



I COMPLEX NUMBERS



Let's Study

- A complex number (C.N.)
- Algebra of C.N.
- Geometrical Representation of C.N.
- Polar & Exponential form of C.N.
- De Moivre's Theorem.



Let's Recall

- Algebra of real numbers.
- Solution of linear and quadratic equations
- Representation of a real number on the number line
- Representation of point in a plane
- Trigonometric ratios

Introduction:

Consider, the equation $x^2 + 1 = 0$. This equation has no solution in the set of real numbers because there is no real number whose square is -1 . We need to extend the set of real numbers to a larger set, which would include solutions of such equations.

We introduce a symbol i (greek letter iota) such that $i = \sqrt{-1}$ and $i^2 = -1$. i is called as an **imaginary unit** or an **imaginary number**.

Swiss mathematician Leonard Euler (1707-1783) was the first mathematician to introduce the symbol i with $i = \sqrt{-1}$ and $i^2 = -1$.

1.1 A Complex number :

1.1(a) Imaginary Number :

A number of the form bi , where $b \in \mathbb{R}$, $b \neq 0$, $i = \sqrt{-1}$ is called an imaginary number

Ex : $\sqrt{-25} = 5i$, $2i$, $\frac{2}{7}i$, $-11i$ etc.

Note:

The number i satisfies following properties,

- $i \times 0 = 0$
- If $a \in \mathbb{R}$, then $\sqrt{-a^2} = \sqrt{i^2 a^2} = \pm ia$
- If $a, b \in \mathbb{R}$, and $a^2 = b^2$ then $a = b$

1.1 (b) Complex Number :

Definition : A number of the form $a+ib$, where $a, b \in \mathbb{R}$ and $i = \sqrt{-1}$ with $i^2 = -1$ is called a complex number and is usually denoted by z .

That is $z = a+ib$, $a, b \in \mathbb{R}$ and $i = \sqrt{-1}$

Here 'a' is called the real part of z and is denoted by **Re(z) or R(z)**. 'b' is called imaginary part of z and is denoted by **Im(z) or I(z)**

The set of complex numbers is denoted by \mathbb{C}

$\therefore \mathbb{C} = \{a+ib \mid a, b \in \mathbb{R}, \text{ and } i = \sqrt{-1}\}$

Ex :

z	$a+ib$	$\text{Re}(z)$	$\text{Im}(z)$
$2+4i$	$2+4i$	2	4
$5i$	$0+5i$	0	5
$3-4i$	$3-4i$	3	-4
$5+\sqrt{-16}$	$5+4i$	5	4
$2+\sqrt{5}i$	$2+\sqrt{5}i$	2	$\sqrt{5}$
$7+\sqrt{3}$	$(7+\sqrt{3})+0i$	$(7+\sqrt{3})$	0

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Daniel F McAuley



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