

Lesson 8-2

# Solving Two-Step Equations



**ISG** Interactive Study Guide

See pages 171–172 for:

- Getting Started
- Real-World Link
- Notes

**e** Essential Question

How are equations and inequalities used to describe and solve multi-step problems?

**CCSS** Common Core State Standards

Content Standards  
7.EE.4, 7.EE.4a, 8.EE.7, 8.EE.7b

Mathematical Practices  
1, 3, 4, 7

**Vocab** Vocabulary  
two-step equation

*COEFFICIENT* ↓  
*CONSTANT* ↓  
 $5x - 5 = 15$

1b.  $4x + 5 = -33$   
 $\quad \quad \quad +5 \quad \quad +5$   
 $\frac{4x}{4} = \frac{-28}{4}$   
 $x = -7$

$4(-7) - 5 = -33$   
 $28 - 5$   
 $23 \neq -33$

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**What You'll Learn**

- Solve two-step equations.
- Solve real-world problems involving two-step equations.

**Real-World Link**

**Cheerleading** Cheerleaders on a middle school squad must purchase cheer shoes for \$35, plus several pairs of white ankle socks. An equation involving two operations can be used to find the total cost.

## Solve Two-Step Equations

A **two-step equation** contains two operations. To solve a two-step equation, use inverse operations to undo each operation in reverse order of the order of operations.

### Example 1

Solve  $3a + 9 = 33$ . Check your solution.

**Method 1** The Vertical Method

$$\begin{array}{r} 3a + 9 = 33 \\ 3a + 9 = 33 \\ -9 = -9 \\ \hline 3a = 24 \\ \frac{3a}{3} = \frac{24}{3} \\ a = 8 \end{array}$$

Write the equation.

Subtraction Property of Equality

Simplify.

Division Property of Equality

Simplify.

*COEFFICIENT* ↓  
*CONSTANT* ↓  
 $3a + 9 = 33$   
*VARIABLE* ↑

**Method 2** The Horizontal Method

$$\begin{array}{r} 3a + 9 = 33 \\ 3a + 9 - 9 = 33 - 9 \\ 3a = 24 \\ \frac{3a}{3} = \frac{24}{3} \\ a = 8 \end{array}$$

Write the equation.

Subtraction Property of Equality

Simplify.

Division Property of Equality

Simplify.

$\frac{3a + 9 = 33}{3} = \frac{33}{3}$   
 $a + 3 = 11$   
 $\quad \quad \quad -3 \quad \quad -3$   
 $a = 8$

Using either method, the solution is 8.

**Check**

$$\begin{array}{r} 3a + 9 = 33 \\ 3(8) + 9 \stackrel{?}{=} 33 \\ 24 + 9 \stackrel{?}{=} 33 \\ 33 = 33 \checkmark \end{array}$$

Write the equation.

Replace  $a$  with 8.

Multiply.

The sentence is true.

**Got It?** Do these problems to find out.

Solve each equation. Check your solution.

1a.  $6x + 1 = 25$

$$\begin{array}{r} 6x + 1 = 25 \\ -1 \quad -1 \\ \hline 6x = 24 \\ \frac{6x}{6} = \frac{24}{6} \\ x = 4 \end{array}$$

$6(4) + 1 = 25$   
 $24 + 1 = 25$

1b.  $4x - 5 = -33$



### Example 2

Solve  $\frac{1}{5}p - 12 = 20$ .

$$\frac{1}{5}p - 12 = 20$$

Write the equation.

$$\frac{1}{5}p - 12 + 12 = 20 + 12$$

Addition Property of Equality

$$\frac{1}{5}p = 32$$

Simplify.

$$\frac{5}{1} \cdot \frac{1}{5}p = 5 \cdot 32$$

Multiplication Property of Equality

$$p = 160$$

Simplify. Check your solution.

#### Properties of Equality

Recall that the Addition and Subtraction Properties of Equality state that the same number can be added to or subtracted from each side of an equation.

**Got It?** Do these problems to find out.

2a.  $8 = 15 + \frac{1}{3}n$

2b.  $-\frac{1}{6}x - 3 = 2$

2a.  $8 = 15 + \frac{1}{3}n$

$$-15 \quad -15$$

$$3(-1) = 3\left(\frac{1}{3}n\right)$$

$$-21 = n$$

$$8 = 15 + \frac{1}{3}(-21)$$

$$8 = 15 + -7$$

$$8 = 8$$

### Example 3

Solve  $9 - t = -34$ .

$$9 - t = -34$$

Write the equation.

$$9 - 1t = -34$$

Identity Property:  $t = 1t$

$$9 + (-1t) = -34$$

Definition of Subtraction

$$-9 + 9 + (-1t) = -9 + (-34)$$

Addition Property of Equality

$$-1t = -43$$

Simplify.

$$\frac{-1t}{-1} = \frac{-43}{-1}$$

Division Property of Equality

$$t = 43$$

Simplify. Check your solution.



2b.  $-\frac{1}{6}x - 3 = 2$

$$+3 \quad +3$$

$$-6\left(-\frac{1}{6}x\right) = 5(-6)$$

$$x = -30$$

$$-\frac{1}{6}(-30) - 3 = 2$$

$$5 - 3 = 2$$

**Got It?** Do these problems to find out.

3a.  $-15 - b = 44$

3b.  $-6.5 = -4.3 - n$

### Example 4

Solve  $2x + x - 27 = 3$ .

$$2x + x - 27 = 3$$

Write the equation.

$$2x + 1x - 27 = 3$$

Identity Property;  $x = 1x$

$$3x - 27 = 3$$

Distributive Property;  $2x + 1x = (2 + 1)x$  or  $3x$

$$3x - 27 + 27 = 3 + 27$$

Addition Property of Equality

$$3x = 30$$

Simplify.

$$\frac{3x}{3} = \frac{30}{3}$$

Division Property of Equality

$$x = 10$$

Simplify. Check your solution.

3a.  $-15 - b = 44$

$$+15 \quad +15$$

$$-1(-b) = 59(-1)$$

$$b = -59$$

$$-15 - (-59) = 44$$

$$-15 + 59 = 44$$

$$44 = 44$$

**Got It?** Do these problems to find out.

4a.  $4 - 9c + 3c = 58$

4b.  $3.4 = 0.4m - 2 + 0.2m$

#### Distributive Property

You use the Distributive Property to mentally simplify  $2x + x$ .

$$2x + 1x = (2 + 1)x = 3x$$