Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Algebra II**

**Unit 0:**

**Basic Concepts of**

**Real Numbers**

**Priority Standards:** A-SSE.1a: Interpret parts of an expression, such as terms factors and coefficients

**Unit “I can” statements:**

1. I can graph real numbers on a number line, to compare numbers, and to find their absolute value.
2. I can simplify numerical expressions and evaluate algebraic expressions.
3. I can identify and apply properties of equality of real numbers and properties for adding and multiplying real numbers.
4. I can correctly apply the rules for adding, subtracting, multiplying, and dividing real numbers.

Common Core State Standards that are addressed in this unit include: A.SSE.1a, N-RN.B.3

For more information see [www.corestandards.org/Math/](http://www.corestandards.org/Math/)

**Real Numbers and Their Graphs**

This first chapter will serve as a review of some necessary skills and information that you learned in Algebra I. Some material may be new, but most of it should at least contain a familiar foundation. To begin with, let’s look at some of the sets of numbers that can be used for classifying numbers.

**Digits** - the symbols used to write **ALL** other numbers

 Examples:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Natural Numbers** – the counting numbers

 Examples:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Whole Numbers** – the counting numbers and zero

 Examples:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Integers** – positive and negative whole numbers

 Examples:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Rational Numbers** – any number that can be written as a fraction

 Examples:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Irrational Numbers** – any number that cannot be written as a fraction

 Examples:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Real Numbers** – any number on the number line

 Examples:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Imaginary Numbers** – the square root of a negative number

 Examples:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Break for Practice**: To which set(s) does each number belong?

1. 15 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ , \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ , \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ , \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ , \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ , \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ , \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 4. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. 4 \_\_\_\_\_\_\_\_\_\_\_\_ , \_\_\_\_\_\_\_\_\_\_\_\_ , \_\_\_\_\_\_\_\_\_\_\_\_ , \_\_\_\_\_\_\_\_\_\_\_\_ , \_\_\_\_\_\_\_\_\_\_\_\_ , \_\_\_\_\_\_\_\_\_\_\_\_

Since real numbers can be graphed, we should review the terminology and practice. Consider the number line shown below:

A B C D E F

The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of A is -6. The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of 4 is E. The graph of 0 is C, and

this point is called the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Break for Practice**: Use the number line above to answer the following questions.

1. What is the coordinate of B?
2. What is the coordinate of D?
3. What is the graph of 6?
4. What point is 1/3 of the way from A to F?

Numbers can be compared with inequalities. Rewrite each statement into symbols.

1. Five is greater than negative three.\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Negative four thirds is less than negative two thirds.\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Another concept that should be reviewed is that of absolute value.

Absolute Value: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 Examples:

**Extended Practice:**

|  |  |
| --- | --- |
| 1. Which set of numbers contains all but one of the other sets? Which set is not included in this set? | 2. Does a decimal such as 2.718 represent a rational or an irrational number? Explain. |
| 3. Does a repeating decimal such as represent a rational or an irrational number? Explain. | 4. What real number is neither positive nor negative? |
| 5. Write each statement using symbols. a) Zero is greater than negative six. b) Negative three is less than negative one. |
| 6. Find the coordinate of each point described. Use the number line below. A B C D E F G H I J K L M N P a) B b) The point halfway between D and J c) The point one fourth of the way from F to N |
| 7. Write an inequality statement comparing the two numbers. a) b) -1.5 and 0.5  |
| 8. Find the value of each expression.1. b) c)

  |
| 9. Arrange the list of numbers in order from least to greatest and graph the numbers on the number line.  |
| 10. On a number line, point A has coordinate -5 and point B has coordinate 1. Find the coordinate of each point described.1. The point 2 units to the left of B
2. The point 1.4 units to the right of A
3. Each point that is twice as far from A as from B
 |
| 11. Put a check mark in each box for which the number on the left of the chart belongs to the set across the top

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Integer** | **Digit** | **Rational** | **Irrational** | **Natural** | **Whole** | **Real** | **Imaginary** |
| 5 |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| 20.62 |  |  |  |  |  |  |  |  |
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|  |  |  |  |  |  |  |  |  |
| 0 |  |  |  |  |  |  |  |  |
| 1 |  |  |  |  |  |  |  |  |

 |

**Simplifying Expressions**

It is important to review the terminology and skills needed to simplify numerical expressions and evaluate algebraic expressions. Some of the terms that should be reviewed are in the tables on pages 6-9 in your book. Use these tables to answer the following questions.

1. What operation should you use when you are asked to find each of the following?
2. Sum b) Product c) Quotient d) Difference
3. In the expression 43, what is the 4 called? What is the 3 called?
4. Give 3 different examples of grouping symbols.

To simplify an expression, you need to reduce it down to its simplest form. In order to simplify, you need to know the order of operations. Number the following steps 1-4 in the order that they should be performed when simplifying an expression.

\_\_\_\_\_ Exponents

­­­\_\_\_\_\_ Multiplication and Division- **Work from left to right**

\_\_\_\_\_ Parentheses – **Work from inside to outside and from left to right**

\_\_\_\_\_ Addition and Subtraction- **Work from left to right**

**Break for Practice**: Simplify and show all work

1. 2.

3. 4.

5. 6.

7. Evaluate if

 a) b)

**Extended Practice**:

|  |
| --- |
| 1. Use one of the symbols < , = , or > to make a true statement. a) b) c)  |

**Extended Practice Continued**: Simplify.

|  |  |
| --- | --- |
| 2.  | 3.  |
| 4.  | 5.  |
| 6.  | 7.  |
| 8.  | 9.  |

**Extended Practice Continued:** Evaluate if

|  |  |  |
| --- | --- | --- |
| 10.  | 11.  | 12.  |

**Basic Properties of Real Numbers**

Another topic that should be reviewed is the various properties that we apply when working with Algebra. These properties help us to simplify and solve numerical and/or algebraic problems.

The first set of properties are called properties of equality. These are fairly straight forward even if some of the names are not.

**Properties of Equality**:

 Reflexive Property: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 Symmetric Property: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 Transitive Property: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 Addition Property: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 Multiplication Property: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The next set of properties are called **Field Axiom Properties**.

|  |  |
| --- | --- |
| **Name and Description** | **Example** |
| Commutative Property for Addition – numbers can be added in any order |  |
| Commutative Property for Multiplication – numbers can be multiplied in any order |  |
| Associative Property for Addition – numbers can be regrouped when adding |  |
| Associative Property for Multiplication – numbers can be regrouped when multiplying |  |
| Distributive Property – a single term in front of parentheses can be multiplied by two or more terms inside the parentheses |  |
| Identity Property for Addition – zero can be added to any number without changing the number’s value |  |
| Identity Property for Multiplication – any number can be multiplied by the number one without changing the value of the original number |  |
| Inverse Property for Addition (Property of Opposites) – for each number there is a unique opposite number so that the sum of the two numbers is zero |  |
| Inverse Property for Multiplication (Property of Reciprocals) – for each number (excluding zero) there is a unique reciprocal so that the product of the two numbers is one |  |
| Closure Property for Addition – a set is closed for addition when any two numbers in a set can be added and the sum still belongs to the same set |  |
| Closure Property for Multiplication – a set is closed for multiplication when any two numbers in a set can be multiplied and the product still belongs to the same set |  |

**Break for Practice:**

1. Match each axiom with its definition and example.

|  |  |  |
| --- | --- | --- |
| **Name** | **Definition** | **Example** |
| Commutative Property of Addition |  |  |
| Commutative Property of Multiplication |  |  |
| Associative Property of Addition |  |  |
| Associative Property of Multiplication |  |  |
| Identity Property of Addition |  |  |
| Identity Property of Multiplication |  |  |
| Inverse Property of Addition (Property of Opposites) |  |  |
| Inverse Property of Multiplication (Property of Reciprocals) |  |  |
| Distributive Property |  |  |

**Definitions:**

**Examples:**

 J.)

 K.)

 L.)

 M.)

 N.)

 O.)

 P.)

 Q.)

 R.)

A.) Multiplication distributes over addition

B.) Zero can be added to a number without changing the number’s identity

C.) Numbers can be multiplied in any order

D.) Numbers can be regrouped when adding

E.) Every number can be added to another number to give a value of zero

F.) 1 can be multiplied by a number without changing the number’s identity

G.) Numbers can be added in any order

H.) Every number can be multiplied by another number to give a value of 1

I.) Numbers can be regrouped when multiplying

 Identify the property used in each step.

2.

 =

 =

 = substitution

3.

 =

 =

 =

 = substitution

 =

 =

 =

 = ab

Simplify by applying the various properties.

 5. 6. 7.

**Extended Practice:** Simplify by applying the various properties.

|  |  |
| --- | --- |
| 1.  | 2.  |
| 3.  | 4.  |
| 5.  | 6.  |

**Extended Practice Continued:** Identify the property used in each step.

|  |
| --- |
| 7. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 8. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 9. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Substitution = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

**Basic Operations with Signed Numbers**

 The last topic to review in this unit is how to perform the basic operations of addition, subtraction, multiplication and division on signed numbers.

**Rules for Adding Signed Numbers:**

1. If the two numbers have the same sign, add their absolute values and keep their common sign.
2. If the two numbers have opposite signs, find the difference of their absolute values, and keep the sign of the number with the larger absolute value.

**Rule for Subtracting Signed Numbers:** To subtract any real number, add its opposite.

**Break for Practice**: Simplify each problem by applying the rules from above and using your knowledge of absolute value.

 1. 2. 3.

 4. 5. 6.

 7. 8.

**Definition**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are terms with the exact same variable parts. These can be added and subtracted.

**Break for Practice**: Simplify by applying the distributive property and/or combining like terms.

 9. 10. 11.

**Rules for Multiplying and Multiplying of Signed Numbers**:

1. The product of two positives or the product of two negatives is a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
2. The product of a positive and a negative is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
3. The absolute value of the product of two or more numbers is the product of their absolute values.

Example:

**Break for Practice:** Simplify

 12. 13. 14.

**Multiplicative Property of 0**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Multiplicative Property of -1**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Now let’s extend these ideas: Simplify

 a) b) c)

**Result**: When multiplying a set of numbers, the product is

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_if there are an even number of negative factors.
2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ if there are an odd number of negative factors.
3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ if any of the factors are zero.

**Property of the Opposite of a Product**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Property of the Opposite of a Sum**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Break for Practice**: Simplify

 15. 16.

 17. 18.

 19. 20.

 21. 22.

**Rules for Division and Division of Signed Numbers**:

1. A division problem can be rewritten as multiplication if you multiply by the reciprocal.

Example:

In general:

1. The quotient of two positives or two negatives is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
2. The quotient of a positive and a negative is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Break for Practice:** Simplify

23. 24.

 25. 26.

Consider the following problem. It can actually be solved two different ways.

 **Method 1**: **Method 2:**

**Break for Practice:** Simplify

 27. 28. 29.

**Extended Practice**: Simplify by applying the rules for operating on signed numbers. No Calculator!

|  |  |
| --- | --- |
| 1.  | 2.  |
|  | 4.  |
| 5.  | 6.  |
| 7.  | 8.  |
| 9.  | 10.  |
| 11.  | 12.  |
| 13.  | 14.  |
| 15.  | 16.  |
| 17.  | 18.  |
| 19.  | 20.  |
| 21.  |

**Extended Practice Continued**: Evaluate.

|  |  |
| --- | --- |
| 22. Evaluate the expression when   | 23. Evaluate the expression when   |

**Extended Practice Continued**

|  |
| --- |
| 24. The highest point in the United States is Mt. McKinley, Alaska, at 20,320 ft. above sea level, and the lowest is Bad Water, California, at 282 ft. below sea level. Find the difference between these elevations. |
| 25. Give a numerical example to show that subtraction is not commutative. |