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## Solving Radical Equations

A **radical equation** is an equation that has a variable in a radicand. You can often solve a radical equation by getting the radical by itself on one side of the equation. Then you square both sides. Remember that the expression under a radical must be nonnegative.

$$\text{When } x \geq 0, (\sqrt{x})^2 = x.$$

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## 1 EXAMPLE Solving by Isolating the Radical

Solve each equation. Check your solution.

a.  $\sqrt{x} - 3 = 4$

1 Solve each equation. Check your solution.

a.  $\sqrt{x} + 7 = 12$

b.  $\sqrt{a} - 4 = 5$

c.  $\sqrt{c - 2} = 6$

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## Real-World Connection

When the roller coaster cars are upside down, the riders and the cars fall at the same rate and stay together.

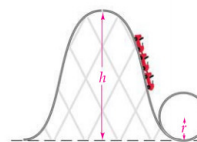
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## 2 EXAMPLE Real-World Problem Solving

**Designing a Ride** On a roller coaster ride, your speed in a loop depends on the height of the hill you have just come down and the radius of the loop in feet. The equation  $v = 8\sqrt{h - 2r}$  gives the velocity  $v$  in feet per second of a car at the top of the loop.

Suppose the loop has a radius of 18 ft. You want the car to have a velocity of 30 ft/s at the top of the loop. How high should the hill be?

Solve  $v = 8\sqrt{h - 2r}$  for  $h$  when  $v = 30$  and  $r = 18$ .



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- 2 a. Find the height of the hill when the velocity at the top of the loop is 35 ft/s, and the radius of the loop is 24 ft.

$$v = 8\sqrt{h - 2r}$$



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## 3 EXAMPLE Solving With Radical Expressions on Both Sides

**Gridded Response** Solve  $\sqrt{3n - 2} = \sqrt{n + 6}$ .

- 3 Solve  $\sqrt{3r + 4} = \sqrt{5r - 6}$ . Check your answer.

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### Solving Equations With Extraneous Solutions

When you solve an equation by squaring each side, you create a new equation. This new equation may have solutions that do not solve the original equation.

Original equation	Square of each side	New equation	Solutions of new equation
$x = 2$	$\longrightarrow$	$(x)^2 = (2)^2 \longrightarrow x^2 = 4$	$\longrightarrow 2, -2$

In the example above,  $-2$  does not satisfy the original equation. It is an extraneous solution. An **extraneous solution** is a solution that does not satisfy the original equation. Be sure to check all solutions in the original equation to determine whether a solution is extraneous.

### 4 EXAMPLE Identifying Extraneous Solutions

Solve  $x = \sqrt{x + 6}$ .

b. Solve  $y = \sqrt{y + 2}$ . Check your solutions.

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It is possible that the only solution you get after squaring both sides of an equation is extraneous. In that case, the original equation has no solution.

### 5 EXAMPLE No Solution

Solve  $\sqrt{2x} + 6 = 4$ .

5 Solve  $8 - \sqrt{2n} = 20$ . Check your solution.

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