

Solving Equations Using Multiplication or Division

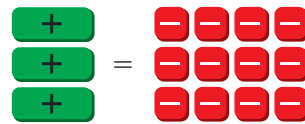
Essential Question How can you use multiplication or division to solve an equation?

1 ACTIVITY: Using Division to Solve an Equation

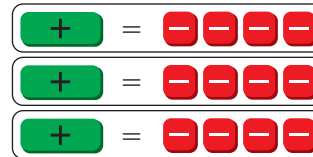
Work with a partner. Use algebra tiles to model and solve the equation.

- a. **Sample:** $3x = -12$

Model the equation $3x = -12$.



Your goal is to get one green tile by itself. Because there are three green tiles, divide the red tiles into three equal groups.



Keep one of the groups. This shows the value of x .



So, $x = -4$.

b. $2k = -8$

c. $-15 = 3t$

d. $-20 = 5m$

e. $4h = -16$

2 ACTIVITY: Writing and Solving Equations

Work with a partner. Write an equation shown by the algebra tiles. Then solve.

a.

b.

c.

d.

3 ACTIVITY: The Game of Math Card War

Preparation:

- Cut index cards to make 40 playing cards.
- Write each equation in the table on a card.

To Play:

- Play with a partner. Deal 20 cards to each player face-down.
- Each player turns one card face-up. The player with the greater solution wins. The winner collects both cards and places them at the bottom of his or her cards.
- Suppose there is a tie. Each player lays three cards face-down, then a new card face-up. The player with the greater solution of these new cards wins. The winner collects all ten cards, and places them at the bottom of his or her cards.
- Continue playing until one player has all the cards. This player wins the game.

$-4x = -12$	$x - 1 = 1$	$x - 3 = 1$	$2x = -10$	$-9 = 9x$
$3 + x = -2$	$x = -2$	$-3x = -3$	$\frac{x}{-2} = -2$	$x = -6$
$6x = -36$	$-3x = -9$	$-7x = -14$	$x - 2 = 1$	$-1 = x + 5$
$x = -1$	$9x = -27$	$\frac{x}{3} = -1$	$-8 = -2x$	$x = 3$
$-7 = -1 + x$	$x = -5$	$-10 = 10x$	$x = -4$	$-2 = -3 + x$
$-20 = 10x$	$x + 9 = 8$	$-16 = 8x$	$x = 2$	$x + 13 = 11$
$x = -3$	$-8 = 2x$	$x = 1$	$\frac{x}{2} = -2$	$-4 + x = -2$
$\frac{x}{5} = -1$	$-6 = x - 3$	$x = 4$	$x + 6 = 2$	$x - 5 = -4$

What Is Your Answer?

4. **IN YOUR OWN WORDS** How can you use multiplication or division to solve an equation without using algebra tiles? Give two examples.

Practice

Use what you learned about solving equations to complete Exercises 7–10 on page 80.

Key Ideas

Multiplication Property of Equality

Words Multiplying each side of an equation by the same number produces an equivalent equation.

Algebra If $a = b$, then $a \cdot c = b \cdot c$.

Division Property of Equality

Words Dividing each side of an equation by the same number produces an equivalent equation.

Algebra If $a = b$, then $a \div c = b \div c$, $c \neq 0$.

EXAMPLE 1 Solving Equations

a. Solve $\frac{x}{3} = -6$.

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

Write the equation.

$$3 \cdot \frac{x}{3} = 3 \cdot (-6)$$

Multiply each side by 3.

$$x = -18$$

Simplify.

∴ So, the solution is $x = -18$.

b. Solve $18 = -4y$.

$$18 = -4y$$

Write the equation.

$$\frac{18}{-4} = \frac{-4y}{-4}$$

Divide each side by -4 .

$$-4.5 = y$$

Simplify.

∴ So, the solution is $y = -4.5$.

Check

$$18 = -4y$$

$$18 \stackrel{?}{=} -4(-4.5)$$

$$18 = 18 \quad \checkmark$$

On Your Own

Solve the equation. Check your solution.

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

2. $-a = -24$

3. $3 = -1.5n$

Now You're Ready
Exercises 7–18

EXAMPLE 2 Solving an Equation Using a Reciprocal

Solve $-\frac{4}{5}x = -8$.

$$-\frac{4}{5}x = -8$$

Write the equation.

$$-\frac{5}{4} \cdot \left(-\frac{4}{5}x\right) = -\frac{5}{4} \cdot (-8)$$

Multiply each side by $-\frac{5}{4}$, the reciprocal of $-\frac{4}{5}$.

$$x = 10$$

Simplify.

∴ So, the solution is $x = 10$.

On Your Own

Now You're Ready
Exercises 19–22

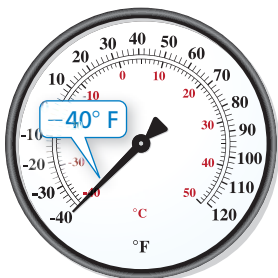
Solve the equation. Check your solution.

4. $-14 = \frac{2}{3}x$

5. $-\frac{8}{5}b = 5$

6. $\frac{3}{8}h = -9$

EXAMPLE 3 Real-Life Application



Record low temperature in Arizona

The record low temperature in Arizona is 1.6 times the record low temperature in Rhode Island. What is the record low temperature in Rhode Island?

Words The record low in Arizona is 1.6 times the record low in Rhode Island.

Variable Let t be the record low in Rhode Island.

Equation $-40 = 1.6 \times t$

$$-40 = 1.6t$$

Write equation.

$$-\frac{40}{1.6} = \frac{1.6t}{1.6}$$

Divide each side by 1.6.

$$-25 = t$$

Simplify.

∴ The record low temperature in Rhode Island is -25°F .

On Your Own

7. The record low temperature in Hawaii is -0.15 times the record low temperature in Alaska. The record low temperature in Hawaii is 12°F . What is the record low temperature in Alaska?


Vocabulary and Concept Check

- WRITING** Explain why multiplication can be used to solve equations involving division.
- OPEN-ENDED** Turning a light on and then turning the light off are considered to be inverse operations. Describe two other real-life situations that can be thought of as inverse operations.

Describe the inverse operation that will undo the given operation.


- Multiplying by 5
- Subtracting 12
- Dividing by -8
- Adding -6


Practice and Problem Solving

Solve the equation. Check your solution.

- $3h = 15$
 - $-5t = -45$
 - $\frac{n}{2} = -7$
 - $\frac{k}{-3} = 9$
- $5m = -10$
 - $8t = -32$
 - $-0.2x = 1.6$
 - $-10 = -\frac{b}{4}$
- $-6p = 48$
 - $-72 = 8d$
 - $\frac{n}{1.6} = 5$
 - $-14.4 = -0.6p$
- $\frac{3}{4}g = -12$
 - $8 = -\frac{2}{5}c$
 - $-\frac{4}{9}f = -3$
 - $26 = -\frac{8}{5}y$

- ERROR ANALYSIS** Describe and correct the error in finding the solution.



$$\begin{array}{l}
 -4.2x = 21 \\
 \frac{-4.2x}{4.2} = \frac{21}{4.2} \\
 x = 5
 \end{array}$$

Write the verbal sentence as an equation. Then solve.

- A number divided by -9 is -16 .
- A number multiplied by $\frac{2}{5}$ is $\frac{3}{20}$.
- The product of 15 and a number is -75 .
- The quotient of a number and -1.5 is 21.

In Exercises 28 and 29, write an equation. Then solve.

- NEWSPAPERS** You make $\$0.75$ for every newspaper you sell. How many newspapers do you have to sell to buy the soccer cleats?
- ROCK CLIMBING** A rock climber averages $12\frac{3}{5}$ feet per minute. How many feet does the rock climber climb in 30 minutes?



OPEN-ENDED (a) Write a multiplication equation that has the given solution.
 (b) Write a division equation that has the same solution.

30. -3

31. -2.2

32. $-\frac{1}{2}$

33. $-1\frac{1}{4}$

34. **REASONING** Which of the methods can you use to solve $-\frac{2}{3}c = 16$?

Multiply each side by $-\frac{2}{3}$.

Multiply each side by $-\frac{3}{2}$.

Divide each side by $-\frac{2}{3}$.

Multiply each side by 3, then divide each side by -2 .

35. **STOCK** A stock has a return of $-\$1.26$ per day. Write and solve an equation to find the number of days until the total return is $-\$10.08$.

36. **ELECTION** In a school election, $\frac{3}{4}$ of the students vote. There are 1464 ballots. Write and solve an equation to find the number of students.

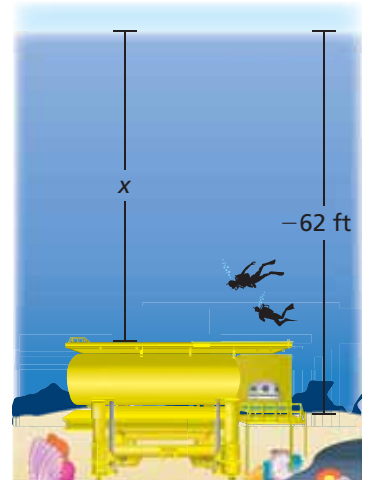
37. **OCEANOGRAPHY** Aquarius is an underwater ocean laboratory located in the Florida Keys National Marine Sanctuary. Solve the equation $\frac{31}{25}x = -62$ to find the value of x .

38. **SHOPPING** The price of a bike at store A is $\frac{5}{6}$ the price at store B. The price at store A is $\$150.60$. Write and solve an equation to find how much you save by buying the bike at store A.

39. **CRITICAL THINKING** Solve $-2|m| = -10$.

40. **Number Sense** In four days, your family drives $\frac{5}{7}$ of a trip.

Your rate of travel is the same throughout the trip. The total trip is 1250 miles. How many more days until you reach your destination?



Fair Game Review What you learned in previous grades & lessons

Subtract.

41. $5 - 12$

42. $-7 - 2$

43. $4 - (-8)$

44. $-14 - (-5)$

45. **MULTIPLE CHOICE** Of the 120 apartments in a building, 75 have been scheduled to receive new carpet. What fraction of the apartments have not been scheduled to receive new carpet?

(A) $\frac{1}{4}$

(B) $\frac{3}{8}$

(C) $\frac{5}{8}$

(D) $\frac{3}{4}$