Types of and Properties of Real Numbers

Name ______________________________ Class __________

Types of Real Numbers:

Natural: Counting numbers Example: 1, 2, 3, 4, …	*Whole:* The set of numbers containing *zero* and all of the *natural numbers* Example: 0, 1, 2, 3, 4, …	*Integer:* The set of numbers containing zero, the natural numbers, and all the negatives of the natural numbers. Example: …, -3, -2, -1, 0, 1, 2, 3, …
Rational: A number that can be expressed as the ratio of two integers. (Either terminates **or** repeats) Example: -½, 6.25, $0.\overline{318}$, $\sqrt{4}$, etc…	*Irrational:* A number that can**not** be expressed as the ratio of two integers. (Doesn't terminate **and** doesn't repeat) Example: 0.121221222…, $\sqrt{3}$, π, etc…	*Real:* The combined set of rational and irrational numbers. Basically any number that can be represented on a number line. Includes naturals, wholes, and integers.

Properties of Real Numbers

Addition and multiplication are closed under the reals.

Property Name	*Example*	*Description in Your Words*
Distributive Property $a \cdot (b+c) = a \cdot b + a \cdot c$	$3 \cdot (4+5) = 3 \cdot 4 + 3 \cdot 5$	Multiply the number on the outside of the parentheses by each number on the inside
Commutative Property of Addition $a + b = b + a$	$3 + 4 = 4 + 3$	You can add numbers in any order

Commutative Property of Multiplication $a \cdot b = b \cdot a$	$3 \cdot 4 = 4 \cdot 3$	You can multiply numbers in any order
Associative Property of Addition $a + (b + c) = (a + b) + c$	$3 + (4 + 5) = (3 + 4) + 5$	You can change groups when adding
Associative Property of Multiplication $a \cdot (b \cdot c) = (a \cdot b) \cdot c$	$3 \cdot (4 \cdot 5) = (3 \cdot 4) \cdot 5$	You can change groups when multiplying.
Additive Identity Property $a + 0 = a$	$4 + 0 = 4$	Any number plus zero is itself
Multiplicative Identity Property $a \cdot 1 = a$	$4 \cdot 1 = 4$	Any number times one is itself.
Additive Inverse Property $a + (-a) = 0$	$4 + (-4) = 0$	Any number plus its negation is zero
Multiplicative Inverse Property, where $4 \cdot \left(\frac{1}{4}\right) = 1$, $a \neq 0$	$4 \cdot \left(\frac{1}{4}\right) = 1$	Any number multiplied by its reciprocal is 1
Zero Property of Multiplication $a \cdot 0 = 0$	$4 \cdot 0 = 0$	Zero multiplied by any number is 0.

Addition Property of Equality If $a = b$, then $a + c = b + c$	If $x = 10$, then $x + 3 = 10 + 3$	You can add the same number to both sides of an equation, and it will still be equal
Subtraction Property of Equality If $a = b$, then $a - c = b - c$	If $x = 10$, then $x - 3 = 10 - 3$	You can subtract the same number from both sides of the equation and it will still be equal.
Multiplication Property of Equality If $a = b$, then $a \cdot c = b \cdot c$	If $x = 10$, then $x \cdot 3 = 10 \cdot 3$	You can multiply by the same # on both sides of an equation and it will still be equal.
Division Property of Equality If $a = b$, then $a \div c = b \div c$, where $c \neq 0$	If $x = 10$, then $x / 3 = 10 / 3$	You can divide by the same # (except on both sides of an equation and it will still be equal.
Substitution Property If $a = b$, then a may be substituted for b, or conversely	If $x = 5$ and $x + y = z$, then $5 + y = z$	You can replace one #/variable for another
Reflexive (Identity) Property of Equality $a = a$	$12 = 12$	A #/variable is equal to itself.
Symmetric Property of Equality If $a = b$ then $b = a$	If $x = 2.7$ then $2.7 = x$	You can change the order in an equation.
Transitive Property of Equality If $a = b$ and $b = c$, then $a = c$.	If $5x = 12$ and $12 = 3z$ then $5x = 3z$	You can take out the "middle man"

1 Which choice is equivalent to $-3(5+x)+4x$?

(1) $4x+(-15+3x)$
(2) $4x+(-3x-15)$
(3) $(-15+3x)+4x$
(4) $-15+3x+4x$

$-15-3x+4x$

2 According to the Multiplicative Identity, $(x+7)\cdot \boxed{1} = \boxed{x}+7$, which choice shows the correct box entries (in order)?

multiply by 1

(1) 0, (x + 7)
(2) 0, 0
(3) 1, (x + 7)
(4) 1, 1

3 What is the additive inverse of $a-b$?

(1) $-a+b$
(2) $a+b$
(3) $a-b$
(4) $-a-b$

$-a+b$ negate

$a+(-a)=0$
$-b+b=0$

4 Which property is illustrated by the statement $9+(x+5)=9+(5+x)$?

(1) Associative Property of Addition
(2) Distributive Property
(3) Associative Property of Multiplication
(4) Commutative Property of Addition

change order

5 Which property is illustrated by the statement $3.5a+0=3.5a$?

(1) Additive Inverse Property
(3) Distributive Property
(3) Zero Property of Multiplication
(4) Additive Identity Property

Add 0, = itself

Identify the property.

6 $x(yz)=x(zy)$

Commutative of mult.

7 $2(x+y)=2x+2y$

Distributive

8 $(x+y)+z=(y+x)+z$

Commutative of add.

9 $(x+y)+z=x+(y+z)$

Associative of add.

10 Using the Distributive Property, write an expression equivalent to $5(x-6)$.

$5x-30$

11 Using the Distributive Property, write an expression equivalent to $6x+12$.

$6(x+2)$

12 Using the Distributive Property, write an expression equivalent to $-5x - 25$.

$-5(x+5)$

13 Using the Commutative Property, write an equivalent expression for $5 \cdot (7x)$.

$5 \cdot (x \cdot 7)$ or $(7x) \cdot 5$

14 The following equation is solved. Identify what properties are used to solve the equations.

$$4 \cdot \frac{3}{4}x = 9 \cdot 4$$

$3x = 36$ ($\frac{3x}{3} = \frac{36}{3}$)	Mult. Prop. of Eq.
$1x = 12$	Div. Prop. of Eq.
$x = 12$	Mult. Identity Prop.

15 The following equation is solved. Identify what properties are used to solve the equations.

$$\frac{1}{2}x - g = m$$
$+g \quad +g$

$\frac{1}{2}x + 0 = m + g$	Add. Prop. of Equality
$\frac{1}{2}x = m + g$	Add. Identity Prop.
$1x = (m+g)2$	Multiplication Prop. of Equality
$x = (m+g)2$	Mult. Identity Prop.
$x = 2m + 2g$	Distributive Prop.

16 The following equation is solved. Identify what properties are used to solve the equations.

$$3(5 - 5x) = 5x$$

$15 - 15x = 5x$ ($+15x \quad +15x$)	Distributive
$15 + 0 = 20x$	Add. Prop. of Eq.
$15 = 20x$ ($\frac{15}{20} = \frac{20x}{20}$)	Additive Identity
$\frac{3}{4} = 1x$	Division Prop. of Eq.
$\frac{3}{4} = x$	Multiplicative Id.
$x = \frac{3}{4}$	Reflexive Property

17 The following equation is solved. Identify what properties are used to solve the equations.

$$\frac{3}{4}(x+2)=6(x+12)$$

$\frac{3}{4}x+\frac{6}{4}=6x+72$ $-6/4$ $-6/4$	Distributive Prop.
$\frac{3}{4}x+0=6x+\frac{282}{4}$	Subtraction Prop. of Eq.
$\frac{3}{4}x=6x+\frac{282}{4}$ $-6x$ $-6x$	Add. Identity Property
$4\cdot -\frac{21}{4}x=\frac{282}{4}\cdot 4$	Subtraction Prop. of Eq.
$-21x=282$	Multiplication Prop. of Eq.
$1x=-\frac{282}{21}$	Division Prop. of Eq.
$x=-\frac{282}{21}$	Mult. Identity Prop.

18 The following expression is simplified. Write a justification for each step.

$$12+3(a+2b-1)-2a-3b-9+b$$

$12+3a+6b-3-2a-3b-9+b$	Distributive Property	1
$12-3-9+3a-2a+6b-3b+b$	Commutative Property	2
$(12-3-9)+(3a-2a)+(6b-3b+b)$	Associative Property	3
$(0)+(3a-2a)+(6b-3b+b)$	just adding	4
$(3a-2a)+(6b-3b+b)$	Add. Identity Property	5
$a(3-2)+b(6-3+1)$	Distributive property	6
$a(1)+b(4)$	Just adding/subtracting	7
$1a+4b$	Commutative Prop.	8
$a+4b$	Mult. Identity Prop.	9