inches. The volume of a can with radius r is given by the formula $V = \pi r^2 h$.

a. Write an equation describing this situation, where r is the radius of the can.

b. Find the radius of the can.

18. Solve each equation without graphing.

a. $x^2 + 6x + 9 = 25$

b. $x^2 - 10x + 25 = 49$

c. $x^2 - 1 = 24$