Day 3 – Properties of Expressions & Equations Notes

Properties of Addition Operations			
Property	**What It Means**	**General Example**	**Example 1**
Commutative Property of Addition	Rearrange the order and the sum will stay the same.	$a + b = b + a$	$2 + 4 = 4 + 2$
Associative Property of Addition	Change the order of the grouping and the sum will stay the same.	$(a + b) + c = a + (b + c)$	$(4 + 6) + 1 = 4 + (6 + 1)$
Additive Identity	Zero added to any number will equal that number.	$a + 0 = a$	$4 + 0 = 4$
Additive Inverse	A number plus its inverse equals 0.	$a + -a = 0$	$7 + -7 = 0$
Properties of Multiplication Operations			
Commutative Property of Multiplication	Rearrange the order and the product will stay the same.	$a \cdot b = b \cdot a$	$5 \cdot 2 = 2 \cdot 5$
Associative Property of Multiplication	Change the order of the grouping and the product will stay the same.	$(a \cdot b) \cdot c = a \cdot (b \cdot c)$	$(3 \cdot 4) \cdot 2 = 3 \cdot (4 \cdot 2)$
Multiplicative Identity	One times any number equals that number.	$a \cdot 1 = a$	$8 \cdot 1 = 8$
Multiplicative Inverse (Reciprocal)	A number times its reciprocal equals 1.	$a \cdot \frac{1}{a} = 1$	$3 \cdot \frac{1}{3} = 1$
Zero Property of Multiplication	Any number times 0 will always equal 0.	$a \cdot 0 = 0$	$7 \cdot 0 = 0$
Distributive Property	Multiply a number to every term within a quantity (parenthesis).	$a(b + c) = ab + ac$	$4(x + 5) = 4x + 4(5)$ $= 4x + 20$

Practice: Each of the following expressions has been simplified one step at a time. Next to each step, identify the property or simplification used in the step.

1. $4 + 5(x + 7)$ **Given**
   $4 + (5x + 35)$ Distributive Property
   $5x + 4 + 35$ Commutative Prop of +
   $5x + (4 + 35)$ Associative Prop of +
   $5x + 39$ Add

2. $4(10x + 2) - 40x$ **Given**
   $40x + 8 - 40x$ Distributive Prop
   $8 + 40x - 40x$ Commutative Prop of +
   $8 + 0$ Additive Inverse or Subtract
   8 Additive Identity

Properties of Equality

Properties of Equality		
Property	**General Example**	**Example 1**
Addition Property	If a = b, then a + c = b + c	If x – 4 = 8, then x = 12
Subtraction Property	If a = b, then a – c = b - c	If x + 5 = 7, then x = 2
Multiplication Property	If a = b, then ac = bc	If $\frac{x}{2} = 9$, then x = 18
Division Property	If a = b, then $\frac{a}{c} = \frac{b}{c}$	If 2x = 10, then x = 5
Reflexive Property	a = a	5 = 5 (Equality) $\angle A \cong \angle A$ (Congruence) $\overline{AB} \cong \overline{AB}$ (Congruence)
Symmetric Property	If a = b, then b = a	If 2 = x, then x = 2 (Equality) If $\angle A \cong \angle B$, then $\angle B \cong \angle A$ (Congruence) If $\overline{AB} \cong \overline{CD}$, then $\overline{CD} \cong \overline{AB}$ (Congruence)
Transitive Property	If a = b and b = c, then a = c	If x + 2 = y and y = 4x + 3, then x + 2 = 4x + 3 (Equality) If $\angle A \cong \angle B$ and $\angle B \cong \angle C$, then $\angle A \cong \angle C$ (Congruence) If $\overline{AB} \cong \overline{CD}$ and $\overline{CD} \cong \overline{EF}$, then $\overline{AB} \cong \overline{EF}$ (Congruence)
Substitution Property	If x = y, then y can be substituted for x in any expression	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

x + 4 = 9	**Given**
x = 5	Subtraction Prop of =

Example 2

7 = x - 5	**Given**
12 = x	Addition Prop of =
x = 12	Symmetric Prop

Example 3

$\frac{x}{3} = 5$	Given
x = 15	Multiplication Prop of =

Example 4

6x = 24	Given
x = 4	Division Prop of =

Justifying the Solutions to Two & Multi-Step Equations

Practice: Identify the property or simplification that is used in each step to solve the equation.

Example 1

3x + 5 = -13	Given
3x = -18	Subtraction Prop of =
x = -6	Division Prop of =

Example 2

12 = 2(x – 4)	Given
12 = 2x – 8	Distributive Prop
20 = 2x	Addition Prop of =
10 = x	Division Prop of =
x = 10	Symmetric Prop

Example 3

5n – 3 = 2(n + 3) + 9	Given
5n – 3 = 2n + 6 + 9	Distributive Prop
5n – 3 = 2n + 15	Add / CLT
3n – 3 = 15	Subtraction Prop of =
3n = 18	Addition Prop of =
n = 6	Division Prop of =