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### 8.3 Solving Equations with Variables and Constants on Both Sides

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#### Solving Equations of the Form $ax + b = c$ ( $a \neq 0$ )

To solve equations in this form, we must undo the operations that are being done to the variable in reverse order from the order of operations. Since addition is done *after* multiplication in the order of operations, we undo the addition first and then undo the multiplication.

Follow these steps:

1. Subtract  $b$  from (or add the opposite of  $b$  to) both sides of the equation.
2. Divide by  $a$  (or multiply by  $\frac{1}{a}$ ) both sides of the equation.
3. Check your solution.

For example, consider

$$-3x + 2 = 14$$

1. **Subtract 2** from both sides of the equation:

$$\begin{array}{r} -3x + 2 = 14 \\ \underline{-2 \quad -2} \\ -3x + 0 = 12 \end{array}$$

2. **Divide** both sides of the equation by  $-3$ :

$$\begin{array}{r} \frac{-3x}{-3} = \frac{12}{-3} \\ x = -4 \end{array}$$

3. Check your solution:

$$\begin{array}{l} -3x + 2 = 14 \\ -3(-4) + 2 = 14? \\ 12 + 2 = 14 \end{array}$$

<i>Demonstration Problems</i>	<i>Practice Problems</i>
Solve each equation and check your answers.	Solve each equation and check your answer.
<b>1. (a)</b> $3r - 5 = 0$	<b>1. (b)</b> $4y - 1 = 0$
<b>2. (a)</b> $12 = 2.5a - 8$	<b>2. (b)</b> $10 = 1.6x - 2$
Answers: <b>1. (b)</b> $\frac{1}{4}$ ; <b>2. (b)</b> 7.5	

**Steps for solving linear equations in general:**

Example:

$$2(x + 8) - 1 = 2x + 5 - 5x$$

1. Simplify both sides, if necessary.  $\rightarrow 2x + 16 + -1 = 2x + 5 + -5x$
2. Add the opposite of the least amount of the variable to both sides of the equation.  $\rightarrow 2x + 15 = -3x + 5$   
 $\rightarrow \frac{+3x}{+3x} \quad \frac{+3x}{+3x}$
3. Isolate the variable, using steps from previous page.  $\rightarrow 5x + 15 = 0 + 5$   
 $\rightarrow \frac{-15}{-15} \quad \frac{-15}{-15}$   
 $5x = -10$   
 $\rightarrow \frac{5x}{5} = \frac{-10}{5}$   
 $x = -2$
4. Check your solution.

$$\begin{aligned}
 2(x + 8) - 1 &= 2x + 5 - 5x \\
 2(-2 + 8) - 1 &\stackrel{?}{=} 2(-2) + 5 - 5(-2) \\
 2(6) - 1 &\stackrel{?}{=} -4 + 5 + 10 \\
 12 - 1 &\stackrel{?}{=} -4 + 15 \\
 11 &= 11
 \end{aligned}$$

<i>Demonstration Problems</i>	<i>Practice Problems</i>
Solve and check. <b>3 (a)</b> $3(x - 5) - 4 = x + 1 - 8x$	Solve and check. <b>3 (b)</b> $4(x + 2) - 7 = 6x + 8 - 3x$
Check:	Check:

Answer: **3. (b)** 7

## Mixed Practice

<i>Demonstration Problems</i>	<i>Practice Problems</i>
Solve and check. <b>4. (a)</b> $3x - 3 = x + 5$	Solve and check. <b>4. (b)</b> $9y - 1 = 6y + 5$
Check:	Check:
<b>5. (a)</b> $2w = \frac{1}{3}$	<b>5. (b)</b> $3x = \frac{6}{11}$
Check:	Check:
<b>6. (a)</b> $6y = -1 + 4y$	<b>6. (b)</b> $10m = 2 + 2m$
Check:	Check:
Answers: <b>4. (b)</b> 2; <b>5. (b)</b> $\frac{2}{11}$ ; <b>6. (b)</b> $\frac{1}{4}$	



<i>Demonstration Problems</i>	<i>Practice Problems</i>
<p>Solve and check.</p> <p><b>9 (a)</b>     <math>2 - 3(m - 1) = 10 - (9m + 1)</math></p>          <p>Check:</p>	<p>Solve and check.</p> <p><b>9 (b)</b>     <math>3 - (x - 1) = 2(x + 1) - x</math></p>          <p>Check:</p>
Answer: <b>9. (b)</b> 1	