

2-4 Reteaching

Solving Equations With Variables on Both Sides

To solve equations with variables on both sides, you can use the properties of equality and inverse operations to write a series of simpler equivalent equations.

Problem

What is the solution of $2m - 4 + 5m = 13 - 6m - 4$?

$$7m - 4 = -6m + 9$$

Add the terms with variables together on the left side and the constants on the right side to combine like terms.

$$7m - 4 + 6m = -6m + 9 + 6m$$

To move the variables to the left side, add $6m$ to each side.

$$13m - 4 = 9$$

Simplify.

$$13m - 4 + 4 = 9 + 4$$

To get the variable term alone on the left, add 4 to each side.

$$13m = 13$$

Simplify.

$$\frac{13m}{13} = \frac{13}{13}$$

Divide each side by 13 since x is being multiplied by 13 on the left side. This isolates x .

$$m = 1$$

Simplify.

Problem

What is the solution of $3(5x - 2) = -3(x + 6)$?

$$15x - 6 = -3x - 18$$

Distribute 3 on the left side and -3 on the right side into the parentheses by multiplying them by each term inside.

$$15x - 6 + 6 = -3x - 18 + 6$$

To move all of the terms without a variable to the right side, add 6 to each side.

$$15x = -3x - 12$$

Simplify.

$$15x + 3x = -3x - 12 + 3x$$

To get the variable terms to the left side, add $3x$ to each side.

$$18x = -12$$

Simplify.

$$\frac{18x}{18} = -\frac{12}{18}$$

Divide each side by 18 since x is being multiplied by 18 on the left side. This isolates x .

$$x = -\frac{2}{3}$$

Simplify and reduce the fraction.

Solve each equation. Check your answer.

1. $-5x + 9 = -3x + 1$

2. $14 + 7n = 14n + 28$

3. $22(g - 1) = 2g + 8$

4. $-d + 12 - 3d = 5d - 6$

5. $4(m - 2) = -2(3m + 3)$

6. $-(4y - 8) = 2(y + 4)$

7. $5a - 2(4a + 5) = 7a$

8. $11w + 2(3w - 1) = 15w$

9. $4(3 - 5p) = -5(3p + 3)$

An equation that is true for every value of the variable for which the equation is defined is an identity. For example, $x - 5 = x - 5$ is an identity because the equation is true for any value of x . An equation has no solution if there is no value of the variable that makes the equation true. The equation $x + 6 = x + 3$ has no solution.

Problem

What is the solution of each equation?

a) $3(4x - 2) = -2(-6x + 3)$ Distribute 3 on the left side and -2 on the right side into the parentheses by multiplying them by each term inside.
 $12x - 6 = 12x - 6$

$12x - 6 - 12x = 12x - 6 - 12x$ To get the variable terms to the left side, subtract $12x$ from each side.

$-6 = -6$ Simplify.

Because $-6 = -6$ is always true, there are infinitely many solutions of the original equation. The equation is an identity.

b) $2n + 4(n - 2) = 8 + 6n$ Distribute 4 into the parentheses by multiplying it by each term inside.
 $2n + 4n - 8 = 8 + 6n$

$6n - 8 = 8 + 6n$ Add the variable terms on the left side to combine like terms.

$6n - 8 - 6n = 8 + 6n - 6n$ To get the variable terms to the left side, subtract $6n$ from each side.

$-8 = 8$ Simplify.

Since $-8 \neq 8$, the equation has no solution.

Determine whether each equation is an *identity* or whether it has *no solution*.

10. $-3(2x + 1) = 2(-3x - 1)$ 11. $4(-3x + 4) = -2(6x - 8)$ 12. $3n + 3(-n + 3) = 3$

Solve each equation. If the equation is an identity, write *identity*. If it has no solution, write *no solution*.

13. $-(4n + 2) = -2(2n - 1)$ 14. $2(-d + 4) = 2d + 8$ 15. $-k - 18 = -5 - k - 13$

16. Open-Ended Write three equations with variables on both sides of the equal sign with one having no solution, one having exactly one solution, and one being an identity.

Lesson 2-4

Solve each equation. If the equation is an identity, write *identity*. If it has no solution, write *no solution*.

1. $4h + 5 = 9h$

2. $2(3x - 6) = 3(2x - 4)$

3. $7t = 80 + 9t$

4. $m + 3m = 4$

5. $-b + 4b = 8b - b$

6. $6p + 1 = 3(2p + 1)$

7. $10z - 5 + 3z = 8 - z$

8. $3(g - 1) + 7 = 3g + 4$

9. $17 - 20q \frac{13}{14} = (-13 - 5q)4$

Answers: 1, all real numbers (identity), -40, 1, 0, no solution, 13/14, all real numbers (identity), no solution