Sets of Numbers

Natural Numbers = $\{1, 2, 3, \ldots\}$ = $\mathbb{N}$

Whole Numbers = $\{0, 1, 2, 3, \ldots\}$ = $\mathbb{W}$

Hint:
{ The phrase "natural numbers" has no letter O, just as the set has no 0.
  The phrase "whole numbers" has a letter O, just as the set has the number 0.

Integers = $\{\ldots -3, -2, -1, 0, 1, 2, 3 \ldots\}$ = $\mathbb{Z}$

$\hookleftarrow$ from German for counting, "Zahlen".

Rational Numbers: can be written as a fraction
or decimal either terminates or repeats.

Examples: $1 = \frac{1}{1}$ is rational

$2 = \frac{2}{1}$ is rational

$0 = \frac{0}{1}$ is rational

$\frac{1}{2} = .5$ is rational

$\frac{3}{4} = .75$ is rational

$.12306 = \frac{12306}{100000}$ is rational

$.\overline{3} = \frac{1}{3}$ is rational

$.\overline{6} = \frac{2}{3}$ is rational

$.\overline{1} = \frac{1}{9}$ is rational

$.\overline{2} = \frac{2}{9}$ is rational

$.\overline{4} = \frac{4}{9}$ is rational

$.\overline{5} = \frac{5}{9}$ is rational

$.\overline{7} = \frac{7}{9}$ is rational

Note $\frac{1}{0}$ is undefined

= $\mathbb{Q}$
rational $\Rightarrow$
root ratio $\Rightarrow$
fraction $\Rightarrow$
division $\Rightarrow$
quotient $\Rightarrow$
$\mathbb{Q}$.

All of these are rational because they can be written as a fraction (even if not in lowest terms)

$$\overline{.8} = \frac{8}{9} \text{ is rational}$$

$$\overline{.37} = \frac{37}{99} \text{ is rational}$$

$$\overline{.207} = \text{ even if you don't know what the fraction is, repeating decimal means it \underline{can} be written as a fraction.}$$

Irrational Numbers : cannot be written as a fraction

$= \mathbb{I}$

or decimal neither terminates nor repeats. ↖ The opposite of rational

examples : π

e

$\sqrt{2}$

$\sqrt{3}$

Real Numbers = $\mathbb{R}$ = all rationals and all irrationals together.

Math 45 Handout for 1.3 The Number Systems and the Real Number Line
Objectives:
1. Classify numbers as natural, whole, integer, rational, irrational, real
2. Plot points with fractional or decimal parts on a number line.
3. Use inequalities to compare two numbers.
4. Evaluate expressions with absolute values.

Write the set.

1) C is the set of integers between –5 and 3. $\{-4, -3, -2, -1, 0, 1, 2\}$

does not include endpoints!

List all the elements of B that belong to the given set.

2) $B = \{11, \sqrt{7}, -24, \frac{0}{7}, \sqrt{4}, 0.33, -7\pi, 0.444.....\}$ $\frac{0}{7} = 0$ $\sqrt{4} = 2$ $.444... = .\overline{4} = \frac{4}{9}$

$\{1,2,3...\}$ ℕ   Natural Numbers   11, 2

$\{0,1,2,3...\}$ 𝕎   Whole Numbers   11, 0, 2

$\{...-1,0,1,2...\}$ ℤ   Integers   11, -24, 0, 2

can be written as fraction ℚ   Rational Numbers   11, -24, 0, 2, .33, $\frac{4}{9}$

can't be written as fraction 𝕀   Irrational numbers $\sqrt{7}$, -7π

all rational & irrationals ℝ   Real Numbers   11, $\sqrt{7}$, -24, 0, 2, 0.33, -7π, $\frac{4}{9}$

Answer True or False to the statement.

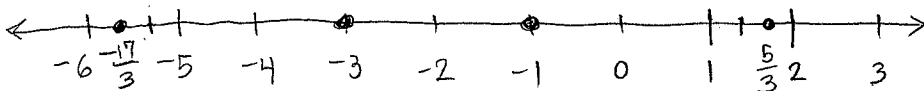3) Every rational number is an integer.   false. ex: $\frac{2}{3}$

4) Every whole number is a real number.   true

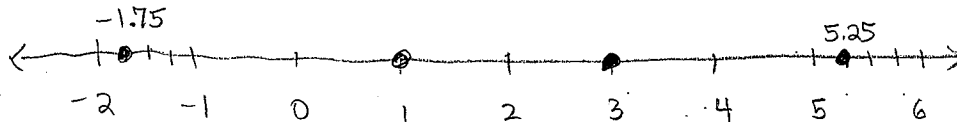5) Some rational numbers are irrational.   false

6) Some rational numbers are integers.   true

Plot the points in the set on a real number line. Use correct scale and label each point.

7) $\left\{-1, \frac{5}{3}, -\frac{17}{3}, -3\right\}$ $= \left\{-1, 1\frac{2}{3}, -5\frac{2}{3}, -3\right\}$ $\Rightarrow$ $-5\frac{2}{3} < -3 < -1 < 1\frac{2}{3}$


step 1: Simplify all numbers
step 2: Write numbers in order from smallest to largest
step 3: Draw a number line and mark evenly spaced integers covering all numbers in list.

8) $\{-1.75, 5.25, 1, 3\}$ $= \left\{-1\frac{3}{4}, 5\frac{1}{4}, 1, 3\right\}$ $\Rightarrow$ $-1\frac{3}{4} < 1 < 3 < 5\frac{1}{4}$

step4: Plot dots on the line
step5: To plot numbers with fraction parts, identify the two integers on either side.
e.g. $-6 < -5\frac{1}{3} < -5$
$1 < 1\frac{2}{3} < 2$
Use denominator to divide the segment.
step 6: Label all points

9) $\left\{3, 5\frac{2}{3}, -1\frac{2}{3}, 1\right\}$ ⇒ $-1\frac{2}{3} < 1 < 3 < 5\frac{2}{3}$
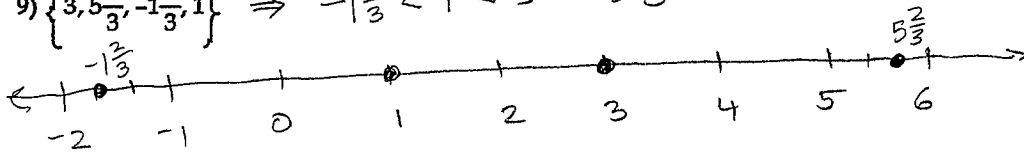
Replace the ? with the correct symbol >, <, =.

10) –7 ? 0 $<$

11) 10 ? –84 $>$

12) –2.5 ? –1.7 $<$

13) $\frac{8}{2}$? $\frac{12}{3}$ $4 = 4$

14) $\frac{2}{5}$? $\frac{5}{9}$ $\frac{18}{45} < \frac{25}{45}$

15) $-\frac{5}{7}$? $-\frac{3}{10}$ $\frac{-50}{70} < \frac{-21}{70}$

16) $-\frac{3}{7}$? $-\frac{5}{8}$ $\frac{-24}{56} > -\frac{35}{56}$

17) $|-2|$? $|-17|$ $2 < 17$

18) $|-9.5|$? $|-9|$ $9.5 > 9$

19) $|-11|$? $\frac{33}{-3}$ $11 > -11$

Math 45: Useful Math Terminology

Operation: add, subtract, multiply, divide, exponent, radical, absolute value, etc.

Order of Operations: Rules for which part of a calculation to do first, and then what order to proceed

Variable: A letter used to represent any or a specific number, often unknown

Expression: A combination of variables and numbers with no equal sign, though operations are permitted

Substitute: Replace a variable or an expression by a variable or expression which is known to be equal

Evaluate: Give a number answer as a result, often by substituting given values for a variable then performing any operations

Terms: Parts of an expression that are separated by addition (rewrite subtraction as addition)

Distribute: Multiply a single term by all terms within parentheses that follow or precede it

Factors: Parts of a term that are separated by multiplication (rewrite division as multiplication)

Factor: Find the prime factors (numbers or polynomials) which multiply to give the original expression

Reduce: Put a fraction in lowest terms. A reduced fraction has no common factors, decimals or fractions within fractions

Constant: An expression which is a number without variables

Coefficient: A number, especially if multiplied times a variable or product of variables

Equation: Two expressions separated by an equal sign

Inequality: (a) One of the four symbols $<, >, \leq, \geq$
                    (b) Two expressions separated by an inequality symbol

Solve: Find all solutions, meaning the values for a variable which make an equation or inequality true.
Solution may be a list, set, interval, or a graph.

Isolate: Perform operations to both sides of an equation or inequaltiy so the isolated item is alone on one side

Set equal to zero: Write an equation by writing a given expression, an equal sign, and a zero

Rational: A number or expression which is or can be written as a fraction

Simplify: Final form for an answer. Reduce fractions, distribute, combine like terms, evaluate operations. If simplifying a rational expression, factor and divide out common factors, then leave final answer factored.

Interval: A set of all values between two given endpoints. Notation will specify if endpoints are included.

Ordered Pair or Point: A pair of numbers in parentheses, separated by a comma, denoting the x- and y-coordinates on a rectangular coordinate graph