

Extension

Apply Properties of Equality

GOAL Use algebraic properties to help solve equations.

Key Vocabulary

- equation
- solve an equation

COMMON CORE

CC.9-12.A.REI.1 Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.

When you *solve an equation*, you use properties of real numbers. In particular you use the *algebraic properties of equality* and the *distributive property*.

KEY CONCEPT

For Your Notebook

Algebraic Properties of Equality

Let a , b , and c be real numbers.

Addition Property

If $a = b$, then $a + c = b + c$.

Subtraction Property

If $a = b$, then $a - c = b - c$.

Multiplication Property

If $a = b$, then $ac = bc$.

Division Property

If $a = b$ and $c \neq 0$, then $\frac{a}{c} = \frac{b}{c}$.

Substitution Property

If $a = b$, then a can be substituted for b in any equation or expression.

EXAMPLE 1 Write reasons for each step

Solve $4x + 7 = -2x - 5$. Write reasons for each step.

Solution

Equation	Explanation	Reason
$4x + 7 = -2x - 5$	Write original equation.	Given
$4x + 7 + 2x = -2x - 5 + 2x$	Add $2x$ to each side.	Addition Property of Equality
$6x + 7 = -5$	Combine like terms.	Simplify.
$6x + 7 - 7 = -5 - 7$	Subtract 7 from each side.	Subtraction Property of Equality
$6x = -12$	Combine like terms.	Simplify.
$x = -2$	Divide each side by 6.	Division Property of Equality

► The value of x is -2 .

GUIDED PRACTICE for Example 1

Solve the equation. Write a reason for each step.

1. $5x - 7 = 8$

2. $13 - 2x = x + 25$

Distributive Property
 $a(b + c) = ab + ac$, where a , b , and c are real numbers.
EXAMPLE 2 Use the Distributive PropertySolve $7(5 - x) = 14$. Write reasons for each step.**Solution**

Equation	Explanation	Reason
$7(5 - x) = 14$	Write original equation.	Given
$35 - 7x = 14$	Multiply.	Distributive Property
$-7x = -21$	Subtract 35 from each side.	Subtraction Property of Equality
$x = 3$	Divide each side by -7 .	Division Property of Equality

▶ The value of x is 3.**PRACTICE**

Copy the logical argument. Write a reason for each step.

1. $3x - 12 = 7x + 8$	Given	2. $5(x - 1) = 4x + 3$	Given
$-4x - 12 = 8$?	$5x - 5 = 4x + 3$?
$-4x = 20$?	$x - 5 = 3$?
$x = -5$?	$x = 8$?

For Exercises 3–14, solve the equation. Write a reason for each step.

3. $5x - 10 = -40$ 4. $4x + 9 = 16 - 3x$ 5. $5 - x = 17$
 6. $2x - 3 = x - 5$ 7. $19 - 2x = -17$ 8. $-3x = -5x + 12$
 9. $5(3x - 20) = -10$ 10. $3(2x + 11) = 9$ 11. $2(-x - 5) = 12$
 12. $4(5x - 9) = -2(x + 7)$ 13. $13 - x = -2(x + 3)$ 14. $3(7x - 9) - 19x = -15$
 15. **ERROR ANALYSIS** Describe and correct the error in solving for x .

$7x = x + 24$	Given	X
$8x = 24$	Addition Property of Equality	
$x = 3$	Division Property of Equality	

16. **DEBATE** Mrs. Sinclair divided her 30 history students into 6 debate teams, with each team consisting of a secretary to take notes during the debates and x debaters. The solution of the equation $6(x + 1) = 30$ represents the number of debaters on each team. Solve the equation and write a reason for each step.