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**8.1 Solving Equations Using the Subtraction and Addition Properties of Equality**


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**Properties of Equality**
**The Addition Property of Equality**

 For any real number  $c$ , if  $a = b$ , then

$$a + c = b + c$$

**The Subtraction Property of Equality**

 For any real number  $c$ , if  $a = b$ , then

$$a - c = b - c$$

We can use these properties to *solve* (find the solutions to) equations. First, let's look at how we can use the addition property of equality. This property allows us to "undo" an addition or subtraction that has been done to the variable in an equation.

**Example (a) Solve  $x - 5 = 8$** 

By the addition property of equality,

$$\begin{aligned} x - 5 &= 8 \\ x - 5 + 5 &= 8 + 5 \\ x + 0 &= 13 \\ x &= 13 \end{aligned}$$

Alternatively, we can use the following notation:

$$\begin{array}{r} x - 5 = 8 \\ \quad \color{green}{5} \quad \color{green}{5} \\ \hline x + 0 = 13 \\ x = 13 \end{array}$$

 To check the solution, we replace  $x$  with  $13$  in the original equation.

$$\begin{aligned} x - 5 &= 8 \\ 13 - 5 &\stackrel{?}{=} 8 \\ 8 &= 8 \quad \checkmark \end{aligned}$$

 The solution set is  $\{13\}$ .

**Example (b) Solve  $x + 3 = 7$** 

 By the **subtraction property of equality**,

$$\begin{aligned} x + 3 &= 7 \\ x + 3 - 3 &= 7 - 3 \\ x + 0 &= 4 \\ x &= 4 \end{aligned}$$

Alternatively, we can use the following notation:

$$\begin{array}{r} x + 3 = 7 \\ \quad \color{green}{-3} \quad \color{green}{-3} \\ \hline x + 0 = 4 \\ x = 4 \end{array}$$

 To check the solution, we replace  $x$  with  $4$  in the original equation.

$$\begin{aligned} x + 3 &= 7 \\ 4 + 3 &\stackrel{?}{=} 7 \\ 7 &= 7 \quad \checkmark \end{aligned}$$

 The solution set notation for  $x + 3 = 7$  is  $\{4\}$ .

**Example (c) Solve**

$$1.3 = -2.4 + y$$

By the addition property of equality,

$$\begin{aligned} 1.3 &= -2.4 + y \\ 2.4 + 1.3 &= 2.4 + -2.4 + y \\ 3.7 &= 0 + y \\ 3.7 &= y \end{aligned}$$

Alternatively, we can use the following notation:

$$\begin{array}{r} 1.3 = -2.4 + y \\ \underline{2.4 \quad 2.4} \\ 3.7 = 0 + y \\ 3.7 = y \end{array}$$

To check the solution, we replace  $y$  with  $3.7$  in the original equation.

$$\begin{aligned} 1.3 &= -2.4 + y \\ 1.3 &= ? -2.4 + 3.7 \\ 1.3 &= 1.3 \quad \checkmark \end{aligned}$$

The solution set is  $\{3.7\}$ .

<i>Demonstration Problems</i>	<i>Practice Problems</i>
<p>Solve each equation and check your answer.</p> <p><b>1. (a)</b>      <math>w - \frac{1}{3} = \frac{1}{3}</math></p> <p><b>2. (a)</b>      <math>x + 4 = -6</math></p> <p><b>3 (a)</b>      <math>-13 = y - 9</math></p> <p><b>4. (a)</b>      <math>-8.2 = y - 2.1</math></p>	<p>Solve each equation and check your answer.</p> <p><b>1. (b)</b>      <math>a - \frac{1}{5} = \frac{1}{5}</math></p> <p><b>2. (b)</b>      <math>x + 7 = -14</math></p> <p><b>3. (b)</b>      <math>-10 = m - 2</math></p> <p><b>4. (b)</b>      <math>-13.3 = 10.7 + y</math></p>
<p>Answers: <b>1. (b)</b> <math>2/5</math>; <b>2. (b)</b> <math>-21</math>; <b>3. (b)</b> <math>-8</math>; <b>4. (b)</b> <math>-24</math></p>	