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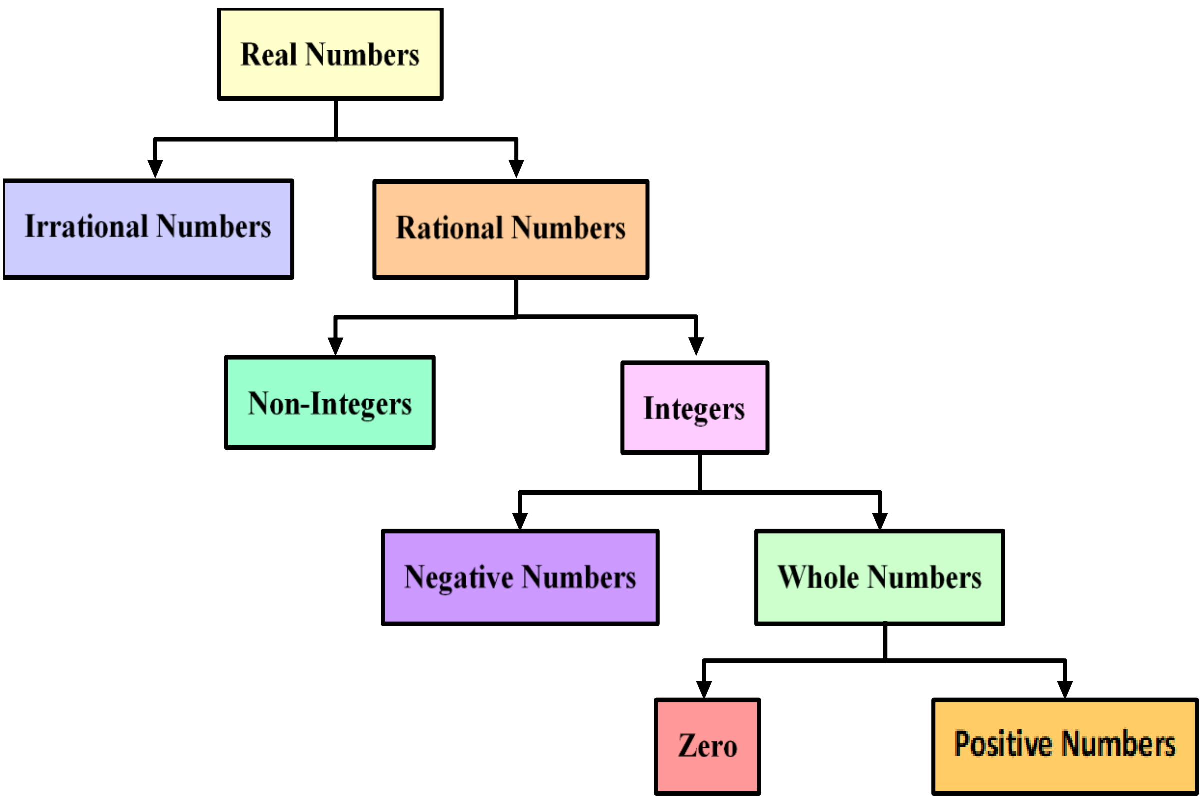
The Real Number System Guide Notes

THE SET OF REAL NUMBERS

When we were young, we were taught how to count using the set of counting numbers.

{1, 2, 3, 4, 5, 6, …}

Little did we know that numbers too have different types. The tree diagram below shows the different types numbers and how each kind is related to one another.



REAL NUMBERS

Apparently, any number that you can think of are called **REAL NUMBERS**. These are the set of numbers that is formed by combining the **rational numbers** and the **irrational numbers**.

Examples:

$$\pi,\ e,\ \frac{22}{7},\ \sqrt{2},\ \sqrt{3},\ \sqrt{7}, \frac{3}{4}, \frac{27}{11},\ 9i,\ -2,\ -1,\ 0,\ 1,\ 2,\ 3$$

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The Real Number System Guide Notes

REAL NUMBERS can be IRRATIONAL or RATIONAL.

IRRATIONAL NUMBERS

Irrational means "**not rational**". These are the set of all numbers whose decimal representation are neither terminating nor repeating. It cannot be expressed as a quotient of integers. These numbers cannot be expressed as a ratio of two numbers

Examples:

$$\pi,\ e,\ \frac{22}{7},\ \sqrt{2},\ \sqrt{3},\ \sqrt{7}$$

RATIONAL NUMBERS

These are the set of all numbers which can be expressed in the form: $\frac{a}{b}$, where a and b are integers and b is not equal to 0, written as $b \neq 0$. It can be expressed as **terminating** or **repeating** decimals.

Examples:

$$\frac{3}{4}, \frac{27}{11},\ -2,\ -1,\ 0,\ 100,\ -25,\ 3.75$$

RATIONAL NUMBERS can be NON-INTEGERS or INTEGERS.

NON-INTEGERS

These are the set of all numbers that is neither a positive whole number, nor a negative whole number, nor zero. These include **decimals**, **fractions**, and **imaginary numbers**.

Examples:

$$\frac{3}{4}, \frac{27}{11}, 9i, -\frac{1}{2}, -0.25, 1.75, \frac{5}{7}, 3\frac{2}{3}$$

INTEGERS

These are the set of numbers formed by **positive whole numbers**, **negative whole numbers**, and **zero**.

Examples:

$$\ldots, -3, -2,\ -1,\ 0,\ 1,\ 2,\ 3, \ldots$$

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The Real Number System Guide Notes

INTEGERS can be NEGATIVE or WHOLE NUMBERS.

NEGATIVE INTEGERS

These are whole numbers **less than zero** and usually mean a value that is a deficit or shortage.

Examples:

$\ldots, -5, -4, -3, -2, -1$

WHOLE NUMBERS

These are the set of numbers formed by adding **0** to the set of **natural numbers** (also called as counting numbers).

Examples:

$0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, \ldots$

WHOLE NUMBERS include ZERO and POSITIVE INTEGERS.

ZERO

Zero denotes the absence of all magnitude or quantity.

0

POSITIVE INTEGERS

These are the set of numbers that include all **natural numbers** (also known as **counting numbers**)

Examples:

$1, 2, 3, 4, 5, 6, 7, 8, \ldots$

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The Real Number System Guide Notes

Sample Problem 1: Look at the numbers inside the box and classify each according to the type of number described.

$$-0.2 \qquad 1 \qquad 0.\overline{4} \qquad 0.71771777177771\ldots$$

$$\pi \qquad 3 \qquad 7 \qquad 41 \qquad 56 \qquad -5 \qquad \frac{7}{8}, \qquad 0.454545\ldots$$

$$0, \qquad -\frac{1}{2}, \qquad -100, \qquad 0.75, \qquad \sqrt{2}$$

a. **Real Numbers** $-0.2, 1, 0.4, 0.71771777177771\ldots, \pi, 3, 7, 41, 56, -5, \frac{7}{8}, 0.454545\ldots, 0, -\frac{1}{2}, -100, 0.75, \sqrt{2}$

b. **Irrational Numbers** $0.71771777177771\ldots, \pi, \sqrt{2}$

c. **Rational Numbers** $-0.2, 1, 0.4, 3, 7, 41, 56, -5, \frac{7}{8}, 0.454545\ldots, 0, -\frac{1}{2}, -100, 0.75$

d. **Non-Integers** $-0.2, 0.4, -5, \frac{7}{8}, 0.454545\ldots, -\frac{1}{2}, 0.75$

e. **Integers** $1, 3, 7, 41, 56, -5, 0, -100$

f. **Negative Integers** $-5, -100$

g. **Whole Numbers** $1, 3, 7, 41, 56, 0$

h. **Positive Integers** $1, 3, 7, 41, 56$

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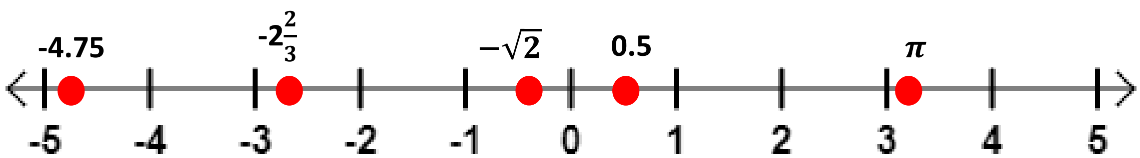
The Real Number System Guide Notes

REAL NUMBERS ON THE NUMBER LINE

A **NUMBER LINE** is a straight line with numbers written in equal intervals. It can be used to show the sets of **real numbers** composed of **rational** and **irrational numbers**. On a **REAL NUMBER LINE**:

- There is a point that corresponds for every real number.
- There is a real number for each point.



OPPOSITES

The idea of opposites used in real-life can include, but are not limited to the following:

Direction	**Length**	**Size**	**Temperature**
North or South	Long Short or South	Big or Small	Warm or Cold

Height	**Altitude**	**Quantity**	**Color**
Tall or Short	Low or High	Many or Few	Bright or Dark

In Mathematics, on the other hand, OPPPOSITES are denoted by the following signs:

Positive Sign $+$

This symbol is written before a number that is positive.

Example: $+7$ is read as "**positive 7**"

If there no sign before a number, then that number is considered positive.

Example: 7 is understood to be "**positive 7**"

Negative Sign $-$

This symbol is written before a number that is negative.

Example: -7 is read as "**negative 7**"

It is very important to write that symbol before a negative number to indicate that it is negative.

Example: -10 is read as "**negative 10**"

Also, ZERO IS NEITHER POSITIVE NOR NEGATIVE.

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The Real Number System Guide Notes

REPRESENTATIONS OF OPPOSITES IN REAL LIFE

POSITIVE	NEGATIVE
An increase of \$1 is denoted by $+1$.	A decrease of \$1 is denoted by -1.
Walking 10 steps north is denoted by $+10$.	Walking 10 steps south is denoted by 10.
An increase of 6 degrees in temperature is denoted by $+6$.	A decrease of 6 degrees in temperature is denoted by -6.
5 feet above sea level is denoted by 5.	5 feet below sea level is denoted by -5.
A deposit of \$5000 denotes $+5000$.	A withdrawal of \$5000 denotes -5000.

Sample Problem 2: Represent the following with integers.

a. A weight loss of 7 kilograms **-7**

b. Walking 10 blocks north **+10**

c. 225 meters below sea level. **-225**

d. Going up the stairs by 6 steps **+6**

e. The temperature drops 5 degrees **-5**

f. Losing 10 points in a game **-10**

g. Moving a table 5 meters forward **5**

h. A debt of \$10,000 **-10,000**

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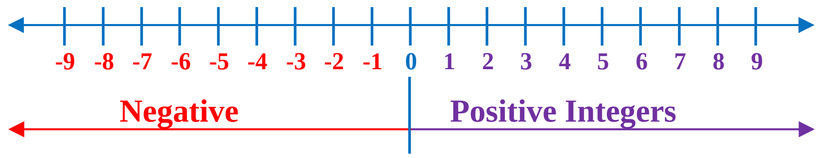
The Real Number System Guide Notes

INTEGERS ON THE NUMBER LINE

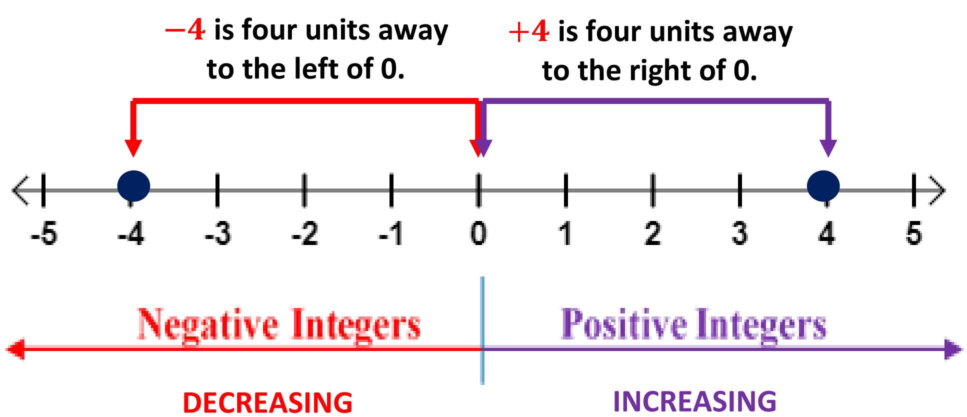
Integers, composed of negative whole numbers, positive whole numbers and zero, can be graphed or plotted on a number line.

The starting point of a number line is at its origin, at **ZERO**.



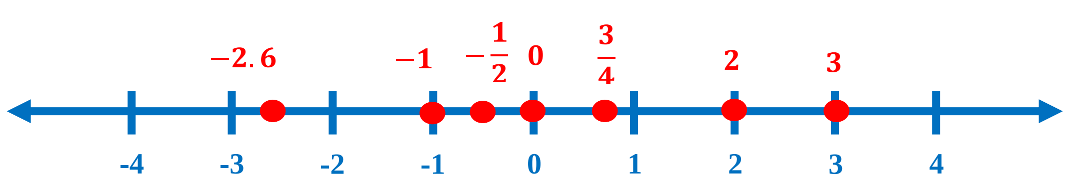
POSITIVE INTEGERS on the number line are the integers that are found to the right of zero. As the number line extends to the right of zero, the integers increase.

NEGATIVE INTEGERS on the number line are the integers that are found to the left of zero. As the number line extends to the left of zero, the integers decrease.



Sample Problem 3: Graph the real numbers $-1,\ 3,\ 0,\ 2,\ \frac{3}{4},\ -\frac{1}{2}$ and -2.6 on the number line and write the numbers in increasing order.

Solution:



$$-2.6,\ -1,\ -\frac{1}{2},\ 0,\ \frac{3}{4},\ 2,\ 3$$

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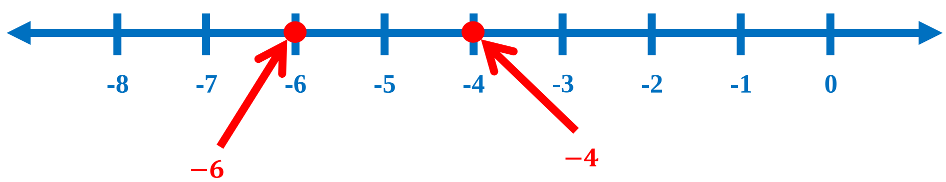
The Real Number System Guide Notes

Sample Problem 4: Plot the integers -4 and -6 on the number line and write two inequalities, using the symbols > or <, that compare the two numbers.

Solution:



$-6 < -4$ $-4 > -6$

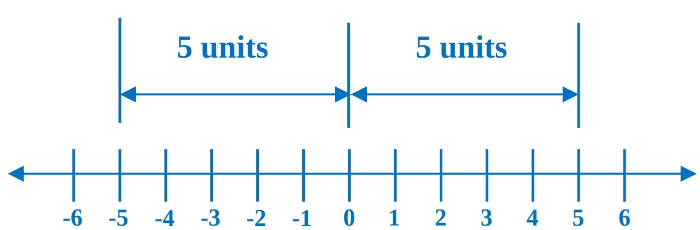
Sample Problem 5: Arrange the real numbers below in descending order.

$-0.25,$	$\frac{3}{4},$	$-\frac{1}{2},$	$9,$	$0,$	$-7,$	$\frac{2}{3},$	$-3,$	$3,$	1

Solution: $9,\ 3, 1, \frac{3}{4}, \frac{2}{3}, 0, -0.25, -\frac{1}{2}, -3, -7$

ABSOLUTE VALUE OF A REAL NUMBER

ABSOLUTE VALUE of a real number is the **distance between the origin and the point representing the real number**. The symbol $|x|$ represents the absolute value of a number x.



$|-5| = 5$

The distance of -5 to the origin is 5 units.

$|5| = 5$

The distance of 5 to the origin is 5 units.

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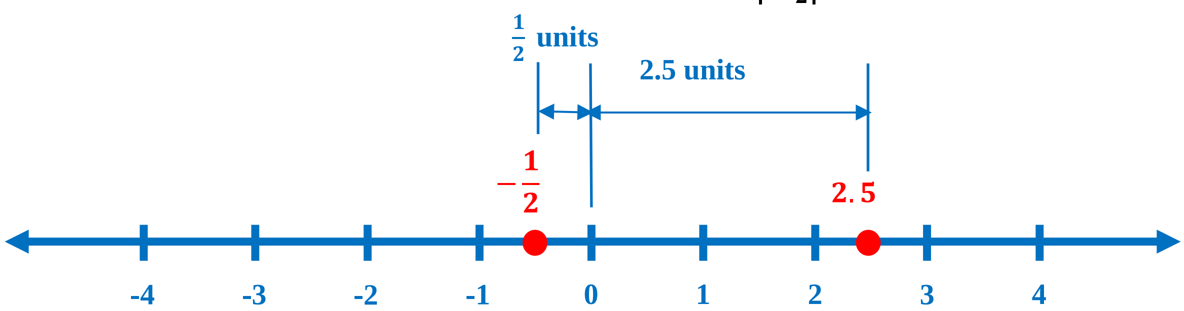
The Real Number System Guide Notes

Sample Problem 6: Evaluate and graph the numbers $|\mathbf{2.5}|$ and $\left|-\frac{1}{2}\right|$ on the number line.



$\left|-\frac{1}{2}\right| = \frac{1}{2}\boldsymbol{units}$ $\quad$ $|2.5| = 2.35\boldsymbol{units}$

Sample Problem 7: Determine the value of each.

a. $|0.25|$ 0.25

b. $|-9|$ 9

c. $\left|-\frac{6}{5}\right|$ $\frac{6}{5}$

d. $|-11|$ 11

e. $|32|$ 32