3.4 Solving Equations Using Multiplication or Division

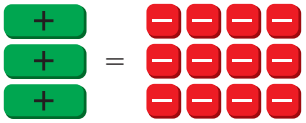
Essential Question How can you use multiplication or division to solve equations?

1 ACTIVITY: Using Division to Solve Equations

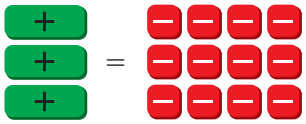
Work with a partner. Use algebra tiles to model and solve the equation.

a. $3x = -12$

Model the equation $3x = -12$.



Your goal is to get one variable tile by itself. Because there are ____ variable tiles, divide the ____ tiles into ____ equal groups. Circle the groups.



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

∴ So, $x =$ ____.

b. $2k = -8$

c. $-15 = 3t$

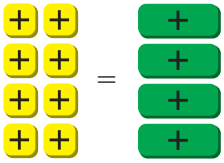
d. $-20 = 5m$

e. $4h = -16$

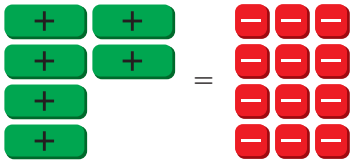
2 ACTIVITY: Writing and Solving Equations

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

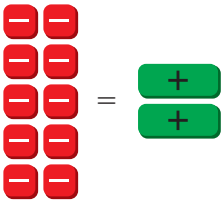
a.



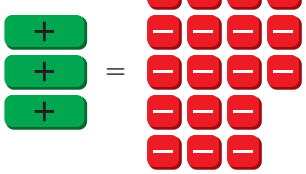
b.



c.



d.



Solving Equations

In this lesson, you will

- solve equations using multiplication or division.
- solve real-life problems.

3 ACTIVITY: Using a Different Method to Find a Solution

Work with a partner. Choose the equation you can use to solve each problem. Solve the equation. Then explain how to solve the problem without using an equation. How are the two methods related?

Math Practice

Analyze Givens

How can you use the given information to decide which equation represents the situation?

a. For the final part of a race, a handcyclist travels 32 feet each second across a distance of 400 feet. How many seconds does it take for the handcyclist to travel the last 400 feet of the race?

$32x = 400$ | $400x = 32$

$\frac{x}{32} = 400$ | $\frac{x}{400} = 32$

b. The melting point of the element radon is about $-96°$F. The melting point of nitrogen is about 3.6 times the melting point of radon. What is the melting point of nitrogen?

$3.6x = -96$ | $x + 96 = 3.6$

$\frac{x}{3.6} = -96$ | $-96x = 3.6$

c. This year, a hardware store has a profit of $-\$6.0$ million. This profit is $\frac{3}{4}$ of last year's profit. What is last year's profit?

$\frac{x}{-6} = \frac{3}{4}$ | $-6x = \frac{3}{4}$

$\frac{3}{4} + x = -6$ | $\frac{3}{4}x = -6$

What Is Your Answer?

4. IN YOUR OWN WORDS How can you use multiplication or division to solve equations? Give an example of each.

Practice Use what you learned about solving equations to complete Exercises 7–10 on page 106.

3.4 Lesson

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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 $a \cdot c = b \cdot c$.

Remember

Multiplication and division are inverse operations.

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.

Undo the division. → $3 \cdot \frac{x}{3} = 3 \cdot (-6)$ Multiplication Property of Equality

$x = -18$ Simplify.

∴ The solution is $x = -18$.

Check

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

$\frac{-18}{3} \stackrel{?}{=} -6$

$-6 = -6$ ✓

b. Solve $18 = -4y$.

$18 = -4y$ Write the equation.

Undo the multiplication. → $\frac{18}{-4} = \frac{-4y}{-4}$ Division Property of Equality

$-4.5 = y$ Simplify.

∴ The solution is $y = -4.5$.

Check

$18 = -4y$

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

$18 = 18$ ✓

On Your Own

Now You're Ready
Exercises 7–18

Solve the equation. Check your solution.

1. $\frac{x}{5} = -2$
2. $-a = -24$
3. $3 = -1.5n$

EXAMPLE 2 Solving an Equation Using a Reciprocal

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

$$-\frac{4}{5}x = -8$$ Write the equation.

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

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

$$x = 10$$ Simplify.

∴ The solution is $x = 10$.

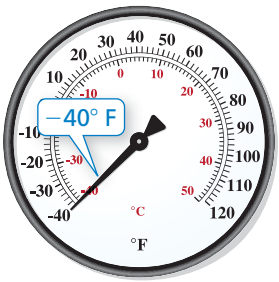
On Your Own

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.

$$-\frac{40}{1.6} = \frac{1.6t}{1.6}$$ Division Property of Equality

$$-25 = t$$ Simplify.

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

On Your Own

Now You're Ready
Exercises 24–27

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?

3.4 Exercises

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Vocabulary and Concept Check

1. **WRITING** Explain why you can use multiplication to solve equations involving division.
2. **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.

3. multiplying by 5
4. subtracting 12
5. dividing by -8
6. adding -6

Practice and Problem Solving

Solve the equation. Check your solution.

1 7. $3h = 15$
8. $-5t = -45$
9. $\frac{n}{2} = -7$
10. $\frac{k}{-3} = 9$
11. $5m = -10$
12. $8t = -32$
13. $-0.2x = 1.6$
14. $-10 = -\frac{b}{4}$
15. $-6p = 48$
16. $-72 = 8d$
17. $\frac{n}{1.6} = 5$
18. $-14.4 = -0.6p$

2 19. $\frac{3}{4}g = -12$
20. $8 = -\frac{2}{5}c$
21. $-\frac{4}{9}f = -3$
22. $26 = -\frac{8}{5}y$

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

$$-4.2x = 21$$
$$\frac{-4.2x}{4.2} = \frac{21}{4.2}$$
$$x = 5$$

Write the word sentence as an equation. Then solve.

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

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

28. **NEWSPAPERS** You make \$0.75 for every newspaper you sell. How many newspapers do you have to sell to buy the soccer cleats?

29. **ROCK CLIMBING** A rock climber averages $12\frac{3}{5}$ feet per minute. How many feet does the rock climber climb in 30 minutes?

3.4 Exercises

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