Tishk International University

Architecture Department

First Grade

Fall semester 2024-2025

Calculus

Lecture -1-
Set of Numbers

Lecturer ‐ *Asmaa Abdulmajeed*

1

Contents

1. Natural Numbers
2. Whole Numbers
3. Integers
4. Rational Numbers
5. Irrational Numbers
6. Real Numbers
7. Imaginary Numbers
8. Complex Numbers

2

1. Natural Numbers

- Natural numbers are also called "counting numbers" which contains the set of positive integers from 1 to infinity.

- The set of natural numbers is represented by the letter "N". The natural number set is defined by:

- No zero or negative numbers

- N = {1, 2, 3, 4, 5, ……….}

- Examples: 35, 59, 110, etc.

3

2. Whole Numbers

- Whole numbers are also known as natural numbers with zero. The set consists of non-negative integers where it does not contain any decimal or fractional part. The whole number set is represented by the letter "W". The natural number set is defined by:

- W = {0,1, 2, 3, 4, 5, ……….}

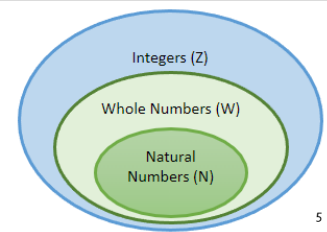- Examples: 67, 0, 49, 52, etc.

4

2
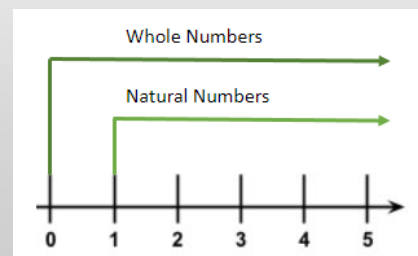
3. Integers

- Integers are defined as the set of all whole numbers with a negative set of natural numbers. The integer set is represented by the symbol "Z". The set of integers is defined as:
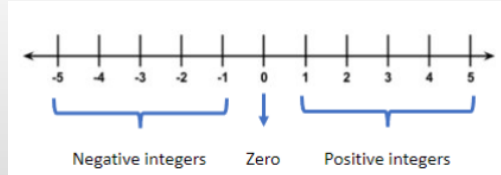
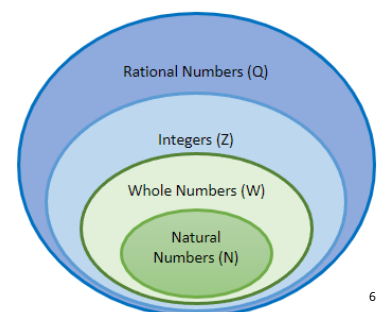- Z = {-3, -2, -1, 0, 1, 2, 3}

- Examples: -52, 0, -1, 16, 82, etc.

5

5

4. Rational Numbers

- Any number that can be written in the form of p/q, i.e., a ratio of one number over another number is known as rational numbers. A rational number can be represented by the letter "Q".

- Examples: 7/1, 10/2, 1/1, etc.

6

6

5. Irrational Numbers

- The number that cannot be expressed in the form of p/q. It means a number that cannot be written as the ratio of one over another is known as irrational numbers. It is represented by the letter "P".

- Examples: √2, π, Euler's constant, etc
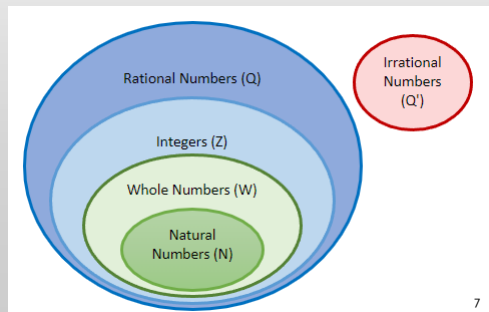
- $\sqrt{2} = 1.41421356237 \dots$

  As you can see
  - **Number of decimals are unlimited and**
  - **They are not similar to each other.**

  Therefore, they are irrational number.

- $\sqrt{3} = 1.7320508075 \dots$

- $\sqrt{5} = 2.2360679774 \dots$

- $\pi = 3.14159265358 \dots$

Tishk International University   Lecturer - Asmaa Abdulmajeed

Rational Numbers (Q)

Integers (Z)

Whole Numbers (W)

Natural Numbers (N)

Irrational Numbers (Q')

7

7

6. Real Numbers

- Real numbers include all the numbers that you can think of, which you can find in the real world, apart from imaginary numbers.

- Any number such as positive integers, negative integers, fractional numbers or decimal numbers without imaginary numbers are called the real numbers. It is represented by the letter "R".

- Examples: ¾, 0.333, √2, 0, -10, 20, etc.

- Used for limits, derivatives, and integrals in calculus

Tishk International University   Lecturer - Asmaa Abdulmajeed

Real Numbers (R)

Rational Numbers (Q)

Integers (Z)

Whole Numbers (W)

Natural Numbers (N)

Irrational Numbers (Q')
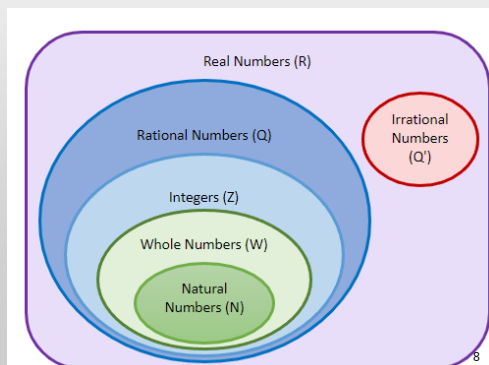
8

8

7. Imaginary Numbers

- We know that we can't take the square root of negative numbers, because there is no number that when squared will result in a negative number. In this case, we need to use imaginary numbers.

- The imaginary numbers are categorized under complex numbers. It is the product of real numbers with the imaginary unit "i". The imaginary part of the complex numbers is defined by Im (Z).

- $i = \sqrt{-1}$

- Examples: $\sqrt{2}$, i2, 3i, etc.

- Example: What is the square root of -16? Write your answer in terms of the imaginary number i.

Answer = 4i

- $1 \times i = i$
- $i \times i = -1$
- $-1 \times i = -i$
- $-i \times i = 1$

Tishk International University   Lecturer - Asmaa Abdulmajeed   9

9

8. Complex Numbers

- An imaginary number is combined with a real number to obtain a complex number. It is represented as a + bi, where a is the real part and b is the complex part of the complex number.

$$a + i\, b$$

Real Part   Imaginary Part

Tishk International University   Lecturer - Asmaa Abdulmajeed   10

10

Classification of Numbers

Real Numbers | Complex Numbers

Rational Numbers
3.64

Irrational Numbers
$\sqrt{2}$ $\sqrt{5}$ π

Integers 20 -8 1
0

Whole Numbers 3
0   2

Natural Numbers 4
1 12 7   10   11   -17

$\frac{5}{8}$
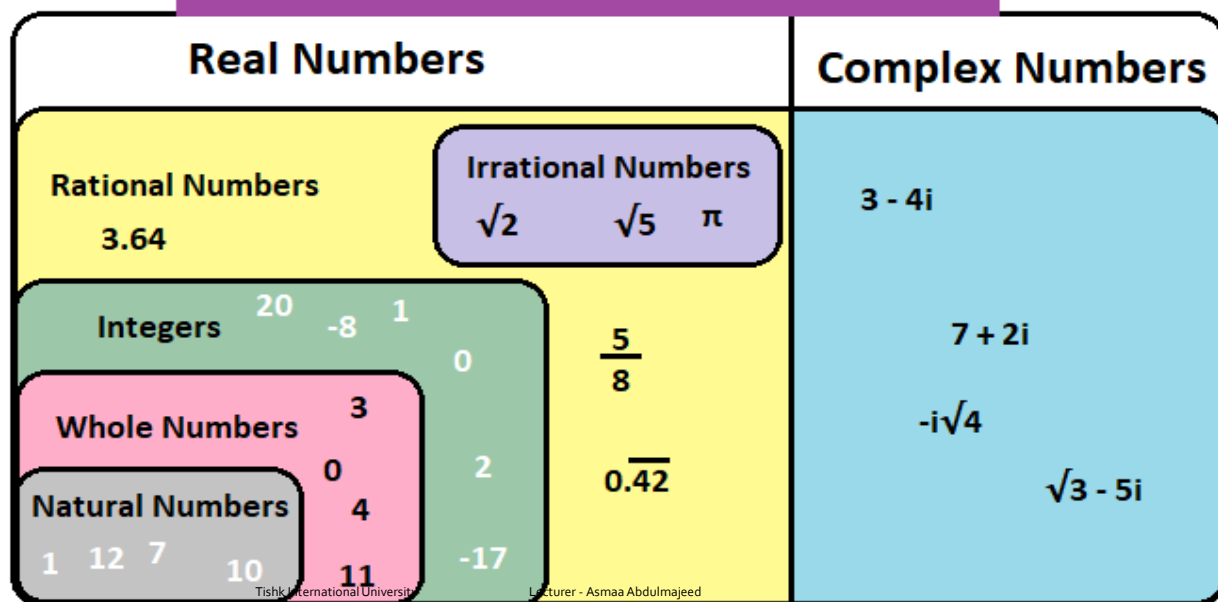
$0.\overline{42}$

3 - 4i

7 + 2i

-i$\sqrt{4}$

$\sqrt{3}$ - 5i

Tishk International University   Lecturer - Asmaa Abdulmajeed   11

11

Student Activity

Classify all the following numbers as **natural**, **integer**, **rational**, **irrational or real** using the table below. List all that apply.

	Natural $\mathbb{N}$	Integer $\mathbb{Z}$	Rational $\mathbb{Q}$	Irrational $\mathbb{R}\backslash\mathbb{Q}$	Real $\mathbb{R}$
5	✔	✔	✔		✔
$1 + \sqrt{2}$				✔	✔
$-9.6403915\ldots$				✔	✔
$-\frac{1}{2}$			✔		✔
$6.\dot{3}\dot{6}$			✔		✔
2π				✔	✔
-3		✔	✔		✔
$\sqrt[3]{8}$	✔	✔	✔		✔
0		✔	✔		✔
$-\sqrt{3}$				✔	✔

Tishk International University   Lecturer - Asmaa Abdulmajeed   12

12

6

Set of Numbers Test -1-

1. _____ is the set of numbers that includes positive and negative numbers.
   - A. Whole numbers
   - B. Rational numbers
   - C. Natural numbers
   - D. Integers

2. To which number set does -3.5 belong?
   - A. Real numbers
   - B. Whole numbers
   - C. Natural numbers
   - D. Integers

3. The number that can be written as a fraction is _____ .
   - A. Natural number
   - B. Rational number
   - C. Whole number
   - D. All of the above

4. Which number set would be best used to measure temperatures?
   - A. Whole numbers
   - B. Natural numbers
   - C. Integers
   - D. None of the above

13

---

5. Choose the equation(s) that fit the pattern $N/N = 1$.
   - A. $3/3 = 1$
   - B. $0/0 = 1$
   - C. $1,435/1,435 = 1$
   - D. $1.5/1.5 = 1$

6. Which number is not an integer?
   - A. -1
   - B. 0
   - C. 7/1
   - D. 4.3

7. Identify the set(s) to which the number -1/8 belongs.
   - A. Natural numbers
   - B. Whole numbers
   - C. Integers
   - D. Rational numbers

8. Choose the rational number between 1 and 4.
   - A. 2
   - B. 3/2
   - C. 3
   - D. 1/2

14

References

- Thomas-Calculus-14th-Edition
- Internet sources

15