

2-4

Solving Equations With Variables on Both Sides

 Check Skills You'll Need

1. **Vocabulary Review**
Operations that undo each other are called ? .

Simplify.

2. $9(t + 7) - 16$
3. $12 - 6(2r - 8)$
4. $2x - (5x + 7)$.

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Lesson 2-2

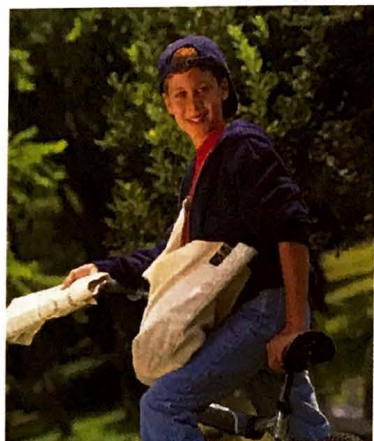
What You'll Learn

To write and solve equations with variables on both sides

Why Learn This?

Equations can help you calculate your savings from part-time jobs. An equation shows that two expressions are equal. Because expressions can contain variables, some equations have variables on both sides of the equal sign.

To solve an equation with variables on both sides, bring all the variable terms to one side of the equation.


 CONTENT STANDARDS

8.EE.7, 8.EE.7b

EXAMPLE Variables on Both Sides

1 Solve $7 + 3h = -1 - 5h$.

$$7 + 3h = -1 - 5h$$

$$7 + 3h + 5h = -1 - 5h + 5h \quad \leftarrow \text{Add } 5h \text{ to each side.}$$

$$7 + 8h = -1 \quad \leftarrow \text{Combine like terms.}$$

$$7 - 7 + 8h = -1 - 7 \quad \leftarrow \text{Subtract } 7 \text{ from each side.}$$

$$8h = -8 \quad \leftarrow \text{Simplify.}$$

$$\frac{8h}{8} = \frac{-8}{8} \quad \leftarrow \text{Divide each side by } 8.$$

$$h = -1 \quad \leftarrow \text{Simplify.}$$

Check $7 + 3h = -1 - 5h$

$$7 + 3(-1) \stackrel{?}{=} -1 - 5(-1) \quad \leftarrow \text{Substitute } -1 \text{ for } h.$$

$$4 = 4 \quad \checkmark \quad \leftarrow \text{The solution checks.}$$

 Quick Check

1. Solve $7b - 2 = b + 10$. Check the solution.

EXAMPLE Application: Science

- 2 Gridded Response** Your science class is doing an experiment. You start with 2 plants. Plant A is 5 cm tall and Plant B is 8 cm tall. Plant A is fertilized and grows 2 cm per day. Plant B is not fertilized and grows 1.5 cm per day. Predict in how many days the plants will be the same height.

Words $5 + 2 \text{ cm} \cdot \text{number of days} = 8 + 1.5 \text{ cm} \cdot \text{number of days}$

↓ Let d = the number of days.

Equation $5 + 2 \cdot d = 8 + 1.5 \cdot d$

$$5 + 2d = 8 + 1.5d$$

$$5 + 2d - 2d = 8 + 1.5d - 2d \leftarrow \text{Subtract } 2d \text{ from each side.}$$

$$5 = 8 - 0.5d \leftarrow \text{Simplify.}$$

$$5 - 8 = 8 - 8 - 0.5d \leftarrow \text{Subtract 8 from each side.}$$

$$-3 = -0.5d \leftarrow \text{Simplify.}$$

$$\frac{-3}{-0.5} = \frac{-0.5d}{-0.5} \leftarrow \text{Divide each side by } -0.5.$$

$$6 = d \leftarrow \text{Simplify.}$$

			6
.	.	.	.
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

The plants will be the same height in 6 days.

Quick Check

2. One cell phone plan costs \$29.94 per month plus \$.10 for each text message sent. Another plan costs \$32.99 per month plus \$.05 for each text message sent. For what number of text messages will the monthly bill for both plans be the same?

Check Your Understanding

Identify the like terms in each group of expressions.

1. $-\frac{7}{9}, -2.8, 3, 0$ 2. xy, x, y, yx 3. $11a, -4.1a^2, a, a^2$

4. Is 7 a solution of the equation $3x + 8 - x = 5x - 4$?

5. **Error Analysis** A student solved an equation as shown at the left. Explain the error the student made. Solve the equation correctly.

6. **Mental Math** Is the solution of $2x = 3x - 12 - 5x$ a positive or a negative integer? Explain.

$$\begin{aligned} 3x + 4 - x &= 7 + x \\ 3x + 4 &= 7 \\ 3x &= 3 \\ x &= 1 \end{aligned}$$

Homework Exercises

For more exercises, see Extra Skills and Word Problems.

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For Exercises	See Examples
7-15	1-2

Solve each equation. Check the solution.

7. $2 + 14z = -8 + 9z$

8. $-8 - 5y = 12 - 9y$

9. $22 + 2x = 37 + 6 + x$

10. $\frac{2}{3}d + 1 = 16 - d$

11. $-k = 9(k - 10)$

12. $7m = 9(m + 4)$

13. $0.8(4 - a) = 5.6a$

14. $8 - 3(p - 4) = 2p$

15. At Video Shack, movie rentals cost \$3.99 each. The cost of renting three movies and one video game is \$.11 less than the cost of renting five video games. How much does renting a video game cost?

GPS

16. **Guided Problem Solving** A croquet ball weighs 460 grams. Together a golf ball and a croquet ball weigh the same as 11 golf balls. How much does one golf ball weigh?

- What quantity will you represent with a variable?
- Write and solve an equation.

17. Efren leaves home at 9 A.M. and walks 4 miles per hour. His brother, Gregory, leaves half an hour later and runs 8.5 miles per hour in the same direction as Efren. Predict the time at which Gregory will catch up to Efren.

18. **Writing in Math** Explain how to solve an equation with the same variable on both sides.

19. **Challenge** Solve $0.75 + 2(x - 0.5) = 3x - 0.4$.

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Test Prep and Mixed Review

Practice

Gridded Response

20. The side of a square is $2x + 8$ inches long. The perimeter of the square is $20x + 8$ inches. What is the side length of the square in inches?
21. A selection of jigsaw puzzles at one store is priced at \$12 each. During a sale, a customer who buys 2 of these puzzles at the regular price may buy additional puzzles at half price. How many puzzles could a customer buy for \$42?
22. A square has an area of 40 square units. To the nearest tenth, how many units long is each side of the square?

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For Exercises	See Lesson
23-24	2-3

Algebra Solve each equation.

23. $6q + 3 - 4q = 9$

24. $7(x + 1) - 1 = 34$