

Lesson 8-1

Solving Equations with Rational Coefficients

ISG Interactive Study Guide

See pages 169–170 for:

- Getting Started
- Vocabulary Start -Up
- 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, 8.EE.7, 8.EE.7b

Mathematical Practices
1, 3, 4, 5, 7

Vocab Vocabulary

solution
inverse operations
equivalent equations

What You'll Learn

- Solve equations by using the Division Property of Equality.
- Solve equations by using the Multiplication Property of Equality.



Real-World Link

Social Networks Do you have a social network profile? While gaming, blogging, and watching videos continue to be popular online activities, more preteens and teens are participating in social networking than ever before. Three-fourths of teens surveyed said they belonged to a social network, compared to 40% of adults surveyed.



Solve Equations by Dividing

An *equation* is a mathematical sentence stating that two expressions are equal. If 72 teens in a survey say they have a social network profile, and these teens are three-fourths of the teens surveyed, then the equation $\frac{3}{4}x = 72$ can be used to find the total number of teens surveyed. A value for the variable that makes an equation true is called a **solution**. For $\frac{3}{4}x = 72$, the solution is 96, since $\frac{3}{4}(96) = 72$ is a true statement.

Key Concept Properties of Equality

Words	Symbols
Multiplication Property of Equality If you multiply each side of an equation by the same nonzero number, the two sides remain equal.	For any numbers a , b , and c , if $a = b$, then $ca = cb$.
Division Property of Equality If you divide each side of an equation by the same nonzero number, the two sides remain equal.	For any numbers a , b , and c , where $c \neq 0$, if $a = b$, then $\frac{a}{c} = \frac{b}{c}$.

You can use the above properties and inverse operations to solve an equation.

Inverse operations “undo” each other. To undo the multiplication of $\frac{3}{4}$ in $\frac{3}{4}x = 72$, you can apply the Division Property of Equality to divide each side of the equation by $\frac{3}{4}$. Applying the above properties creates **equivalent equations**, which are equations that have the same solution.



Example 1

Vocabulary Link solution

Everyday Use the answer to a problem, such as the solution to a mystery

Math Use a value of the variable that makes an equation true

Solve $4.2x = -52.5$. Check your solution.

$4.2x = -52.5$ Write the equation.

$\frac{4.2x}{4.2} = \frac{-52.5}{4.2}$ Division Property of Equality

$1x = -12.5$ $4.2 \div 4.2 = 1$; $-52.5 \div 4.2 = -12.5$

$x = -12.5$ Identity Property; $1x = x$

To check your solution, replace x with -12.5 in the original equation.

Check $4.2x = -52.5$ Write the equation.

$4.2(-12.5) \stackrel{?}{=} -52.5$ Replace x with -12.5 .

$-52.5 = -52.5$ ✓ The sentence is true.

The solution is -12.5 .

Got It? Do these problems to find out.

1a. Solve $-19.6 = 5.6x$. **-3.5**

1b. Solve $-20.9y = -250.8$. **12**

1c. Solve $-13.6a = 217.6$. **-16**

1d. Solve $323.4 = -13.2z$. **-24.5**



Example 2



A drive-through safari zoo charges \$12.50 per person for admission. In one hour, the park raised \$675 in admission fees. Write and solve an equation to find how many people visited that hour.

Words

Admission fee times the number of visitors equals the total money raised.



Variable

Let v = the number of zoo visitors.



Equation

$12.50 \cdot v = 675$

$12.5v = 675$ Write the equation.

$\frac{12.5v}{12.5} = \frac{675}{12.5}$ Division Property of Equality

$v = 54$ Simplify. Check this solution.

The zoo admitted 54 people in one hour.

Got It? Do this problem to find out.

180p = 8280; 46 permits

2. A one-year, in-state camping permit for New Mexico State Parks costs \$180. If the total income from the camping permits is \$8280 during the first day of sales, write and solve an equation to find how many permits were purchased.

Solve Equations by Multiplying

Equations in which a variable is divided can be solved by multiplying each side by the same number. This method is also useful when the coefficient of the variable is a fraction.

Example 3



Solve each equation. Check your solution.

a. $\frac{1}{4}y = -8$

$$\frac{1}{4}y = -8$$

Write the equation.

$$4 \cdot \frac{1}{4}y = 4 \cdot (-8)$$

Multiplication Property of Equality

$$1y = -32$$

Multiplicative Inverse Property; $4 \cdot \frac{1}{4} = 1$

$$y = -32$$

Identity Property. Check your solution.

b. $-\frac{3}{5}x = -\frac{6}{25}$

$$-\frac{3}{5}x = -\frac{6}{25}$$

Write the equation.

$$-\frac{5}{3} \left(-\frac{3}{5} \right) x = -\frac{5}{3} \left(-\frac{6}{25} \right)$$

Multiply each side by $-\frac{5}{3}$.

$$1x = \frac{2}{5}$$

Multiplicative Inverse Property; $-\frac{5}{3} \left(-\frac{3}{5} \right) = 1$

$$x = \frac{2}{5}$$

Identity Property. Check your solution.

Multiplicative Inverse

Remember that the product of a number and its multiplicative inverse is 1. Use this property when the coefficient of x is a fraction.

Got It? Do these problems to find out.

3a. $7 = -\frac{1}{2}x$ **-14**

3b. $\frac{6}{7}m = -\frac{3}{14}$ **$-\frac{1}{4}$**

3c. $-9 = \frac{1}{3}n$ **-27**

3d. $-\frac{1}{4} = \frac{2}{7}y$ **$-\frac{7}{8}$**

Guided Practice



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

1. $1.3c = -65$ **-50**

2. $-4.2 = -7m$ **0.6**

3. $0.8p = 9.6$ **12**

4. $\frac{1}{12}n = 12$ **144**

5. $18 = \frac{-1}{2}t$ **-36**

6. $0.6h = 1.8$ **3**

7. $-3.4 = 0.4j$ **-8.5**

8. $-\frac{3}{4}k = \frac{2}{3}$ **$-\frac{8}{9}$**

9. $\frac{1}{25} = \frac{3}{5}m$ **$\frac{1}{15}$**

10. A forest preserve rents canoes for \$22.50 per hour. Corey has \$90 to spend. Write and solve an equation to find how many hours he can rent a canoe. (Example 2) **$22.50h = 90$; 4 h**

11. **STEM** The weight of an object on the Moon is one-sixth its weight on Earth. If an object weighs 54 pounds on the Moon, write and solve an equation to find how much it weighs on Earth. (Example 2) **$\frac{1}{6}x = 54$; 324 lb**