Warm-Up

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Is the equation $3(2x - 4) = -18$ equivalent to $6x - 12 = -18$?

A Yes, the equations are equivalent by the Associative Property of Multiplication

B Yes, the equations are equivalent by the Commutative Property of Multiplication

C Yes, the equations are equivalent by the Distributive Property of Multiplication over Addition

D No, the equations are not equivalent

Review: Grade 7 AF 1.3

Which property is used in the equation below?

$$12(x + 4) = 12x + 48$$

x

Current: Algebra 5.0

Colleen solved the equation $2(2x + 5) = 8$ using the following steps.

Given: $2(2x + 5) = 8$

Step 1: $4x + 10 = 8$

Step 2: $4x = -2$

Step 3: $x = -\dfrac{1}{2}$

To get from Step 2 to Step 3, Colleen —

A divided both sides by 4.

B subtracted 4 from both sides.

C added 4 to both sides.

D multiplied both sides by 4.

Other: Algebra 25.1

John's solution to an equation is shown below.

Given: $x^2 + 5x + 6 = 0$

Step 1: $(x + 2)(x + 3) = 0$

Step 2: $x + 2 = 0$ or $x + 3 = 0$

Step 3: $x = -2$ or $x = -3$

Which property of real numbers did John use for Step 2?

A multiplication property of equality

B zero product property of multiplication

C commutative property of multiplication

D distributive property of multiplication over addition

Today's Objective/Standards: Simplify expressions and solve equations using two-column proofs. Grade 7 AF 1.3, Algebra I 5.0, 25.1, 25.2

Simplify Expressions and Solve Equations Using Two-Column Proofs

Students often learn real number properties out of context. By using two-column proofs when simplifying expressions and solving equations, these properties can be learned within the context of how they are actually used. In addition, students will be better prepared for two-column proofs in Geometry.

Example 1: Simplify the expression below. Justify each step.

$$5 \cdot (9 \cdot 4)$$

$5 \cdot (9 \cdot 4)$	**Given**
$= 5 \cdot (4 \cdot 9)$	**Commutative Property of Multiplication**
$= (5 \cdot 4) \cdot 9$	**Associative Property of Multiplication**
$= 20 \cdot 9$	**Simplify using the order of operations**
$\boxed{= 180}$	**Simplify**

You try 1: Simplify the expression below. Justify each step.

$$(33 + 288) + 367$$

$(33 + 288) + 367$	**Given**
$= (288 + 33) + 367$	**Commutative Property of Addition**
$= 288 + (33 + 367)$	**Associative Property of Addition**
$= 288 + 400$	**Simplify using the order of operations**
$\boxed{= 688}$	**Simplify**

Example 2: Simplify the expression below. Justify each step.

$$3(2x-4)+2x$$

$3(2x-4)+2x$	**Given**
$=6x-12+2x$	**Distributive Property of Multiplication over Addition**
$=6x+2x-12$	**Commutative Property of Addition**
$\boxed{=8x-12}$	**Combine Like Terms**

You try 2: Simplify the expression below. Justify each step.

$$-2(8y-4)+9y+6$$

$-2(8y-4)+9y+6$	**Given**
$=-16y+8+9y+6$	**Distributive Property of Multiplication over Addition**
$=-16y+9y+8+6$	**Commutative Property of Addition**
$\boxed{=-7y+14}$	**Combine Like Terms**

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The teacher may want to use the "Sage and Scribe" activity for the following problem to encourage student discourse. It is sometimes to referred to as "Brain and the Hand". Students take turns being the Sage/Brain and Scribe/Hand.

Setup: Student 1 is the Sage/Brain and Student 2 is the Scribe/Hand.

- The Sage/Brain tells the Scribe/Hand what to write
- The Scribe/Hand writes only what the Sage/Brain says. If the Sage/Brain doesn't know what to do or makes a mistake, the Scribe/Hand may ask questions or give hints for guidance
- The Scribe/Hand praises the Sage/Brain for a job well done. "Nice job, Sage/Brain!"
- Students switch roles for the next problem (or next method)

Example 3: Simplify the expression below using two methods. Justify each step.

$$10\left[9 + y + (-4)\right]$$

$10\left[9 + y + (-4)\right]$	**Given**	$10\left[9 + y + (-4)\right]$	**Given**
$= 10\left[9 + (-4) + y\right]$	**Commutative Prop. of +**	$= 90 + 10y + (-40)$	**Distributive Property**
$= 10\left[5 + y\right]$	**Combine Like Terms**	$= 90 + (-40) + 10y$	**Commutative Prop. of +**
$= 50 + 10y$	**Distributive Property**	$= 50 + 10y$	**Combine Like Terms**
$\boxed{= 10y + 50}$	**Commutative Prop. of +**	$\boxed{= 10y + 50}$	**Commutative Prop. of +**

You try 3: Simplify the expression below using two methods. Justify each step.

$$-6\left[-x + 5 + 2x\right]$$

$-6\left[-x + 5 + 2x\right]$	**Given**	$-6\left[-x + 5 + 2x\right]$	**Given**
$= -6\left[-x + 2x + 5\right]$	**Commutative Prop. of +**	$= 6x - 30 - 12x$	**Distributive Property**
$= -6\left[x + 5\right]$	**Combine Like Terms**	$= -12x + 6x - 30$	**Commutative Prop. of +**
$\boxed{= -6x - 30}$	**Distributive Property**	$\boxed{= -6x - 30}$	**Simplify**

Example 4: Solve the equation below. Justify each step.

$$3x + 5 = -13$$

$3x + 5 = -13$	**Given**
$3x + 5 - 5 = -13 - 5$	**Subtraction Property of Equality**
$3x + 0 = -18$	**Combining Like Terms**
$3x = -18$	**Identity Property of Addition**
$\dfrac{3x}{3} = \dfrac{-18}{3}$	**Division Property of Equality**
$1x = -6$	**Simplify**
$\boxed{x = -6}$	**Multiplicative Identity**

You try 4: Solve the equation below. Justify each step.

$$12 = 2(x - 4)$$

$12 = 2(x - 4)$	**Given**
$12 = 2x - 8$	**Distributive Property of Multiplication over Addtion**
$12 + 8 = 2x - 8 + 8$	**Addition Property of Equality**
$20 = 2x + 0$	**Combine Like Terms**
$20 = 2x$	**Additive Identity**
$10 + 10 = x + x$	**Decomposition**
$10 = x$	
$\boxed{x = 10}$	**Symmetric Property of Equality**

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An exit slip can be used as a quick formative assessment. Have the students pair up and give Partner A one slip and Partner B the other. Have each student fill in the first line (1). When both students have finished, exchange slips. Each partner checks the first line (1). If they think there is a mistake they must discuss and come to an agreement. Each student then fills in the second line (2) and the slips are exchanged again. Repeat until all four lines have been filled in. Collect as they leave in order to check for understanding.

Exit Slip (Partner A)

Simplify the expression below. Justify each step.

$3(x+5)+2x$

$3(x+5)+2x$	_____ (1)	**Partner A**
$=$ _____ (2)	**Distributive Property**	**Partner B**
$=3x+2x+15$	_____ (3)	**Partner A**
$=$ _____ (4)	**Combine Like Terms**	**Partner B**

Exit Slip (Partner B)

Solve the equation below. Justify each step.

$2y-6=-10$

$2y-6=-10$	**Given**	
_____ $=$ _____ (1)	**Addition Property of Equality**	**Partner B**
$2y+0=-4$	**Combine Like Terms**	
$2y=-4$	_____ (2)	**Partner A**
$\dfrac{2y}{2}=\dfrac{-4}{2}$	**Division Property of Equality**	
$1y=-2$	_____ (3)	**Partner B**
$y=-2$	_____ (4)	**Partner A**