# Lesson #1: Classifying Real Numbers (Real Number Sets)

- All numbers belong to particular <u>SETS</u>. of numbers

* - A <u>SET</u> is a collection of objects. (A collection of Numbers)
  - each object in the set is called an <u>ELEMENT</u>.
  - A set is written by enclosing the elements within <u>Braces</u>.

$$\{12, 36, 48\}$$

  - <u>There are 3 types of sets</u>:

$\{\ \}$ or $\emptyset$ - <u>EMPTY SET</u> - a set with <u>no</u> elements. also known as the <u>NULL SET</u>.

$\{12, 36, 48\}$ - <u>FINITE SET</u> - a set with a finite number of elements.

$\{1, 3, 5, 7, \ldots\}$ - <u>INFINITE SET</u> - a set that contains an infinite number of elements

- All Numbers belong to one or more of the following subsets of <u>REAL NUMBERS</u>.

Subsets of <u>REAL NUMBERS</u>:

- <u>NATURAL NUMBERS</u> - the numbers used to count objects or things

$$\{1, 2, 3, 4, \ldots\}$$

- <u>WHOLE NUMBERS</u> - the set of natural numbers and zero.

$$\{0, 1, 2, 3, 4, \ldots\}$$

- <u>INTEGERS</u> - the set of whole numbers and the opposites (Negatives) of the natural numbers

$$\{\ldots -4, -3, -2, -1, 0, 1, 2, 3, 4 \ldots\}$$

- RATIONAL NUMBERS - are numbers that can be written in the form $\frac{a}{b}$, where a and b are integers and $b \neq 0$. In decimal form, rational numbers either terminate or repeat.

  Examples: $\frac{1}{2}$, $0.\overline{3}$, $-\frac{2}{3}$, $0.125$

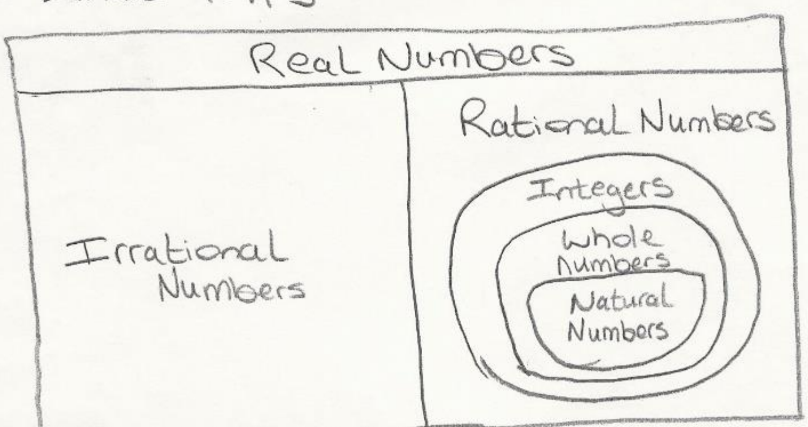
- IRRATIONAL NUMBERS - numbers that cannot be written as the quotient of two integers. In decimal form, irrational numbers neither terminate nor repeat.

  Examples: $\sqrt{2}$, $-\sqrt{2}$, $3\sqrt{3}$, $\pi$, $3\pi$

- REAL NUMBERS - the set includes all rational and Irrational numbers.

(The Key to remember is that all of these sets are INFINITE Sets.)

- Relationships Amongst all Subsets will look Like this




$\boxed{\text{So in Other words:}}$

* - All Natural Numbers : are also considered part of the whole numbers also part of the Integers, also part of the Rational number, and also part of the real numbers!!! $\boxed{\text{WHY:}}$ because natural numbers are subsets of each of these number sets.

* - All Whole Numbers: are also considered part of the Integers, also considered part of the rational numbers, and also considered part of the real numbers. $\boxed{\text{WHY:}}$ because whole Numbers are subsets of each of these number sets.

* - All Integers: are also considered part of the rational numbers, and also considered part of the real numbers. $\boxed{\text{WHY:}}$ because Integers are subsets of each of these number sets.

- All Rational Numbers: are also considered part of the Real numbers. $\boxed{\text{WHY:}}$ because Rational numbers are subsets of these number sets

- So...

Natural → Whole → Integers → Rational → Real

- However...

$$\text{Real} \xrightarrow[\not\phantom{x}]{} \text{Rational} \xrightarrow[\not\phantom{x}]{} \text{Integers} \xrightarrow[\not\phantom{x}]{} \text{Whole} \xrightarrow[\not\phantom{x}]{} \text{Natural}$$

***(in other words all real numbers are not also part of the rational, integers, whole, Natural number sets.)

- The same goes for all Rational being a part of Integers, Whole, and Natural numbers, etc.

***(So be very careful when considering what set a particular number or example falls into.)

Start to write on the board this Chart

| Set | Natural | Whole | Integer | Rational | Real |
|---|---|---|---|---|---|
| all Natural numbers are also part of | True | True | True | True | True |
| all whole numbers are also part of | False | True | True | True | True |
| all Integers are also part of | False | False | True | True | True |

- <u>Now go through Identifying what particular (all particular sets) certain example numbers fall into:</u> (have all of the number sets written up on the board so they know what they are dealing with when you go through the following examples.)

<u>Example Set #1</u>: Identifying Sets
(have them write down next to the number all of the sets in which they belong.) (have students say it out loud or come up to the board)

ⓐ $\frac{1}{2}$ (rational, real)
ⓑ 5 (Natural, whole, integers, rational, real)
ⓒ $3\sqrt{2}$ (irrational, real)
ⓓ 9 (Natural, whole, integers, rational, real)
ⓔ $5\sqrt{3}$ (irrational, real)
ⓕ $\frac{1}{4}$ (rational, real)
ⓖ 2.3 (rational, real)
ⓗ $2.\overline{3}$ (rational, real)

In these answers only one subset will be the answer

<u>Example Set #2</u>: Identifying Sets for Real World Situations
(have them write down the answers in the same way as Example Set #1)

ⓐ the value of the bills in a person's wallet
(answer: whole - because 0 needs to be included)
ⓑ the balance of a checking account
<u>answer</u>: rational
(because may have positive or negative and may

c) The cost of an item at a Store

answer: rational

d) the number of points a team Scores in a football game

answer: whole numbers

e.) the ~~surface~~ circumference of a Circular table when the diameter is a rational number.

answer: irrational

(Since $\pi$ is involved in finding Circumference)

f) the surface area of a sphere where the radius is a rational number

answer: irrational number

($\pi$ is involved.)

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- There will be times when we will be dealing with multiple sets at one time. for example Set A and Set B.

$$A = \{2, 4, 6, 8, 10, 12\} \quad B = \{3, 6, 9, 12\}$$

- When dealing with multiple set there are two important thing we will be dealing with:

  - The INTERSECTION of SETS A and B ($A \cap B$) - which is the set of elements that are in A and B.

    - So $A \cap B = \{6, 12\}$

  - The UNION OF SETS A and B ($A \cup B$) which is the set of all elements that are in A or B. (only need to write duplicate # once)

    - $A \cup B = \{2, 3, 4, 6, 8, 9, 10, 12\}$

- Have Students walk through a few additional examples. (have Students come up to the board, explain why in class, etc.) (Differentiation)

Examples: Find the $A \cap B$ and $A \cup B$ for the following

1. $A - \{11, 13, 15, 17\}$ $B = \{12, 14, 16, 18\}$

Answer: $A \cap B = \{\ \} = \phi$
$A \cup B = \{11, 12, 13, 14, 15, 16, 17, 18\}$

2. $A = \{4, 8, 12, 16\}$ $B = \{5, 8, 11, 14, 17\}$

Answer: $A \cap B = \{8\}$
$A \cup B = \{4, 5, 8, 11, 12, 14, 16, 17\}$

3. $A = \{1, 3, 5, 7, 9\}$ $B = \{2, 4, 6, 8\}$

Answers: $A \cap B = \{\ \}\ \phi$
$A \cup B = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$

*** - Another important aspect of set is the principle of CLOSURE.

- A set of numbers has Closure, or is closed, under a given operation if the outcome of the operation on any two members of the set is also a member of the set.

Example: Is the set of Natural numbers closed under addition?

$1 + 2 = 3 \rightarrow$ Natrual number
$3 + 4 = 5 \rightarrow$ Natural number
$5 + 6 = 7 \rightarrow$ natrual number

*** So therefore, the set of natural numbers is closed under addition.

- Know if a set of numbers is not closed like in the following you need to give a <u>COUNTEREXAMPLE</u> or an instance in which the statement is false.

<u>Example:</u> The set of whole numbers is closed under subtraction.

$6-4=2 \to$ Whole number

$100-90=10 \to$ whole number

$4-6=-2 \to$ <u>NOT A WHOLE NUMBER</u>

the counterexample in this problem is $4-6=-2$.

(Make sure you try a few possibilities when testing these problems out, don't stop after one because you may miss the counterexample. Always try multiple examples and change the order of the larger or smaller number.)

- Have students walk through the following examples:

(a) The set of integers is closed under addition.

<u>Answer:</u> True

$-2+3=1 \to$ Integer

$-1+{}^{-}5=-6 \to$ Integer

$3+{}^{-}6=-3 \to$ Integer

True

(b) the set of natural numbers is closed under subtraction.

Answer: False

$6-4=2 \to$ Natural

$10-9=1 \to$ Natural

<u>Counterexample</u> $\to$ $8-10=-2 \to$ <u>NOT NATURAL</u>

False by counterexample

- Next Pass out the Lesson Practice Sheet and have them work on that in Class. (If I run out of time this will be the homework.) (I will add the homework problems to the next section if needed.)

- Next handout homework and Bonus problem of the day.

- go over bonus problem of the day

- dismissal.

<u>In Classwork:</u> Lesson Practice 1–10

Lesson #1 Reteach 1–14

<u>Homework:</u> Lesson #1 Assignment

~~13-17, 22~~, 25, 26, 30

page 5–6 2–12 (even)

13–17, 22, 25, 26, 30

(15 problems)

<u>Bonus Problem of the Day:</u> 1–10