# Solve Two-Step Equations

## Vocabulary Start-Up

Recall that in mathematics, **properties** are statements that are true for any number.

**Complete the graphic organizer by matching the Property of Equality with the correct example.**

| | |
|---|---|
| Addition Property of Equality | $\frac{1}{2}x = 10$ <br> $2 \cdot \frac{1}{2}x = 10 \cdot 2$ |
| Division Property of Equality | $3x = 9$ <br> $\frac{3x}{3} = \frac{9}{3}$ |
| Multiplication Property of Equality | $x + 3 = 1$ <br> $x + 3 - 3 = 1 - 3$ |
| Subtraction Property of Equality | $x - 5 = 6$ <br> $x - 5 + 5 = 6 + 5$ |

## Real-World Link

A property in science is a t_____en
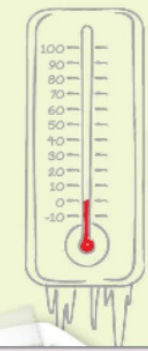
**Essential Question**

WHAT is equivalence?

**Vocabulary**

properties
two-step equation

**CCSS Common Core State Standards**

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

**MP Mathematical Practices**
1, 2, 3, 4

$$\frac{?}{3} = \frac{?}{3}$$

Multiplication Property of Equality

$$x + 3 = 1$$
$$x + 3 - 3 = 1 - 3$$

Subtraction Property of Equality

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

## Real-World Link

A property in science is a trait of matter that is always true under a given set of conditions. For example, pure water freezes at 0°C. How is the definition of *property* similar in science and math? **Sample answer:**

**In science, a property is always true for members of a group. In**

**math, a property is true for members of a group of numbers.**

### Which 🔴MP Mathematical Practices did you use?
### Shade the circle(s) that applies.

① Persevere with Problems      ⑤ Use Math Tools

② Reason Abstractly            ⑥ Attend to Precision

③ Construct an Argument        ⑦ Make Use of Structure

④ Model with Mathematics       ⑧ Use Repeated Reasoning

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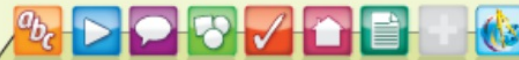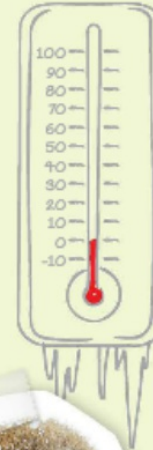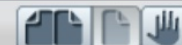
$$2x + 3 - 3 \quad = \quad 7 - 3$$

Separate the remaining tiles into 2 equal groups.

$$2x \quad = \quad 4$$

There are two 1-tiles in each group, so $x = 2$.

**Method 2**  Use symbols.

$2x + 3 = 7$    Write the equation.

$\underline{\quad -3 = -3}$    Subtraction Property of Equality

$2x \quad = 4$

$\dfrac{2x}{2} = \dfrac{4}{2}$    Division Property of Equality

$x = 2$    Simplify.

Using either method, the solution is 2.

Show your work

a. **6**

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

b. **−3**

a.  $3x + 2 = 20$      b.  $5 + 2n = -1$

## Example

**Tutor**

**3.** Solve $6 - 3x = 21$.

| | |
|---|---|
| $6 - 3x = 21$ | Write the equation. |
| $6 + (-3x) = 21$ | Rewrite the left side as addition. |
| $\underline{-6 \qquad\quad = -6}$ | Subtraction Property of Equality |
| $-3x = 15$ | Simplify. |
| $\dfrac{-3x}{-3} = \dfrac{15}{-3}$ | Division Property of Equality |
| $x = -5$ | Simplify. |

The solution is $-5$.

| | | |
|---|---|---|
| **Check** | $6 - 3x = 21$ | Write the equation. |
| | $6 - 3(-5) \stackrel{?}{=} 21$ | Replace $x$ with $-5$. |
| | $6 - (-15) \stackrel{?}{=} 21$ | Multiply. |
| | $6 + 15 \stackrel{?}{=} 21$ | To subtract a negative number, add its opposite. |
| | $21 = 21 \checkmark$ | The sentence is true. |

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

**e.** $10 - \dfrac{2}{3}p = 52$  **f.** $-19 = -3x + 2$  **g.** $\dfrac{n}{-3} - 2 = -18$

**Common Error**

A common mistake when solving the equation in Example 3 is to divide each side by 3 instead of $-3$. Since $6 - 3x = 6 + (-3x)$, the coefficient is $-3$.

e. $\underline{-63}$

f. $\underline{7}$

g. $\underline{48}$

## Guided Practice

**Solve each equation. Check your solution.** (Examples 1–3)

**1.** $6x + 5 = 29$  **4**

**2.** $3 - 5y = -37$  **8**

**3.** $\frac{2}{3}x - 5 = 7$  **18**

*Show your work.*

**4.** Cassidy went to the movies with some of her friends. The tickets cost $6.50 each, and they spent $17.50 on snacks. The total amount paid was $63.00. Solve the equation $63 = 6.50p + 17.50$ to determine how many people went to the movies. (Example 4)

**7 people**

**5.** **Building on the Essential Question** How can you use the *work backward* problem-solving strategy to solve a two-step equation?

**Sample answer: You identify the order in which operations would be performed on the variable, then you undo each operation using its inverse operation in reverse order.**

**Rate Yourself!**

How confident are you about solving equations? Check the box square that applies.
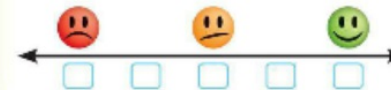
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Tutor

Name _____ My Homework _____

## Independent Practice

eHelp

**Solve each equation. Check your solution.** (Examples 1–3)

**1.** $5 = 4a - 7$  **3**

**2.** $16 = 5x - 9$  **5**

**3.** $3 - 8c = 35$  **−4**

Show your work.

**4.** $-\frac{1}{2}x - 7 = -11$  **8**

**5.** $15 - \frac{w}{4} = 28$  **−52**

**6.** $-3 - 6x = 9$  **−2**

**7.** Larina received a $50 gift card to an online store. She wants to purchase some bracelets that cost $8 each. There will be a $10 overnight delivery fee. Solve $8n + 10 = 50$ to find the number of bracelets she can purchase. (Example 4) _**5 bracelets**_____

**8.** LaTasha paid $75 to join a summer golf program. The course where she plays charges $30 per round. Since she is a student, she receives a $10 discount per round.

some bracelets that cost $8 each. There will be a $10 overnight delivery fee. Solve $8n + 10 = 50$ to find the number of bracelets she can purchase. (Example 4) __**5 bracelets**__

8. LaTasha paid $75 to join a summer golf program. The course where she plays charges $30 per round. Since she is a student, she receives a $10 discount per round. If LaTasha spent $375, use the equation $375 = 20g + 75$ to find how many rounds of golf LaTasha played.

(Example 4) __**15 rounds**__

**Copy and Solve** Solve each equation. Show your work on a separate piece of paper.
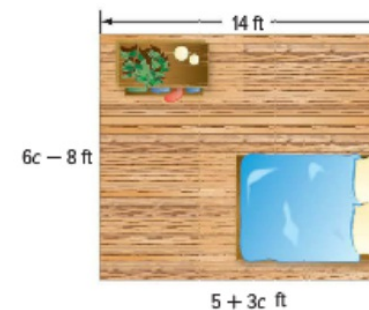
9. $\dfrac{a-4}{5} = 12$  **64**

10. $\dfrac{n+3}{8} = -4$  **−35**

11. $\dfrac{6+z}{10} = -2$  **−26**

12. **MP Reason Abstractly** If Mr. Arenth wants to put new carpeting in the room shown, how many square feet should he order?
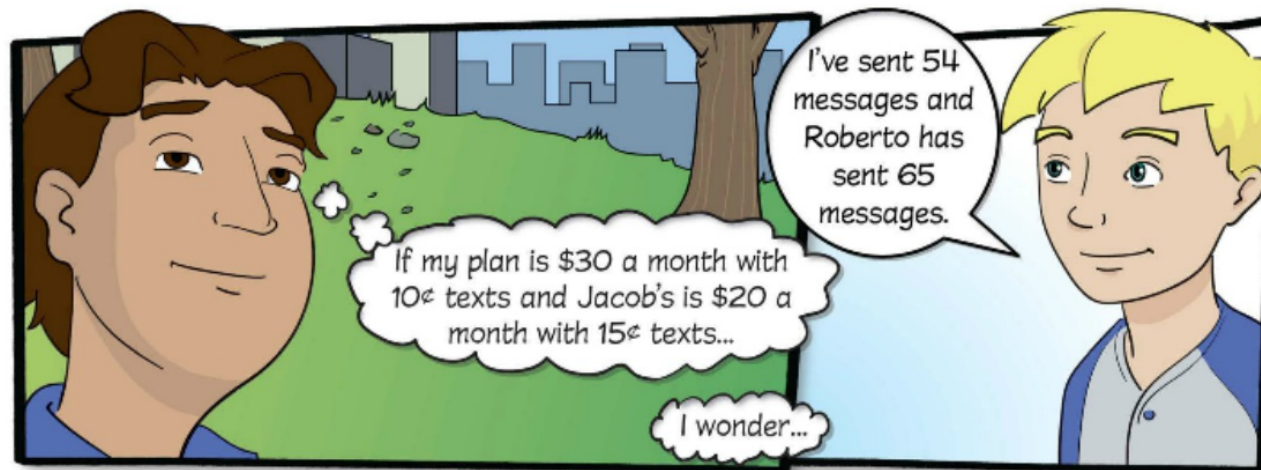
__**140 ft²**__

14 ft

$6c - 8$ ft

$5 + 3c$ ft

**Lesson 2** Solve Two-Step Equations  **125**

**13.** **MP** **Model with Mathematics** Refer to the graphic novel frame below for Exercises a–b.



**a.** The equation $50 = 28.10 + 0.15m$ represents the additonal number of messages Jacob can send with a budget of $50. Solve the equation to find the number of messages he has left to send. _**146 messages**_

Show your work

**b.** The equation $50 = 36.50 + 0.10m$ represents the additional number of messages Roberto can send with a budget of $50. Solve the equation to find the number of messages he has left to send. _**135 messages**_

## H.O.T. Problems  Higher Order Thinking

**14.** **MP** **Persevere with Problems**

**b.** The equation $50 = 36.50 + 0.10m$ represents the additional number of messages Roberto can send with a budget of $50. Solve the equation to find the number of messages he has left to send. <u>**135 messages**</u>

## 🔥 H.O.T. Problems   Higher Order Thinking

**14.** 🔴**MP** **Persevere with Problems**   Solve $(x + 5)(x + 5) = 49$. (*Hint:* There are two solutions.)

**−12 and 2**

**15.** 🔴**MP** **Model with Mathematics**   Write a real-world problem that could be solved by using the equation $3x - 25 = 125$. Then solve the equation.

**Sample answer: Andrea saved *x* dollars each week for 3 weeks. She spent $25 and had $125 left. How much did she save each week?; $50**

**16.** 🔴**MP** **Use a Counterexample**   Determine if the following statement is *true* or *false*. If *false*, provide a counterexample.

*An equation with an integer coefficient will always have an integer solution.*

**false; Sample answer: The coefficient of $-3x + 1 = 8$ is −3. However, its solution is $-\frac{7}{3}$, which is not an integer.**