

# Algebra 1A

## Lesson 3.4

### Solve Equations with Variables on Both Sides

#### Warm-Up

Solve.

(a)  $\frac{a}{4} + 6 = -3$   
 $\quad -6 \quad -6$

$$\frac{a}{4} = -9$$

$$a = -36$$

(b)  $-25 = -3y - 2y$

$$\frac{-25}{-5} = \frac{-5y}{-5}$$

$$5 = y$$

$$y = 5$$

(c)  $2m - 6 + 4m = 12$

$$6m - 6 = 12$$

$$\quad +6 \quad +6$$

$$6m = 18$$

$$\quad \frac{6}{6} \quad \frac{6}{6}$$

$$m = 3$$

(d)  $6x + 5(x - 1) = 11$

$$6x - 5x + 5 = 11$$

$$1x + 5 = 11$$

$$\quad -5 \quad -5$$

$$x = 6$$

#### Steps for Solving

1. Use the Distributive Property to get rid of grouping symbols
2. Simplify on each side of the equal side (combine like terms)
3. Collect all variables on one side and all constants on the other side
4. Use OPPOSITE operations in the OPPOSITE order
5. Give your answer as an  $x =$  (or  $y =$ ,  $t =$ , etc.)

#### Example 1. Solve an Equation with Variables on Both Sides

Solve.

(a)  $13 + 5x = 2x - 8$

$$\quad -2x \quad -2x$$

$$13 + 3x = -8$$

$$\quad -13 \quad -13$$

$$\frac{3x}{3} = \frac{-21}{3}$$

$$x = -7$$

(b)  $24 - 3m = 5m$

$$\quad +3m \quad +3m$$

$$24 = 8m$$

$$\quad \frac{8}{8} \quad \frac{8}{8}$$

$$3 = m$$

$$m = 3$$

#### Example 2. Solve an Equation with Grouping Symbols

Solve.

(a)  $5z - 2 = 2(3z - 4)$

$$5z - 2 = 6z - 8$$

$$\quad -6z \quad -6z$$

$$-1z - 2 = -8$$

$$\quad +2 \quad +2$$

$$-1z = -6$$

$$\quad \frac{-1}{-1} \quad \frac{-6}{-1}$$

$$z = 6$$

(b)  $4x - 5 = \frac{1}{5}(5x + 20)$

$$4x - 5 = 1x + 4$$

$$\quad -1x \quad -1x$$

$$3x - 5 = 4$$

$$\quad +5 \quad +5$$

$$3x = 9$$

$$\quad \frac{3}{3} \quad \frac{9}{3}$$

$$x = 3$$

**Try It!**

Solve.

(a)  $8t + 5 = 6t + 1$

$$\begin{array}{r} -6t \quad -6t \\ \hline 2t + 5 = 1 \end{array}$$

$$\begin{array}{r} -5 \quad -5 \\ \hline 2t = -4 \end{array}$$

$$\begin{array}{r} \frac{2t}{2} = \frac{-4}{2} \\ \hline t = -2 \end{array}$$

$$t = -2$$

(b)  $3 - 4a = 5(a - 3)$

$$\begin{array}{r} 3 - 4a = 5a - 15 \\ +4a \quad +4a \\ \hline 3 = 9a - 15 \end{array}$$

$$\begin{array}{r} +15 \quad +15 \\ \hline 18 = 9a \end{array}$$

$$\frac{18}{9} = \frac{9a}{9}$$

$$2 = a$$

$$a = 2$$

(c)  $8y - 6 = \frac{2}{3}(6y + 15)$

$$8y - 6 = \frac{12y}{3} + \frac{30}{3}$$

$$8y - 6 = 4y + 10$$

$$\begin{array}{r} -4y \quad -4y \\ \hline 4y - 6 = 10 \end{array}$$

$$\begin{array}{r} +6 \quad +6 \\ \hline 4y = 16 \end{array}$$

$$\frac{4y}{4} = \frac{16}{4}$$

$$y = 4$$

**Example 4. Identify the Number of Solutions**

Solve.

(a)  $5x - 6 = 5(x - 1)$

$$5x - 6 = 5x - 5$$

$$\begin{array}{r} -5x \quad -5x \\ \hline -6 = -5 \end{array}$$

$$-6 = -5 \text{ FALSE}$$

$$\text{NO SOLUTION}$$

(b)  $4(3x + 2) = 2(6x + 4)$

$$12x + 8 = 12x + 8$$

$$0 = 0$$

$$\text{ALL REAL NUMBERS (IDENTITY)}$$
**Try It!**Solve if possible. Answer with: the value of the solution, **all real numbers** or **no solution**.

(a)  $5(1 + 4m) = 2(3 + 10m)$

$$5 + 20m = 6 + 20m$$

$$\begin{array}{r} -20m \quad -20m \\ \hline 5 = 6 \end{array}$$

$$5 = 6 \text{ FALSE}$$

$$\text{NO SOLUTION}$$

(b)  $3(2b + 2) = 2(3b + 3)$

$$6b + 6 = 6b + 6$$

$$0 = 0 \text{ TRUE}$$

$$\text{ALL REAL NUMBERS (IDENTITY)}$$

(c)  $7w + 1 = 8w + 1$

$$\begin{array}{r} -7w \quad -7w \\ \hline 1 = 1w + 1 \end{array}$$

$$\begin{array}{r} -1 \quad -1 \\ \hline 0 = w \end{array}$$

$$0 = w$$

$$w = 0$$

**Assignment:** Pages 157 - 158 (4 - 42) even**Review:**

1. A local computer center charges nonmembers \$5 per session to use the media center. If you pay a membership fee of \$25, you pay only \$3 per session. Write an equation that can help you decide whether to become a member. Then solve the equation and interpret the solution.
2. A rock-climbing gym charges nonmembers \$16 per day to use the gym and \$8 per day for equipment rental. Members pay a yearly fee of \$450 for unlimited climbing and \$6 per day for equipment rental. Write and solve an equation to find how many times you must use the gym to justify becoming a member.