**Type of Numbers: Natural, Whole, Integers, Rational, Irrational & Real**

### Natural Numbers (N):
Natural Numbers are counting numbers from 1, 2, 3, 4, 5, ............
\[ N = \{1, 2, 3, 4, 5, ............\} \]

### Whole Numbers (W):
Whole numbers are natural numbers including zero. They are 0, 1, 2, 3, 4, 5, ............
\[ W = \{0, 1, 2, 3, 4, 5, ............\} \]
\[ W = 0 + N \]

### Positive Numbers:
Positive numbers are, 1, 2, 3, 4, 5, ............
Positive Numbers: \{1, 2, 3, ...\}

### Negative Numbers:
Negative numbers are, ............-3, -2, -1.
Negative integers: \{... -3, -2, -1\}

### Integers (Z):
- Whole Numbers together with negative numbers.
- Integers are set containing the positive numbers, 1, 2, 3, 4, ..., and negative numbers, ............-3, -2, -1, together with zero.
- Zero is neither positive nor negative, but is both.
- In other words, Integers are defined as set of whole numbers and their opposites.
- \[ Z = \{..., -3, -2, -1, 0, 1, 2, 3, ...\} \]

### Rational Numbers (Q):
- All numbers of the form \( \frac{a}{b} \), where a and b are integers (but b cannot be zero)
- Rational numbers include fractions:
  * Proper Fraction: Numbers smaller than 1 eg: 1/2 or 3/4
  * Improper Fraction: Numbers greater than 1 eg: 5/2
* Mixed Fraction: 2 1/2 = 5/2
- Powers and square roots may be rational numbers if their standard form is a rational number.
- In rational numbers the denominator cannot be zero

**Example:**
2 can be expressed in the form of p/q as 2/1
-13/9 = -1.444.......
8⁻² = 0.015625
(√16)/3 = 4/3 = ±1.333...
√4 = 2 1/2 = 0. 5 ---- Rational (terminates)
2/3 = 0.6666666....Rational (repeats)
5/11 = 0.454545......Rational (repeats)

**Irrational Numbers Q¹:**
- Cannot be expressed as a ratio of integers.
- As decimals they never repeat or terminate (rationals always do one or the other)
- They go on for ever or infinity.

**Example:** √2, √3, √7, √8
square root of 2 = √2 = 1. 41421356......Irrational (never repeats or terminates)
pi = π = 22/7 = 3.14159265....... Irrational (never repeats or terminates)

**Real Numbers R:**
- Real Numbers are every number, irrational or rational.
- Any number that you can find on the number line.
- It is a number required to label any point on the number line; or it is a number that names the distance of any point from 0.
- \( R = Q + Q^1 \)
- Natural Numbers are Whole Numbers, which are Integers, which are Rational Numbers, which are Real Numbers.
- Irrational Numbers are Real Numbers, but not all Real Numbers are Irrational Numbers.

**Examples:**

<table>
<thead>
<tr>
<th>Number</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.45</td>
<td>rational, real</td>
</tr>
<tr>
<td>3.1415926535....</td>
<td>irrational, real</td>
</tr>
<tr>
<td>3.14159</td>
<td>rational, real</td>
</tr>
<tr>
<td>0</td>
<td>whole, integer, rational, real</td>
</tr>
<tr>
<td>5/3</td>
<td>rational, real</td>
</tr>
<tr>
<td>Expression</td>
<td>Classification</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>$\frac{1}{2} + \frac{3}{2}$</td>
<td>rational, real</td>
</tr>
<tr>
<td>$\sqrt{2} = 1.41421356\ldots$</td>
<td>irrational, real</td>
</tr>
<tr>
<td>$-\sqrt{81} = -9$</td>
<td>integer, rational, real</td>
</tr>
<tr>
<td>$-\frac{9}{3}$</td>
<td>rational, real</td>
</tr>
<tr>
<td>$\sqrt{25} = 5$</td>
<td>natural, whole, integer, rational, real</td>
</tr>
<tr>
<td>$\frac{9}{3} = 3$</td>
<td>natural, whole, integer, rational, real</td>
</tr>
<tr>
<td>$-\frac{3}{4}$</td>
<td>rational, real</td>
</tr>
<tr>
<td>$\pi = 3.1428571\ldots$</td>
<td>irrational, real</td>
</tr>
<tr>
<td>$3.14444\ldots$</td>
<td>rational, real (since it is a repeating decimal)</td>
</tr>
</tbody>
</table>