Algebra Unit 1: The Number System Name: _____Answer Key______

Study Guide and Review Sheet Date : ___________ Period: ___

Define and/or give examples of each term or phrase. (Sample responses are provided.)

**Absolute Value of a number:** The number of units a number is from zero. This number cannot be a negative number. The absolute value of a number is either positive or zero.

Examples: The Absolute value of 5 is 5. The Absolute value of -9 is 9.

The Absolute Value of 0 is 0.

**Additive Inverse (opposite):** The number that can be added to get a sum of 0.

Examples: 5 and -5 are additive inverses (opposites) of each other because 5 + (-5) = 0.

-3.75 and 3.75 are additive inverses (opposites) of each other because -3.75 + 3.75 = 0.

0 and 0 are additive inverses (opposites) of each other because 0 + 0 = 0.

**Base:** The base of an exponential expression is the value that is multiplied by itself.

Examples: $3^2$ 3 is the base. This expression means 3 times itself 2 times. ($3^2$=3x3=9)

$1.5^3$ 1.5 is the base. This expression means 1.5 times itself 3 times.($1.5^3$=1.5x1.5x1.5=3.375)

**Coefficient:** The constant that is multiplied by the variable or variables.

Examples: The coefficient of 3xy is 3. The coefficient of y is 1. The coefficient of $\frac{x}{4}$ is $\frac{1}{4}$.

**Combining Like Terms:** Like Terms have the same variables with the same exponents. To combine like terms, add the coefficients.

Examples: $5xy^2$ and -3xy are ***not like terms*** because the exponents are not the same. They cannot be combined (added together). $8x^2$ and $-6x^2$ are ***like terms*** because they have the same variables and the same exponents. They can be combined (added together).
$8x^2 + (-6x^2) = 2x^2$ -2.5x + 3x = 0.5x -x + 5y + 6x + (-7y) = 5x + (-2y)

**Constant:** A constant is a value that doesn't change. All real numbers are constants. This includes rational numbers like 4, -8, 3.25, and $\frac{2}{3}$ as well as irrational numbers like $\pi$.

**Difference:** The result of a subtraction problem. The difference between 4 and 8 is -4 because 4 – 8 = -4. The difference between 5.75 and 3.4 is 2.35 because 5.75 – 3.4 = 2.35.

**Distributive Property:** The distributive property can be used to either multiply by a sum or difference or to write a sum or difference as a product.

Examples: $3(x + 5) = 3x + 15$ $5x(x - 7) = 5x^2 - 35x$ $12a + 6b = 6(2a + b)$

**Equation:** A mathematical sentence involving an equal sign. ( = )

**Evaluate:** Perform all operations.

**Exponent (Power):** An exponent or power is a raised number that indicates how many times to multiply the base by itself.

Example: $2^4$ 4 is the exponent and means to multiply 2 by itself 4 times. $2^4 = 2 \times 2 \times 2 \times 2 = 16$

**Expression:** A series of operations involving constants and variables without an equal sign.

**Inequality:** A mathematical sentence involving an inequality symbol. ( $<, >, \leq, \geq$ )

**Integer:** A whole number or its opposite. (…, -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5, …)

**Interval:** The number you are counting by. In the set -6, -4, -2, 0, 2, the interval is 2. In the set 0, 10, 20, 30, 40, the interval is 10.

**Irrational Number:** A number that cannot be expressed as a ratio of integers.

Examples: $\pi, \sqrt{2}, \sqrt{15}$

**Multiplicative Identity:** The number 1. One is the multiplicative identity because a number times 1 is itself. $4 \times 1 = 4$ $\frac{1}{2} \times 1 = \frac{1}{2}$

**Multiplicative Inverse (Reciprocal):** The number that can be multiplied to get a product of 1.

Examples: 2 and $\frac{1}{2}$ are multiplicative inverses (reciprocals) of each other because $2 \times \frac{1}{2} = 1$.
$-\frac{2}{3}$ and $-\frac{3}{2}$ are multiplicative inverses (reciprocals) of each other because $(-\frac{2}{3}) \times (-\frac{3}{2}) = 1$ .
0 does not have a multiplicative inverse (reciprocal) because no number times 0 equals 1.

**Number Line:** A horizontal or vertical line that counts by a chosen interval. All numbers on the number line indicate a location away from 0.

**Order of Operations:** The agreed upon order in which operations must be applied. (1) Evaluate all operations within grouping symbols. (2) Apply exponents. (3) Multiply or divide from left to right. (4) Add or subtract from left to right.

**Product:** The result of a multiplication problem. The product of -6 and 10 is -60 because $-6 \times 10 = -60$.

**Quotient:** The result of a division problem. The quotient of 2 and 4 is $\frac{1}{2}$ because $2 \div 4 = \frac{1}{2}$.

**Rational Number:** A number that can be expressed as a ratio of integers.

Examples: 2 is a rational number because it can be written as $\frac{2}{1}$. 0.5 is a rational number because it can be written as $\frac{5}{10}$ or $\frac{1}{2}$. $.\overline{3}$ is a rational number because it can be written as $\frac{1}{3}$.

**Real Number:** Any rational or irrational number.

**Simplify:** Perform all operations.

**Substitute:** Replace one expression with an equivalent one.

**Sum:** The result of an addition problem. The sum of 5 and -3 is 2 because 5 + (-3) = 2.

**Variable:** A letter that represents a number or set of numbers.

**Whole Number:** The counting numbers and zero. 0, 1, 2, 3, 4, 5, …

Provide detailed responses for the following questions. (Sample responses are provided.)

**1. What symbols do practitioners use to create numeric and algebraic expressions?**

Addition: 10 + 6 Subtraction: 10 - 6 Division: division symbol 8 ÷ 4, division bar $\frac{8}{4}$

Multiplication: multiplication symbol 5x3; raised dot 5 · 3; parentheses 5(3), (5)3, or (5)(3); brackets 5[3], [5]3, or [5][3]; constants next to variables or grouping symbols 3y, $5|2|$, $4\sqrt{9}$

Exponents: $6^4$ read "Six to the fourth power" means to multiply 6 by itself 4 times.

Absolute Value Symbol: $|-15|$ read "The absolute value of negative fifteen" means "How many units is -15 away from zero?"

Radical Symbol: $\sqrt{25}$ read "The positive square root of 25" means "What positive number squared (or to the second power) is 25?"

**2. What are the different grouping symbols and how are they used?**

***Parentheses*** and ***brackets*** are used in the same way. They can show multiplication (see above) but they also force the order in which you evaluate other symbols. Any operation(s) within parentheses or brackets must be evaluated before the multiplication outside the parentheses or brackets. For example, in the expression $4(20 - 15)$, 20-15 must be evaluated before you multiply the result by 4.

***Absolute value*** and ***radical symbols*** are similar in the way they are used. Any operation(s) within the absolute value symbols or under the radical symbol must be evaluated before finding the absolute value or the square root. For example, in the expression $|3(2) + 5|$, 3(2) + 5 must be evaluated before you find the absolute value of the result. In the expression $\sqrt{9 + 3(3) - 4}$, 9 + 3(3) – 4 must be evaluated before you find the square root of the result.

A ***division bar***, forces you to evaluate the expressions in both the numerator and denominator before you complete the division. In the expression $\frac{25-9}{1+3}$, you must find the results of the expressions 25 – 9 and 1 + 3 first to get the new expression $\frac{16}{4}$. Lastly you will divide to get a result of 4.

**3. What are the different forms of numbers that practitioners use?**

Practitioners can represent numbers with either a fraction or a decimal notation.

**4. Why would a practitioner use one form of a number over another?**

Fractions/mixed numbers can be used to represent any rational number. These are often more exact and can be easier to work with in certain expressions. Practitioners would almost exclusively use fractions/mixed numbers when measuring with standard units like inches, feet, yards, pounds, gallons, etc.

Decimals (which are representations of common fractions) are often used when exact numbers are not necessary and a quantity is to be rounded. Practitioners would almost exclusively use decimals when they are dealing with money or when measuring with metric units like centimeters, meters, grams, liters, etc.

**5. How are operations applied to different forms of numbers?**

***Fractions/Mixed Numbers***

Adding and Subtracting: Fractions must be converted to a common denominator before they can be added together or subtracted from one another. Depending on the problem, add or subtract numerators while keeping the same denominator.

Multiplying: In order to multiply fractions, multiply numerators to get a new numerator. Then multiply denominators to get a new denominator. To multiply mixed numbers, first convert all mixed numbers to improper fractions before multiplying as described above.

Dividing: In order to divide by a fraction, convert the problem to an equivalent multiplication problem. To do this, multiply the first fraction by the reciprocal of the second fraction. To divide using mixed numbers, first convert all mixed numbers to improper fractions before dividing as described above.

***Decimals***

Adding and Subtracting: Decimal numbers can be added together or subtracted from each other by lining up the place value of the decimal numbers.

Multiplying: In order to multiply decimals numbers, multiply as you would with whole numbers but determine the place value of your result by counting the number of decimal digits.

Dividing: In order to divide by a decimal number, first convert to an equivalent division problem with a whole number divisor.

**6. How can fraction operations be used to justify decimal operations?**

Decimals are representations of common fractions with denominators of 10, 100, 1000, etc. The algorithms (plans for calculating) for working with decimals are based on the algorithms for working with fractions. Example: .7 x .9 means $\frac{7}{10} \times \frac{9}{10}$. By the fraction multiplication algorithm, the result would be $\frac{63}{100}$. Therefore, .7 x .9 = .63. We can predict the result by counting "decimal digits." Since tenths times tenths equals hundredths, seven tenths times nine tenths will equal sixty-three hundredths.

**7. How is simplifying numeric expressions similar to simplifying algebraic expressions?**

In order to add expressions together, they must be the same kind of expression. Fractions have to have a common denominator, decimals have to be lined up with the same place value, and variable expressions have to be "like terms".