

UNIT 2 • REASONING WITH LINEAR EQUATIONS AND INEQUALITIES

Lesson 4: Solving Equations and Inequalities

Instruction

Prerequisite Skills

This lesson requires the use of the following skills:

- applying the order of operations (5.OA.1)
- simplifying expressions (5.OA.1)

Introduction

Equations are mathematical sentences that state two expressions are equal. In order to solve equations in algebra, you must perform operations that maintain equality of the two sides of the equation using the properties of equality. The **properties of equality** are rules that allow you to balance, manipulate, and solve equations.

Key Concepts

- In mathematics, it is important to follow the rules when solving equations, and to be able to justify, or prove, that the steps we are following to solve problems are correct and allowed.
- The following table summarizes some of these rules.

Properties of Equality

Property	In symbols	In words
Reflexive property of equality	$a = a$	A number is equal to itself.
Symmetric property of equality	If $a = b$, then $b = a$.	If numbers are equal, they will still be equal if the order is changed.
Transitive property of equality	If $a = b$ and $b = c$, then $a = c$.	If numbers are equal to the same number, then they are equal to each other.
Addition property of equality	If $a = b$, then $a + c = b + c$.	Adding the same number to both sides of an equation does not change the equality of the equation.
Subtraction property of equality	If $a = b$, then $a - c = b - c$.	Subtracting the same number from both sides of an equation does not change the equality of the equation.

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Multiplication property of equality	If $a = b$ and $c \neq 0$, then $a \cdot c = b \cdot c$.	Multiplying both sides of the equation by the same number, other than 0, does not change the equality of the equation.
Division property of equality	If $a = b$ and $c \neq 0$, then $a \div c = b \div c$.	Dividing both sides of the equation by the same number, other than 0, does not change the equality of the equation.
Substitution property of equality	If $a = b$, then b may be substituted for a in any expression containing a .	If two numbers are equal, then substituting one in for another does not change the equality of the equation.

- You may remember from other classes the properties of operations that explain the effect that the operations of addition, subtraction, multiplication, and division have on equations. The following table describes some of those properties.

Properties of Operations

Property	General rule	Specific example
Commutative property of addition	$a + b = b + a$	$3 + 8 = 8 + 3$
Associative property of addition	$(a + b) + c = a + (b + c)$	$(3 + 8) + 2 = 3 + (8 + 2)$
Commutative property of multiplication	$a \cdot b = b \cdot a$	$3 \cdot 8 = 8 \cdot 3$
Associative property of multiplication	$(a \cdot b) \cdot c = a \cdot (b \cdot c)$	$(3 \cdot 8) \cdot 2 = 3 \cdot (8 \cdot 2)$
Distributive property of multiplication over addition	$a \cdot (b + c) = a \cdot b + a \cdot c$	$3 \cdot (8 + 2) = 3 \cdot 8 + 3 \cdot 2$

- When we solve an equation, we are rewriting it into a simpler, equivalent equation that helps us find the unknown value.
- When solving an equation that contains parentheses, apply the properties of operations and perform the operation that's in the parentheses first.
- The properties of equality, as well as the properties of operations, not only justify our reasoning, but also help us to understand our own thinking.

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- When identifying which property is being used, it helps to review each step and make note of what operation was performed, and whether it was done to one side of the equation or both.
- When operations are performed on one side of the equation, such as when an expression is simplified, this signifies the use of the properties of operations.
- When an operation is performed on both sides of the equation, such as subtracting the same value from both sides, this signifies the use of the properties of equality.
- Once you have noted which operations were used, match them to the properties listed in the tables.

Common Errors/Misconceptions

- incorrectly identifying operations
- incorrectly identifying properties
- performing an operation that is not justifiable or does not follow the properties of equality and/or the properties of operations