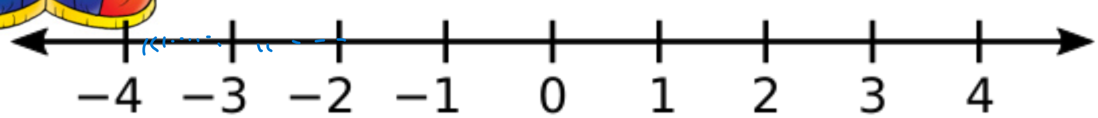
Name Mrs. Jacob .

Math 9

(MTH1W)

Unit 1: Number System

What's in
a Number?



My Goals for this Unit:

Math 9 – Unit 1: Real Numbers Name: ____________________

Lesson #1: Number Systems, Number Sets, Rational and Irrational Numbers Date: Sep 9, 2025

Learning Goal: We are learning to appreciate the thousands of years that led to the development of our decimal number system, recognize the different number sets, and relate rational numbers to decimals, fractions, and integers.

Prehistoric people probably counted using Tally Marks.

- The oldest record of humans using (probable) tally marks is on a bone of a baboon, found in Southern Africa, dated to 20,000 - 30,000 B.C.

You can still see our history of tally marks in the way numbers are written in some languages!
Check out the Japanese characters for 1 to 5

1	2	3	4	5
一	二	三	四	五

- Tally marks are great for counting small numbers, but as society advanced, people needed to write larger numbers.
- So eventually, people started representing large quantities of tally marks with a symbol.

- But society advanced again, and these tally-based symbol systems got cumbersome.
- We needed a better system: DECIMAL SYSTEM (POSITIONAL NUMBER SYSTEM)
- In a positional system, you reuse the ***same symbols*** – it's their ***position*** in the number that tells you how big they are!

For example,

H T O
376

$6 \times 1 = 6$
$7 \times 10 = 70$
$3 \times 100 = 300$
376

Today, we use a <u>positional</u> number system called the DECIMAL SYSTEM **for our numbers.**

- ▶ The decimal system has a **base of ten.**
- ▶ "Base ten" means that there are 10 digits before you have to start reusing digits again.

1, 2, 3, 4, 5, 6, 7, 8, 9, 0

Welcome to the wonderful and beautiful world of formal Mathematics. Math is a language with its own syntax, grammar, and rules. Also, for Math to be readable and elegant (yes, it can be elegant), it needs to be written in a certain way. It is essential that you learn and adapt to this structure. First, we begin by looking at sets of numbers.

A set is a well-defined collection of things or numbers.

There are different types of number sets.

NATURAL # = $\{1, 2, 3, \ldots\} \equiv \mathbb{N}$

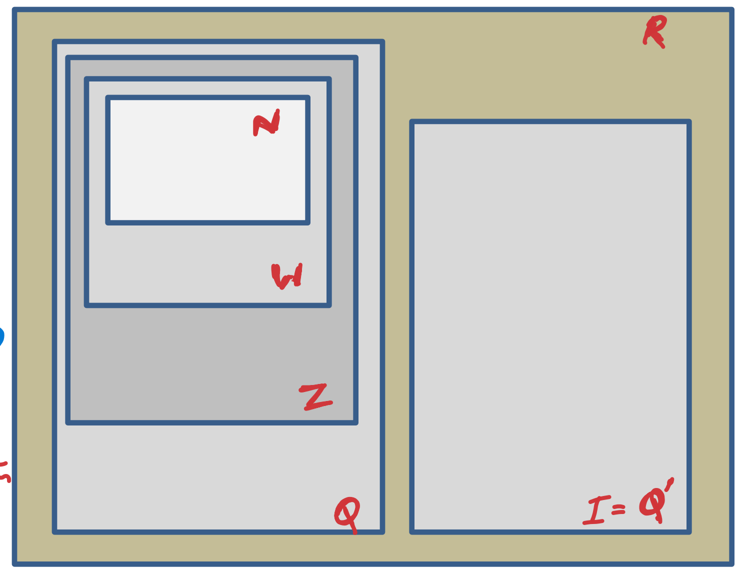
WHOLE # = $\{0, 1, 2, 3, \ldots\} \equiv \mathbb{W}$

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

RATIONAL #S = $\left\{ \frac{N}{D} \right.$, N and D are integers, $\left. D \neq 0 \right\} \equiv \mathbb{Q}$

IRRATIONAL #S = NOT RATIONAL
i.e. not a positive or negative fraction

REAL #S = All Rational and Irrational #s together



We will focus our attention on rational and irrational numbers.

A rational number is: a number of the form $\frac{N}{D}$ where N and D are integers and $D \neq 0$

DECIMALS

RATIONAL TERMINATING
$1.5 = \frac{15}{10}$
$-7.398 = \frac{-7398}{1000}$

NON-TERMINATING
REPEATING RATIONAL
$3.333\ldots = 3.\overline{3}$
$13.\overline{235} = 13.235235235\ldots$
$7.9\overline{82} = 7.9828282\ldots$

NON-REPEATING
$1.01001000100001\ldots$

An irrational number is: a number that cannot be written as $\frac{N}{D}$ where N and D are integers and $D \neq 0$

NON-TERMINATING
NON-REPEATING
Irrational

eg $\pi, \sqrt{2}, \sqrt{5}$

$\sqrt{p} \rightarrow$ prime #

$3.141592\ldots = \pi$

R Ir N

State if the following are rational, irrational, or neither:

a) $\frac{1}{2}$ b) $\frac{-3}{0}$ c) $\frac{-0}{4}$ d) $\sqrt{5}$ c) $\sqrt{-9}$

R N R Ir N

Rational numbers can be represented as fractions or decimals. In decimal form, it can terminating or repeating.

Write the fraction as a decimal:

a) $\frac{2}{3}$ b) $\frac{3}{8}$ c) $\frac{10}{7}$ d) $\frac{5}{12}$

$=0.\overline{6}$ $=0.375$ $=1.\overline{428571}$ $=0.41\overline{6}$

If the decimal is a terminating decimal, it can be quickly converted to a fraction. (Repeating decimals can be converted, but it can be more complicated and we will not do it here.) The denominator is the place value of the right-most digit. The numerator is the number without the decimal. To finish it off, simplify the fraction to lowest terms.

Write the decimal as a fraction in lowest terms:

a) 0.6 b) 1.42 c) −0.875 d) −3.25

a) $= \frac{\cancel{6}\ 3}{\cancel{10}\ 5} = \frac{3}{5}$

b) $= \frac{\cancel{142}\ 71}{\cancel{100}\ 50}$ $1\frac{42}{100} =$

c) $= -\frac{\cancel{875}\ \cancel{175}\ \cancel{35}\ 7}{\cancel{1000}\ \cancel{200}\ \cancel{40}\ 8} = -\frac{7}{8}$

d) $= -\frac{\cancel{325}\ 13}{\cancel{100}\ 4} = \frac{-13}{4}$

Finally, rational numbers can also be written as a percent. **Convert the following to a <u>percent (over 100)</u>**

$\frac{1}{100} \equiv \%$

a) 0.32 b) 1.045 c) $\frac{7}{25}$ d) $\frac{23}{32}$

a) $= \frac{32}{100}$ $= 32\%$

b) $= \frac{1045}{1000}$ $= \frac{1045}{100 \times 10}$ $= \frac{1045}{10}\%$ $= 104.5\%$

$1.045 \times 100\%$
1.045×100
$= 104.5\%$

c) $= \frac{7}{25} \times 100\%$ $= 28\%$

$\frac{7 \times 4}{25 \times 4} = \frac{28}{100}$ $= 28\%$

d) $= \frac{23 \times 100}{32}\%$ $= 71.875\%$ $\approx 71.88\%$

Complete the chart:

FRACTION	DECIMAL	PERCENT
$^{3}/_{5}$	0.6	60%
$^{16}/_{25}$	0.64	64%
$^{11}/_{20}$	0.55	55%
$^{4}/_{25}$	0.16	16%
$^{17}/_{100}$	0.17	17%
$^{7}/_{20}$	0.35	35%
$^{7}/_{25}$	0.28	28%

Success Criteria:

- I can identify rational and irrational numbers
- I can convert between decimals, fractions and percents

Build your Skills: :)

A subset is a smaller set inside a set i.e. a collection inside a collection.

1. Identify each of the following statements as true (T) or false (F).

a) The set of whole numbers is a subset of the set of real numbers. T

b) The set of natural numbers is a subset of the set of integers. T

c) The set of whole numbers is a subset of the set of natural numbers. F

d) The set of rational numbers is a subset of the set of real numbers. T

e) The set of irrational numbers is a subset of the set of rational numbers. F

f) The set of prime numbers is a subset of the set of rational numbers. T

g) {2,3,π } is a subset of the rational numbers. F

2. Create a problem for which the answer involves the irrational number $\sqrt{5}$

* There are many possible answers. One example: $x = \sqrt{5}$ is the solution of $\boxed{x^2 + 2 = 7}$

3. Express the following sets in braces, { }.

a) The set of natural numbers less than 10. = {1, 2, 3, 4, 5, 6, 7, 8, 9}

b) The set of odd integers from −5 to 5. = {−5, −3, −1, 1, 3, 5}

c) The set of all even whole numbers greater than or equal to 20. = {20, 22, 24, 26, 28, 30, 32, ...}

d) The set of all integers that are multiples of 5. = {5, −5, 10, −10, 15, −15, 20, −20, 25, −25, ...}