Q: What is a Real number?
A: It is the collection of numbers that we work with in Basic Math – Intermediate Algebra. These numbers represent values associated with any fixed point along the number line. They are concrete numbers, that have tangible (“real”) values associated with them, derived from our study of the natural world. There are infinitely many Real numbers that exist along the continuous Real Number Line.

Q: Do the Real numbers represent the only type of numbers we work with in Mathematics courses at the College Level?
A: No. In order to model more complicated physical situations (think “Engineering Math”) we need to expand our number system to include Imaginary numbers. Later, the Complex Number System will be composed of 1.) The Real numbers; and 2.) The Imaginary numbers.

Q: So, how do we represent the Real numbers if they represent an infinite set (collection) of numbers?
A: The Real numbers are traditionally represented visually in one of three ways:
1. Number Line
2. Venn Diagram
3. Flow Chart
Each representation has its advantages and disadvantages for students. We choose a particular representation depending on which of the three best fits our needs.

**Real Number Line:**

![Real Number Line Diagram]

**Venn Diagram:**

![Venn Diagram Diagram]
Flow Chart:

Real numbers \( \mathbb{R} \)

Q Rational numbers
(Fractions: Decimal form they Terminate or Repeat)

\( \mathbb{Q} \)

Rational numbers

Irrational numbers
(Non-Fractional: Decimal form they are Non-Terminating and Non-Repeating decimal expansions)

Examples: \( \pi, e, \sqrt{2}, \sqrt{3} \)

\( \mathbb{Z} \)
Integers
{…-4, -3, -2, -1, 0, 1, 2, 3, 4, …}

Non-Integer Rational numbers
(Rational Number in Lowest Terms, where Denominator \( \neq 1 \))

Examples: \( \frac{1}{2}, -\frac{2}{3}, \frac{9}{5}, -\frac{11}{3} \)

\( \mathbb{N} \)
Natural numbers
{1, 2, 3, 4, 5, 6, …}

Negative Integers
{…-5, -4, -3, -2, -1}

Whole numbers
{0, 1, 2, 3, 4, 5, 6, 7, …}

Generally speaking, …

- Math 20 (Basic Math) was all about the Whole numbers.
- Math 40 (Prealgebra) was all about Integers.
- Math 60 (Elementary Algebra) is all about Rational numbers.
- Math 80 (Intermediate Algebra) will be all about the Irrational numbers and some Imaginary numbers.
- Then, in your 100-level coursework you will work in the Complex Number System composed of Real numbers and Imaginary numbers.

For our discussion of rational numbers, since “rational” rhymes with “fractional”, just think of rational numbers as fractions. However, officially fractions are non-negative. Whereas, rational numbers can be either positive, negative or zero. Compare, their official definitions …

\[
\mathbb{Q} = \left\{ \frac{p}{q} \mid p, q \in \mathbb{Z}, q \neq 0 \right\} \quad \text{with} \quad \text{Fractions} = \left\{ \frac{a}{b} \mid a, b \in \text{Whole Numbers}, b \neq 0 \right\}.
\]

Also, the name “rational” number is derived from the word “ratio”. A rational number is a ratio of two integers, where the denominator is non-zero.