Justifying the Solving of Equations

Properties of Operations

Properties of Addition Operations		
Property	**What It Means**	**Example 1**
Commutative Property of Addition	Rearrange the order and the sum will stay the same.	$2 + 4 = 4 + 2$
Associative Property of Addition	Change the order of the grouping and the sum will stay the same.	$(4 + 6) + 1 = 4 + (6 + 1)$

Properties of Multiplication Operations		
Property	**What It Means**	**Example 1**
Commutative Property of Multiplication	Rearrange the order and the product will stay the same.	$5 \cdot 2 = 2 \cdot 5$
Associative Property of Multiplication	Change the order of the grouping and the product will stay the same.	$(3 \cdot 4) \cdot 2 = 3 \cdot (4 \cdot 2)$
Distributive Property	Multiply a number to every term within a quantity (parenthesis).	$4(x + 5) = 4x + 4(5)$ $= 4x + 20$

Properties of Equality

Property	**Example 1**
Addition Property	If $x - 4 = 8$, then $x =$ 12
Subtraction Property	If $x + 5 = 7$, then $x =$ 2
Multiplication Property	If $\frac{x}{2} = 9$, then $x =$ 18
Division Property	If $2x = 10$, then $x =$ 5
Symmetric Property	If $2 = x$, then $x =$ 2
Substitution Property	If $x = 3$ and the expression is $2x - 7$, then $2(3) - 7$

Practice: Using properties of operations and equality, list each property next to each step in the equation solving process.

Example 1

$\frac{x}{3} = 5$	**Original Equation**
x = 15	Multiplication Property of Equality

Example 2

7 = x - 5	**Original Equation**
12 = x	Addition Property of Equality
x = 12	Symmetric Property of Equality

Example 3

3x + 5 = -13	**Original Equation**
3x = -18	Subtraction Property of Equality
x = -6	Division Property of Equality

Example 4

12 = 2(x – 4)	**Original Equation**
12 = 2x – 8	Distributive Property
20 = 2x	Addition Property
10 = x	Division Property
x = 10	Symmetric Property

Example 5

3x + 5 – x = 15	**Original Equation**
3x – x + 5 = 15	Commutative Property of Addition
2x + 5 = 15	Combining Like Terms
2x = 10	Subtraction Property of Equality
x = 5	Division Property of Equality