Name: _____   Date: _____

Notes: Properties of Real Numbers

Do Now: Solve the following equation for x.
$$6 + 5(7 + 2x) = 8x - 13$$

$6 + 35 + 10x = 8x - 13$

$41 + 10x = 8x - 13$

$2x = -54$

$x = -27$

Match the properties on the left with their corresponding math on the right.

D Commutative Property of Addition   A) $a \cdot 0 = 0$

B Associative Property of Addition   B) $a + (b + c) = (a + b) + c$

H Commutative Property of Multiplication   C) $a(b + c) = ab + ac$

G Associative Property of Multiplication   D) $a + b = b + a$

C Distributive Property   E) $a \cdot 1 = a$

F Identity Property of Addition   F) $a + 0 = a$

E Identity Property of Multiplication   G) $(ab)c = a(bc)$

A Zero Property of Multiplication   H) $ab = ba$

What Should I Be Able to Do?

- I can explain the commutative property and give one addition and one multiplication example.
- I can explain the associative property and give one addition and one multiplication example.
- I can explain the distributive property and give an example.
- I can explain the identity property and give one addition and one multiplication example.
- I can explain the inverse property and give one addition and one multiplication example.
- I can explain the zero property and give an example.
- I can explain the addition property of equality and give an example.
- I can explain the subtraction property of equality and give an example.
- I can explain the multiplication property of equality and give an example.
- I can explain the division property of equality and give an example.

Properties of Real Numbers

Think "Commute" which means to PHYSICALLY MOVE!

1) **Commutative:** Numbers can be added or multiplied in any order.

$+$

$5+2=7 \qquad 2+5=7$

$5+2=2+5$

$a+b=b+a$

$\times$

$5(2)=10 \qquad 2(5)=10$

$5(2)=2(5)$

$ab=ba$

2) **Associative:** Add or multiply regardless of how the numbers are grouped.

$+$

$(1+2)+3=6 \qquad 1+(2+3)=6$

$(1+2)+3=1+(2+3)$

$(a+b)+c=a+(b+c)$

$\times$

$(2\cdot3)\cdot4=24 \qquad 2\cdot(3\cdot4)=24$

$(2\cdot3)\cdot4=2\cdot(3\cdot4)$

$(ab)c=a(bc)$

3) **Identity:** When you add/multiply to obtain the same number.

$+$

$5+0=5$

$a+0=a$

$\times$

$5\cdot1=5$

$a\cdot1=a$

4) **Inverse:** When you add/multiply to obtain the identity.

$+$

Identity: 0

$5+(-5)=0$

$a+(-a)=0$

$\times$

Identity: 1

$5\cdot\frac{1}{5}=1$

$\frac{a}{b}\cdot\frac{b}{a}=1$

5) Distributive: Multiply a sum or difference by multiplying each addend separately and then add the products.

$$5(x+2) = 15$$
$$5(x) + 5(2) = 15$$
$$5x + 10 = 15$$

6) Zero Property: Any value multiplied by 0 has a product of 0.

$$9(0) = 0$$
$$x(0) = 0$$

7) Addition Property of Equality: Add the same quantity to both sides of the equation.

$$x - 3 = 17$$
$$+3 \quad +3$$
$$x = 20$$

8) Subtraction Property of Equality: Subtract the same quantity to both sides of the equation.

$$x + 2 = 10$$
$$-2 \quad -2$$
$$x = 8$$

9) Multiplication Property of Equality: Multiply the same quantity to both sides of the equation.

$$(3)\frac{x}{3} = 9(3)$$
$$x = 27$$

10) Division Property of Equality: Divide the same quantity to both sides of the equation.

$$\frac{5x}{5} = \frac{10}{5}$$
$$x = 2$$

Checkpoint:

1 When solving the equation $5(x-6)+5=9$, Mary wrote $5(x-6)=4$ as her first step. Which property justifies Mary's first step? $\quad -5 \cdot 5 \quad \rightarrow$
(1) subtraction property of equality
(2) distributive property of multiplication over subtraction
(3) associative property
(4) multiplication property of equality

2 A part of Bianca's work to solve the equation $3(7x^2-10)=15x^2-8x$ is shown below

Given: $3(7x^2-10)=15x^2-8x$
Step 1: $21x^2-30=15x^2-8x$

What property did Bianca use to obtain step 1?
(1) addition property of equality
(2) distributive property of multiplication over subtraction
(3) associative property
(4) multiplication property of equality

3 Given $\blacksquare \neq 0$, the equation where $\nabla(\blacksquare)=\blacksquare$ is an example of the
(1) associative property
(2) inverse property
(3) identity property
(4) zero property

4 When solving for the value of x in the equation $-5(3x-9)+5=65$, Guillermo wrote the following lines on his paper.

[line 1] $-5(3x-9)+5=65$ ✔
[line 2] $-5(3x-9)=60$ ✔
[line 3] $-15x-45=60$ ✘
[line 4] $-15x=105$
[line 5] $x=-7$

Between which two lines did Guillermo make a mistake using a property, which resulted in the incorrect answer?
(1) line 1 – line 2   (3) line 3 – line 4
(2) line 2 – line 3   (4) line 4 – line 5

Success Criteria

- I can explain the commutative property and give one addition and one multiplication example.

Numbers can be added or multiplied in any order.

$$10 + 11 = 11 + 10 \qquad 6(3) = 3(6)$$

- I can explain the associative property and give one addition and one multiplication example.

Add or multiply regardless of how the numbers are grouped.

$$(2 \cdot 5) + 9 = 2 + (5 + 9) \qquad (2 \cdot 5) \cdot 9 = 2 \cdot (5 \cdot 9)$$

- I can explain the distributive property and give an example.

Multiply a sum of a difference by multiplying each addend separately and then add the products.

$$7(x + 9) = 7x + 63$$

- I can explain the identity property and give one addition and one multiplication example.

When you add or multiply to obtain the same number.

$$6 + 0 = 6 \qquad 6(1) = 6$$

- I can explain the inverse property and give one addition and one multiplication example.

When you add or multiply to obtain the identity.

$$9 + (-9) = 0 \qquad \frac{3}{4}\left(\frac{4}{3}\right) = 1$$

- I can explain the zero property and give an example.

Any value multiplied by 0 has a product of 0.

$$500(0) = 0$$

- I can explain the addition property of equality and give an example.

Add the same quantity to both sides of an equation.

$$\begin{aligned} x - 7 &= 9 \\ +7 \quad &+7 \end{aligned} \qquad x = 16$$

- I can explain the subtraction property of equality and give an example.

Subtract the same quantity to both sides of an equation.

$$\begin{aligned} x + 7 &= 8 \\ -7 \quad &-7 \end{aligned} \qquad x = 1$$

- I can explain the multiplication property of equality and give an example.

Multiply the same quantity to both sides of an equation.

$$(5)\frac{x}{5} = 12(5) \qquad x = 60$$

- I can explain the division property of equality and give an example.

Divide the same quantity to both sides of an equation.

$$\frac{3x}{3} = \frac{12}{3} \qquad x = 4$$

Classwork: Properties of Real Numbers

1 State whether each statement is *true* or *false*. If *true*, state the property of real numbers that proves the statement true. If *false*, give a counterexample.

a For all real numbers x, $x(1) = x$.

True, Zero Property

b For all real numbers a, b, and c, $(ab)c = a(bc)$.

True, Associative Property of Multiplication

c For all real numbers g and h, $-2(g - h) = -2g - 2h$.

False, $-2(g-h)$
$-2g + 2h \neq -2g - 2h$

2 Which equation illustrates the additive inverse property?

(1) $\Omega\left(\frac{1}{\Omega}\right) = 1$
(2) $\Omega + (-\Omega) = 0$
(3) $\Omega + \Omega = 2\Omega$
(4) $\Omega(\Omega) = \Omega^2$

3 The equation $\vartheta(\blacksquare + \varDelta) = \vartheta\blacksquare + \vartheta\varDelta$ is an example of the
(1) associative property
(2) commutative property
(3) distributive property
(4) identify property of multiplication

4 Juliane is solving the equation $2(3x - 9) = -6$ is shown below. Identify the property used to obtain each of the steps.

$2(3x - 9) = -6$

$6x - 18 = -6$ *Distributive Property*

$6x = 12$ *Addition Property of Equality*

$x = 2$ *Division Property of Equality*

5 When solving the equation $(5 + 7) + 10 = x$, Ben rewrote the equation $5 + (7 + 10) = x$ as his first step. Which property justifies Ben's first step?
(1) addition property of equality
(2) distributive property of multiplication over addition
(3) associative property
(4) commutative property

6 A part of Hank's work to solve the equation $5(2x^2 - 10x) = 35x^2 - 25$ is shown below

Given: $5(2x^2 - 10x) = 35x^2 - 25$
Step 1: $2x^2 - 10x = 7x^2 - 5$

What property did Hank use to obtain step 1?
(1) division property of equality
(2) distributive property of multiplication over subtraction
(3) associative property
(4) subtraction property of equality

7 When solving for the value of x in the equation $-6(x - 5) + 2(4x + 3) = 12$, Layla wrote the following lines on his paper.
[line 1] $-6x + 30 + 8x + 6 = 12$ ✓
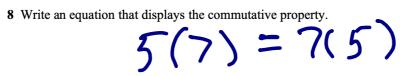[line 2] $2x + 36 = 12$ ✓
[line 3] $2x = 48$ ✗
[line 4] $x = 24$

Which property did Layla perform incorrectly, which resulted in the incorrect answer?
(1) line 1 – line 2
(2) line 2 – line 3
(3) line 3 – line 4
(4) Laya did not make a mistake.

8 Write an equation that displays the commutative property.

$$5(7) = 7(5)$$

Name: _____   Date: _____

Homework: Properties of Real Numbers

1 Janita simplified an equation to $-b + b = 0$. Which property of real numbers is shown by this equation?

(1) additive identity property
(2) multiplicative identity property
(3) additive inverse property
(4) multiplicative inverse property

2 Given the following equations:

I. $a + b = b + a$ III. $5a(8a^2) = 8a^2(5a)$
II. $a + (b + c) = (a + b) + c$ IV. $ab = ba$

Which equations(s) represent the commutative property?
(1) I and IV, only   (3) I, II, III, and IV
(2) II, only   (4) I, III, and IV

3 Brittany is solving the equation $(7 - 4x)2 = -34$ is shown below. Identify the property used to obtain each of the steps.

$(7 - 4x)2 = -34$

$2(7 - 4x) = -34$ *Commutative Property of Multiplication*

$14 - 8x = -34$ *Distributive Property*

$-8x = -48$ *Subtraction Property of Equality*

$x = 6$ *Division Property of Equality*

4 When solving the equation $7(2x^2 - 4) - 11 = 5x^2 - 2$, Emilia rewrote the equation $7(2x^2 - 4) = 5x^2 + 9$ as her first step. Which property justifies Emilia's first step?
(1) distributive property of multiplication over subtraction
(2) addition property of equality
(3) associative property
(4) division property of equality

5 State whether each statement is *true* or *false*. If *true*, state the property of real numbers that proves the statement true. If *false*, give a counterexample.

    a For all real numbers x and y, $x(y) = y + x$.

False, $2(3) \neq 3 + 2$

                  $6 \neq 5$

    b For all real numbers a, $a + 0 = a$.

True, Identity Property of Addition

    c For all real numbers x, y, and z, $x(y + z) = xy + xz$.

True, Distributive Property

6 The equation $\sqcup\sqcap = \sqcap\sqcup$ is an example of the
(1) associative property
(2) commutative property
(3) distributive property
(4) identity property of multiplication

7 Which equation correctly illustrates the distributive property?

(1) w(x) = x(w)
(2) −w(x − y) = −wx − wy
(3) w(x + y) = wx − wy
(4) −w(−x − y) = wx + wy