

We will solve simple radical equations.

CFU

What are we going to learn?

Activate Prior Knowledge

Inverse operations are operations that undo each other.

Solve simple quadratic equations.

$$1. \sqrt{x^2} = \sqrt{81}$$

$$x = 9$$

$$2. \sqrt{x^2} = \sqrt{49}$$

$$x = 7$$


Inverse Operations

$$x^2 \text{ and } \sqrt{x}$$
Make Connection

Students, you already know the inverse operation of squaring is taking the square root. Now, we will use the inverse operation of squaring and taking the square root to solve simple radical equations.

A **radical equation** is an equation where a variable is inside a radical sign.

An **extraneous solution** of an equation is a **derived¹ solution** which does not satisfy the equation.

- To **check for extraneous solutions, substitute** each derived solution into the equation to see if it satisfies the equation.
- An extraneous solution can occur in solving a radical equation when there is a variable outside of the radical sign.

Solving Radical Equations

$$\sqrt{-x - 2} = x + 2$$

$$(\sqrt{-x - 2})^2 = (x + 2)^2$$

Square both sides of the equation

$$-x - 2 = x^2 + 4x + 4$$

Solve the quadratic equation

$$0 = x^2 + 5x + 6$$

$$0 = (x + 2)(x + 3)$$

$$x = -2 \text{ or } x = -3$$

Derived solutions

Check each derived solution:

$$\sqrt{-(-2) - 2} = (-2) + 2$$

$$0 = 0 \quad \text{True}$$

$x = -2$ is a solution.

$$\sqrt{-(-3) - 2} = (-3) + 2$$

$$1 = -1 \quad \text{False}$$

$x = -3$ is an extraneous solution.

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Which of the following are radical equations? How do you know?

1. $\sqrt{x} = 14$ radical
2. $x^2 - 2x = 4$
3. $x - 11 = \sqrt{49} + 5$
4. $\sqrt{7 + x} = x + 2$ radical

In solving the equation $\sqrt{-x + 5} = x + 1$, the derived solutions are $x = -4$ and $x = 1$. Determine which is an extraneous solution and which is an actual solution. Explain.

- $x = -4$ is an extraneous solution
- $x = 1$ is an actual solution

Vocabulary

¹ obtained from a sequence of steps

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- 3 Solve for the variable. Hint: Solving will be different for linear and quadratic expressions.
- 4 Check for extraneous solutions by substituting each derived solution into the equation.

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- 1 How did I/you isolate the square root onto one side of the equation?
- 3 How did I/you solve for the variable?
- 4 How did I/you check for extraneous solutions?

$$1. (\sqrt{x})^2 = (12)^2$$

$$x = 144$$

Check

$$\sqrt{144} = 12$$

$$12 = 12$$

$$2. (\sqrt{x})^2 = (9)^2$$

$$x = 81$$

Check

$$\sqrt{81} = 9$$

$$9 = 9$$

Vocabulary

² get by itself

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$$3. (\sqrt{x - 3})^2 = (9)^2$$

$$x - 3 = 81$$

$$x = 84$$

Check

$$\sqrt{84 - 3} = 9$$

$$\sqrt{81} = 9$$

$$9 = 9$$

$$4. (\sqrt{x + 7})^2 = (6)^2$$

$$x + 7 = 36$$

$$x = 29$$

Check

$$\sqrt{29 + 7} = 6$$

$$\sqrt{36} = 6$$

$$6 = 6$$

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- 4 How did I/you check for extraneous solutions?

$$5. \quad \sqrt{5 + x} + 3 = 13$$

$$(\sqrt{5 + x})^2 = (10)^2$$

$$5 + x = 100$$

$$x = 95$$

Check

$$\sqrt{5 + 95} + 3 = 13$$

$$\sqrt{100} + 3 = 13$$

$$13 = 13$$

$$6. \quad \sqrt{x - 7} + 11 = 19$$

$$(\sqrt{x - 7})^2 = (8)^2$$

$$x - 7 = 36$$

$$x = 43$$

Check

$$\sqrt{43 - 7} + 11 = 19$$

$$\sqrt{36} + 11 = 19$$

$$19 = 19$$

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7. $(\sqrt{3x + 13})^2 = (x - 5)^2$

$$3x + 13 = x^2 - 10x + 25$$

$$0 = x^2 - 13x + 12$$

$$0 = (x - 12)(x - 1)$$

$$x = 12 \text{ or } \cancel{x = 1}$$

Check

$$\sqrt{3(12) + 13} = 12 - 5$$

$$\sqrt{49} = 7$$

$$7 = 7$$

$$\sqrt{3(1) + 13} = 1 - 5$$

$$\sqrt{16} = -4$$

$$4 = -4$$

False, $x = 1$ is an extraneous solution.

8. $(\sqrt{x + 2})^2 = (x - 4)^2$

$$x + 2 = x^2 - 8x + 16$$

$$0 = x^2 - 9x + 14$$

$$0 = (x - 2)(x - 7)$$

$$\cancel{x = 2} \text{ or } x = 7$$

Check

$$\sqrt{2 + 2} = 2 - 4$$

$$\sqrt{4} = -2$$

$$2 = -2$$

False, $x = 2$ is an extraneous solution.

$$\sqrt{7 + 2} = 7 - 4$$

$$\sqrt{9} = 3$$

$$3 = 3$$

Solving Math Problems

- 1 Determine what the question is asking.**
- 2 Determine the math concept required.**
- 3 Determine relevant information.**
- 4 Solve the problem, then interpret the answer.**
- 5 Check the reasonableness of your answer.**

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- 1** How did I/you determine what the question is asking?
- 2** How did I/you determine the math concept required?
- 3** How did I/you determine the relevant information?
- 4** How did I/you solve and interpret the problem?
- 5** How did I/you check the reasonableness of the answer?

Identify all the radical equations where extraneous solutions occur when solving. Solve to confirm whether extraneous solutions exist or not.

$$\sqrt{x + 14} = 7$$

$$\sqrt{2x + 5} = x - 5$$

$$\sqrt{4x} = 6$$

$$\sqrt{x - 1} = x - 7$$

$$\sqrt{x - 2} = 12$$

$$\sqrt{2x - 7} + 4 = 13$$

$$\sqrt{x - 5} + 3 = 14$$

$$\sqrt{3x + 13} = x + 5$$

$$\sqrt{3x - 2} + 4 = x$$

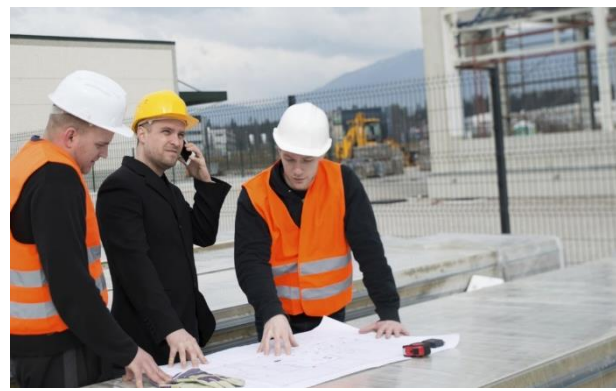
This equation does not have extraneous solutions.

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1 Solving simple radical equations will help you in an engineering career.



Engineers use the radical function $v = \sqrt{2 \cdot 9.8 h}$ to calculate the velocity of an object dropped from a certain height.

2 Solving simple radical equations will help you do well on a test.

9 i ...

Six radical equations are shown.
Select all the equations that have integer solutions.

$\sqrt{64} = x - 3$	$\sqrt{39} - 3 = x$
$x - \sqrt{5} = \sqrt{20}$	$\sqrt{3x} = 75$
$\sqrt{x} = \frac{\sqrt{16}}{8}$	$2x = \sqrt{100}$

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Does anyone else have another reason why it is relevant to solve simple radical equations? (Pair-Share) Why is it relevant to solve simple radical equations? You may give one of my reasons or one of your own. Which reason is more relevant to you? Why?

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Skill Closure

Solve simple radical equations.

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$$1. (\sqrt{x})^2 = (11)^2$$

$$x = 121$$

Check

$$\sqrt{121} = 11$$

$$11 = 11$$

$$2. (\sqrt{x+7})^2 = (5)^2$$

$$x + 7 = 25$$

$$x = 18$$

Check

$$\sqrt{18+7} = 5$$

$$\sqrt{25} = 5$$

$$5 = 5$$

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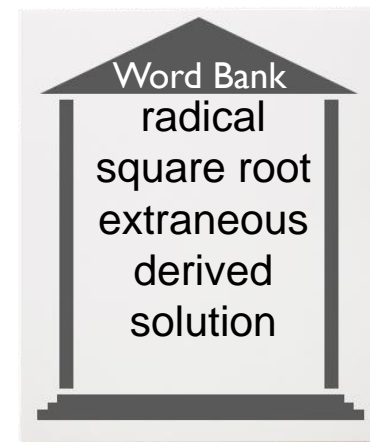
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Julie is solving the radical equation $\sqrt{x + 7} = x + 5$. Her solutions to the equation are $x = -3$ and $x = -6$. Determine whether she is correct. If incorrect, explain her mistake.

$x = -3$ is a solution but $x = -6$ is an extraneous solution. Julie did not check for extraneous solutions.

Summary Closure

What did you learn today about solving simple radical equations? (Pair-Share)
Use words from the word bank.



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1. $(\sqrt{x})^2 = (10)^2$

$x = 100$

Check

$\sqrt{100} = 10$

$10 = 10$

2. $(\sqrt{x})^2 = (-7)^2$

$x = 49$

Check

$\sqrt{49} = -7$

$7 = -7$ False, there is no solution.

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$$3. \quad (\sqrt{4 + x})^2 = (8)^2$$

$$4 + x = 64$$

$$x = 60$$

Check

$$\sqrt{4 + 60} = 8$$

$$\sqrt{64} = 8$$

$$8 = 8$$

$$4. \quad \sqrt{x + 1} + 17 = 6$$

$$(\sqrt{x + 1})^2 = (-11)^2$$

$$x + 1 = 121$$

$$x = 120$$

Check

$$\sqrt{120 + 1} + 17 = 6$$

$$\sqrt{121} + 17 = 6$$

$$28 = 6 \quad \text{False, there is no solution.}$$

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$$5. \quad \sqrt{x - 11} + 8 = 13$$

$$(\sqrt{x - 11})^2 = (5)^2$$

$$x - 11 = 25$$

$$x = 36$$

Check

$$\sqrt{36 - 11} + 8 = 13$$

$$\sqrt{25} + 8 = 13$$

$$13 = 13$$

$$6. \quad (\sqrt{x - 4})^2 = (x - 6)^2$$

$$x - 4 = x^2 - 12x + 36$$

$$0 = x^2 - 13x + 40$$

$$0 = (x - 5)(x - 8)$$

$$~~x = 5~~ \text{ or } x = 8$$

Check

$$\sqrt{5 - 4} = 5 - 6$$

$$\sqrt{1} = -1$$

$$1 = -1$$

False, $x = 5$ is an extraneous solution.

$$\sqrt{8 - 4} = 8 - 6$$

$$\sqrt{4} = 2$$

$$2 = 2$$

Solve simple radical equations.

1. $\sqrt{x} = 8$

$x = 64$

2. $\sqrt{9 + x} = 4$

$x = 5$

3. $\sqrt{x} = -13$

No Solution

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Create two radical equations with one solution. Then solve each equation to confirm there only exists one solution for each.

Answers will vary. However, a correct answer will have equations where there is not an additional variable outside the radical sign, and when the radical is isolated, the other side is a positive constant.

Solve simple radical equations.

1. $\sqrt{x} - 7 = 3$

$x = 100$

2. $\sqrt{-5 + x} = 8$

$x = 69$

3. $\sqrt{3x - 8} + 13 = 17$

$x = 8$

Access Common Core

Create two radical equations with no solutions. Then solve each equation to confirm solutions do not exist.

Answers will vary. However, a correct answer will have equations where when the radical is isolated, there is a negative number on the other side of the equation.

Solve simple radical equations.

1. $\sqrt{x} + 17 = 8$

No Solution

2. $\sqrt{7 + x} - 3 = 5$

 $x = 57$

3. $\sqrt{3x - 2} + 4 = x$

 $x = 9$ **Access Common Core**

Create two radical equations where extraneous solutions may occur. Then solve each equation to confirm whether there are extraneous solutions.

Answers will vary. However, a correct answer will have equations which have an additional variable outside of the radical.