1.1

Natural Numbers, $\mathbb{N}$: The counting numbers starting at 1: {1, 2, 3, ... }.

Whole Numbers, W: The counting numbers again, but starting at 0: {0, 1, 2, 3, ... }.

Integers, $\mathbb{Z}$: The whole numbers and their opposites: {…, -3, -2, -1, 0, 1, 2, 3, ... }.

Rational numbers, Q: Rational numbers are all the possible ratios of two integers, provided that 0 is not in the denominator. It is important to note that as decimals, rational numbers either stop or repeat. For example, ½ = 0.5 (stops), 1/3 = 0.33333… (repeats), 1/4 = 0.25 (stops), 1/5 = 0.2 (stops), 1/6 = 0.166666… (repeats), 6/2 = 3 (stops), 60/4 = 15 (stops), etc.

Irrational numbers, I : Irrational numbers are all the numbers that can't be written as a ratio of two integers. It is important to note that as decimals, irrational numbers neither stop nor repeat. For example, π is an irrational number that is approximately 3.14159. When we write 3.14159, we are actually writing a rational number approximation for the irrational number π. Another example of an irrational number is the square root of 2. The square root of 2 does not stop and it does not have a repeating part. It is approximately 1.4142, but again 1.4142 is a rational number approximation.

Real numbers, $\mathbb{R}$: The real numbers are all the rational numbers and all the irrational numbers.

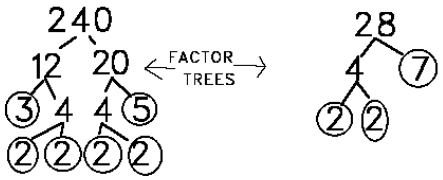
Prime number: A prime is a natural number, greater than 1, that has only 2 factors. The factors of a prime number are 1 and itself. The only way to get a prime number by multiplication is taking 1 times the prime number. {2, 3, 5, 7, 11, 13, 17, 19, …}

Composite number: A composite number is a natural number, greater than 1, that is not prime. Composite numbers have more than 2 factors. {4, 6, 8, 9, 10, 12, 14, 15, 16, 18, …}

Which are prime and which are composite?

39? 48? 57? 59? 0?

We might use a factor tree: … or repeated division by prime factors:



$240 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 3 \cdot 5$

$240 = 2^4 \cdot 3 \cdot 5$

$28 = 2 \cdot 2 \cdot 7$

$28 = 2^2 \cdot 7$

$\overline{)168}$

When we write a number as a product of primes, we call it the **prime factorization** of the number.

$$\frac{numerator}{deno\min ator} = numerator \div deno\min ator$$

Reduce: $\frac{16}{20}$

Ex. $\frac{5}{9} \bullet \frac{10}{7}$

Ex. $\frac{7}{6} \div \frac{9}{10}$

Ex. $2\frac{1}{2} \div 1\frac{5}{7}$

Ex. $\frac{3}{16} + \frac{5}{16}$

Ex. $8\frac{4}{5} - 7\frac{4}{9}$

Ex. $\frac{1}{8} \bullet 7\frac{1}{2}$

1.2

$3^2 = 3 \bullet 3 = 9$ "3 squared" The 3 is the base, the 2 is the exponent or power.

Ex. 4^3

Ex. $\left(\frac{2}{3}\right)^5$

Order of Operations

Parentheses and Exponents	PE	Please Excuse
Multiplication and Division	MD	My Dear
Addition and Subtraction	AS	Aunt Sally

Ex. $6[2+8(3^3)]$

Ex. $\frac{6(5+1)-9(1+1)}{5(8-6)-2^3}$

$>$ greater than

$\geq$ greater than or equal to

$<$ less than

$\leq$ less than or equal to

$=$ equal to

$\neq$ not equal to

Ex. True or False? $6[2+3(2+5)] \leq 135$

Ex. Write in symbols: Twelve is equal to twenty minus eight.

Ex. Write in words and decide whether true: $9<10$

Ex. Write the statement with the inequality symbol reversed while keeping the same meaning. $8>4$

1.3

Algebraic expression: A collection of numbers, variables, operations, and grouping symbols. There are no equal signs in expressions.

Equation: Statement that two algebraic expressions are equal. Equations must have an equal sign.

Ex. Find the value if x=4 and then if x=6:

$5x^2$ $\qquad\qquad$ $\dfrac{4x-1}{3x}$

Ex. Find the value if x=2 and y=1 and then if x=1 and y=5:

$4x+2y+7$

Ex. Write each word phrase as an algebraic expression, using x as the variable.

Nine times a number

A number subtracted from fourteen

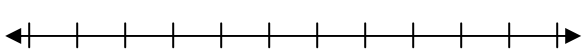
Ex. Decide whether the given number is a solution of the equation.

$3r+5=8$; 1

$6a+2(a+3)=14$; 2

Ex. Write each word sentence as an equation, using x as the variable. Find all solutions from the set {2, 4, 6, 8, 10}: The sum of six-fifths of a number and 2 is 14.

1.4

Number line: 

Negative numbers on this side 0 Positive numbers on this side

Set-builder notation:

{ start with a brace

x, or some other variable, is introduced

| is usually read as “such that” or “so that”. Think also “as long as” or “provided that”.

x’s particular property is described

} end with another brace

{ x | x has some property }

The additive inverse is the number with the opposite sign. The absolute value is the distance from 0, so it will always be a positive value.

$-(-x) = x$

Ex. Write the oppositve of the number and then the absolute value of the number.

-8 11

Ex. Identify the lesser of the two numbers.

-9, -14 $|-8|$, $|-9|$

Ex. True or False?

-8>-(-2) $|-12| \le |-20|$ $-|-12| \le -|-15|$

Ex. Which is greater? 1.8 or -3.1 ?

1.5 The definition of subtraction: $a - b = a + (-b)$

Ex. Find each sum or difference.

12+(-9) -11+(-4)

-12+10 8-13

-4-(5-12)

$|-2-7|-|9-(-3)|$

-3+5+(-12)

7-(-14)

1.6

Multiplying or dividing two numbers with the same sign gives a positive number.

Multiplying or dividing two numbers with opposite signs gives a negative number.

Ex. Find each product or quotient.

(-4)(-6)

(-8)(5)

(-12)(0)

$\left(\frac{-5}{4}\right)\left(\frac{-6}{25}\right)$

Ex. Find all integer factors of 36.

Ex. Find all integer factors of 17.

Ex. Evaluate; simplify completely.

(5-12)(19-4)

$4(-8)+|4-15|$

Ex. Evaluate; simplify completely.

$$\frac{-5(2)+[3(-2)-4]}{-3-(-1)}$$

Ex. Evaluate the expression if x=6, y=-4, and a=3.

$5x-4a^2$

Ex. Write a numerical expression for each phrase and simplify: The sum of -18 and -6, divided by the product of 2 and -4.

Ex. Write in symbols, using x as the variable, then guess or use trial and error to find the solution from the set of integers between -12 and 12, inclusive: Four times a number is -36.

Ex. Find the average of 18, 12, 0, -4, and -10.