

2-4

Solving Equations With Variables on Both Sides



Vocabulary

Review

Write the *like terms* in each expression or equation.

1. $5x + 2x + 6$



2. $1.5y - 1.2 + 1.2z + y$



3. $\frac{1}{2}x + \frac{1}{2} = 3x$



Vocabulary Builder

identity (noun) eye DEN tuh tee

Main Idea: Any equation that is always true is an **identity**.

Examples: The equation $39 = 39$ is an **identity** because it is always true.

The equation $y + 3 = y + 3$ is an **identity** because it is true for all values of y .

Nonexample: The equation $x + 5 = 8$ is *not* an **identity** because it is *not* always true. It is true only when $x = 3$.

$m = m$
is an **identity**.

$m = 15$
is **NOT**
an **identity**.

Use Your Vocabulary

Write a number or expression to make each equation an *identity*.

4. $25 + \square = 25$

5. $27 \cdot \square = 27$

6. $-5x + 3 = \square + 3$

7. **Multiple Choice** Which equation is NOT an *identity*?

(A) $0 + 7 = 7$

(B) $1 \cdot 9 = 9$

(C) $x + 3 = 3 + x$

(D) $x + 1 = x$

8. Draw a line from each equation in Column A to its description in Column B.

Column A

$x = x - 1$

$x + x = 2x$

$5x = 15$

Column B

always true

sometimes true

never true



Problem 1 Solving an Equation With Variables on Both Sides

Got It? What is the solution of $7k + 2 = 4k - 10$?

9. There is a variable on each side of the equation. Are they like terms?

Yes / No

10. Use one of the reasons from the box to justify each step. You may use a reason more than once.

Division Property of Equality
Simplify.
Subtraction Property of Equality
Subtract.

$$7k + 2 = 4k - 10$$

Write the original equation.

$$7k + 2 - 4k = 4k - 10 - 4k$$

$$3k + 2 = -10$$

$$3k + 2 - 2 = -10 - 2$$

$$3k = -12$$

$$\frac{3k}{3} = -\frac{12}{3}$$

$$k = -4$$

Blank yellow boxes for justification.



Problem 2 Using an Equation With Variables on Both Sides

Got It? An office manager spent \$650 on a new energy-saving copier that will reduce the monthly electric bill for the office from \$112 to \$88. In how many months will the copier pay for itself?

11. Complete the model below.

Relate cost of the copier plus new monthly cost times number of months is old monthly cost times number of months

Define Let $m = ?$. Circle the correct answer.

Cost of the copier Number of months Amount of savings

Write \$650 + \$88 · = \$ ·

12. Now write and solve the equation.

Blank yellow box for solving the equation.

13. The copier will pay for itself in about months.



Problem 3 Solving an Equation With Grouping Symbols

Got It? What is the solution of $4(2y - 1) - 5 = 2(y - 2) + 13$?

14. Use the justifications at the right to solve the equation.

$$\begin{array}{r}
 4(2y - 1) - 5 = 2(y - 2) + 13 \\
 4 \cdot (2y) - 4 - 5 = 2 \cdot (y) - 2 + 13 \\
 8y - 4 - 5 = 2y - 2 + 13 \\
 8y - 9 = 2y + 11 \\
 8y - 2y - 9 = 2y - 2y + 11 \\
 6y - 9 = 11 \\
 6y - 9 + 9 = 11 + 9 \\
 6y = 20 \\
 \frac{6y}{6} = \frac{20}{6} \\
 y = \frac{10}{3}
 \end{array}$$

- Write the original equation.
- Distributive Property
- Multiply.
- Subtraction Property of Equality
- Subtract.
- Subtraction Property of Equality
- Subtract.
- Division Property of Equality
- Simplify.

15. Check your answer by substituting it for y in the original equation.



Problem 4 Identities and Equations With No Solution

Got It? What is the solution of $3(4b - 2) - 5 = 2(6 - 1) - 12b$?

16. Circle the first step you would take to isolate the variable. Underline the second step you would take.

- Multiply each side by 3.
- Distribute the 3.
- Subtract $12b$ from each side.

17. Solve the equation.

18. Because $2(6 - 5) - 2(6)$ is always true, the original equation has no solution / infinitely many solutions.

Remember to follow these steps when solving equations.

- STEP 1 Use the Distributive Property to remove any grouping symbols.
Use properties of equality to clear decimals and fractions.
- STEP 2 Combine like terms on each side of the equation.
- STEP 3 Use the properties of equality to get the variable terms on one side of the equation and the constants on the other.
- STEP 4 Use the properties of equality to solve for the variable.
- STEP 5 Check your solution in the original equation.



Lesson Check • Do you UNDERSTAND?

Vocabulary Tell whether each equation has infinitely many solutions, one solution, or no solution.

$$3y - 2 = 5y + 1 - 2y - 2 - 9$$

$$2y - 1 = 4 + 5 - 2(y - 1) - 2$$

$$2y - 2 = 4 + 5 - 3y - 2 = 5$$

Write the steps to isolate the variable in each equation.

19. $3y - 2 = 5y + 1 - 2y - 2 - 9$

20. $2y - 1 = 4 + 5 - 2(y - 1) - 2$

21. $2y - 2 = 4 + 5 - 3y - 2 = 5$

22. Tell whether each equation has infinitely many solutions, one solution, or no solution.

$$3y - 2 = 5y + 1 - 2y - 2 - 9$$

$$2y - 1 = 4 + 5 - 2(y - 1) - 2$$

$$2y - 2 = 4 + 5 - 3y - 2 = 5$$



Math Success

Check off the vocabulary words that you understand.

like terms

identity

Rate how well you can solve equations with variables on both sides.

