Algebra I Notes #3 page 1 Properties of Addition and Subtraction Unit 1

Consider the following examples.

$3 + 5 = 8$ and $5 + 3 = 8$. Therefore, $3 + 5 = 5 + 3$

$7 + 2 = 9$ and $2 + 7 = 9$. Therefore, $7 + 2 = 2 + 7$

$20 + 35 = 55$ and $35 + 20 = 55$. Therefore, $20 + 35 = 35 + 20$

In general, $x + y = y + x$. This property is called the Commutative Law of Addition.

Consider the following examples.

$(3 + 4) + 5 = 7 + 5 = 12$ and $3 + (4 + 5) = 3 + 9 = 12$. Therefore, $(3 + 4) + 5 = 3 + (4 + 5)$

$(7 + 2) + 8 = 9 + 8 = 17$ and $7 + (2 + 8) = 7 + 10 = 17$. Therefore, $(7 + 2) + 8 = 7 + (2 + 8)$

$(1 + 3) + 6 = 4 + 6 = 10$ and $1 + (3 + 6) = 1 + 9 = 10$. Therefore, $(1 + 3) + 6 = 1 + (3 + 6)$

In general, $(x + y) + z = x + (y + z)$. This is called the Associative Law of Addition.

Consider the following examples.

$5 + 0 = 5$ $8 + 0 = 8$ $0 + 7 = 7$ $0 + 2 = 2$
In general, $x + 0 = x$ and $0 + x = x$. This is called the Identity Law of Addition.

Consider the following examples.

$5 + -5 = 0$ $8 + -8 = 0$ $-7 + 7 = 0$ $-2 + 2 = 2$
In general, $x + -x = 0$. This is called the Inverse Law of Addition.
$-x$ is called the opposite of x or the additive inverse of x.

Consider the following examples.

$8 – 3 = 5$ and $8 + -3 = 5$. Therefore, $8 – 3 = 8 + -3$.

$12 – 8 = 4$ and $12 + -8 = 4$. Therefore, $12 – 8 = 12 + -8$.

$3 – 5 = -2$ and $3 + -5 = -2$. Therefore, $3 – 5 = 3 + -5$.

In general, $x – y = x + -y$. This is called the Definition of Subtraction.

Here is a summary of these properties. In all cases, the variables used represent numbers.

Commutative Law of Addition: $x + y = y + x$
Associative Law of Addition: $(x + y) + z = x + (y + z)$
Identity Law of Addition: $x + 0 = x$
Inverse Law of Addition: $x + -x = 0$
Definition of Subtraction: $x – y = x + -y$

Algebra I Notes #3 page 2 Properties of Multiplication and Division Unit 1

Consider the following examples.

$3 \cdot 5 = 15$ and $5 \cdot 3 = 15$. Therefore, $3 \cdot 5 = 5 \cdot 3$

$7 \cdot 2 = 14$ and $2 \cdot 7 = 14$. Therefore, $7 \cdot 2 = 2 \cdot 7$

$6 \cdot 8 = 48$ and $8 \cdot 6 = 48$. Therefore, $6 \cdot 8 = 8 \cdot 6$

In general, $x \cdot y = y \cdot x$. This property is called the Commutative Law of Multiplication.

Consider the following examples.

$(3 \cdot 4) \cdot 5 = 12 \cdot 5 = 60$ and $3 \cdot (4 \cdot 5) = 3 \cdot 20 = 60$. Therefore, $(3 \cdot 4) \cdot 5 = 3 \cdot (4 \cdot 5)$

$(7 \cdot 2) \cdot 8 = 14 \cdot 8 = 112$ and $7 \cdot (2 \cdot 8) = 7 \cdot 16 = 112$. Therefore, $(7 \cdot 2) \cdot 8 = 7 \cdot (2 \cdot 8)$

$(9 \cdot 3) \cdot 6 = 27 \cdot 6 = 162$ and $9 \cdot (3 \cdot 6) = 9 \cdot 18 = 162$. Therefore, $(9 \cdot 3) \cdot 6 = 9 \cdot (3 \cdot 6)$

In general, $(x \cdot y) \cdot z = x \cdot (y \cdot z)$. This is called the Associative Law of Multiplication.

Consider the following examples.

$5 \cdot 1 = 5$ $\quad 8 \cdot 1 = 8$ $\quad 1 \cdot 7 = 7$ $\quad 1 \cdot 2 = 2$
In general, $x \cdot 1 = x$ and $1x = x$. This is called the Identity Law of Multiplication.

Consider the following examples.

$5 \cdot 1/5 = 1$ $\quad 8 \cdot 1/8 = 1$ $\quad 1/7 \cdot 7 = 1$ $\quad 1/2 \cdot 2 = 1$
In general, $x \cdot 1/x = 1$. This is called the Inverse Law of Multiplication. $1/x$ is called the reciprocal of x or the multiplicative inverse of x. (x can not be 0.)

Consider the following examples.

$8 \div 3 = 8/3$ and $8 \cdot (1/3) = 8/3$. Therefore, $8 \div 3 = 8 \cdot 1/3$.

$4 \div 7 = 4/7$ and $4 \cdot (1/7) = 4/7$. Therefore, $4 \div 7 = 4 \cdot 1/7$.

$3 \div 5 = 3/5$ and $3 \cdot (1/5) = 3/5$. Therefore, $3 \div 5 = 3 \cdot 1/5$.

In general, $x \div y = x \cdot 1/y$. This is called the Definition of Division. (y can not be 0.)

Here is a summary of these properties. In all cases, the variables used represent numbers.

Commutative Law of Multiplication: $x \cdot y = y \cdot x$
Associative Law of Multiplication: $(x \cdot y) \cdot z = x \cdot (y \cdot z)$
Identity Law of Multiplication: $1x = x$
Inverse Law of Multiplication: If $x \neq 0$, then $x \cdot 1/x = 1$.
Definition of Division: If $y \neq 0$, then $x \div y = x \cdot 1/y$.