

COMPLEX NUMBER

Part I

Complex Numbers

A number $z = x + iy$ where $x, y \in \mathbb{R}$ and $i = \sqrt{-1}$; $x = \text{Real part or } \text{Re}(z)$; $y = \text{Imaginary part or } \text{Im}(z)$

Magnitude

$$|z| = \sqrt{x^2 + y^2}$$

$$|z| = |\bar{z}|$$

Argument

$$\text{amp}(z) = \arg(z) = \theta = \tan^{-1} \frac{y}{x}$$

General Argument: $2n\pi + \theta, n \in \mathbb{N}$

Principal Argument: $-\pi < \theta \leq \pi$

Least Positive Argument: $0 < \theta \leq 2\pi$

Complex Conjugate

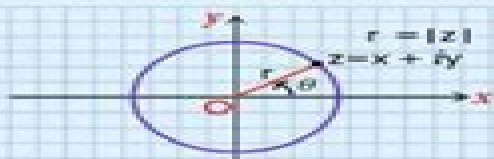
If $z = x + iy$

then the conjugate of 'z' is

$$\bar{z} = x - iy$$

Representation

Polar Representation



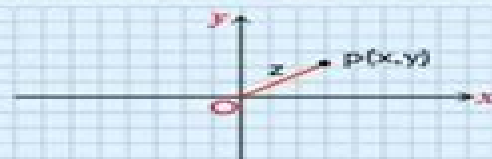
$$x = r \cos \theta, y = r \sin \theta$$

Exponential Form



$$z = r e^{i\theta} \text{ (where } e^{i\theta} = \cos \theta + i \sin \theta \text{)}$$

Vector Representation



$z = x + iy$ may be considered as a position vector of point P.

Properties of argument of a Complex Number

If z, z_1 and z_2 are complex numbers, then

- 1 $\arg(\text{any real positive number}) = 0$
- 2 $\arg(\text{any real negative number}) = \pi$
- 3 $\arg(z - \bar{z}) = \pm \frac{\pi}{2}$
- 4 $\arg(z_1 z_2) = \arg(z_1) + \arg(z_2)$
- 5 $\arg(z_1 \bar{z}_2) = \arg(z_1) - \arg(z_2)$
- 6 $\arg(z_1 / z_2) = \arg(z_1) - \arg(z_2)$
- 7 $\arg(\bar{z}) = -\arg(z) = \arg(1/z)$
- 8 $\arg(-z) = \arg(z) \pm \pi$
- 9 $\arg(z^n) = n \arg(z)$
- 10 $\arg(z) + \arg(\bar{z}) = 0$
- 11 $|z_1 + z_2|^2 + |z_1 - z_2|^2 = 2(|z_1|^2 + |z_2|^2)$
- 12 $|z_1 - z_2| = |z_1 + z_2| \iff \arg(z_1) - \arg(z_2) = \frac{\pi}{2}$
- 13 $|z_1 + z_2| = |z_1| + |z_2| \iff \arg(z_1) = \arg(z_2)$
- 14 $|z_1 + z_2|^2 = |z_1|^2 + |z_2|^2 \iff \frac{z_1}{z_2} \text{ is purely imaginary.}$
- 15 $|z_1 - z_2|^2 \leq (|z_1| - |z_2|)^2 + (\arg(z_1) - \arg(z_2))^2$
- 16 $|z_1 + z_2|^2 \geq (|z_1| + |z_2|)^2 + (\arg(z_1) - \arg(z_2))^2$
- 17 $|z_1 + z_2|^2 = |z_1|^2 + |z_2|^2 + 2|z_1||z_2|\cos(\theta_1 - \theta_2)$, where $\theta_1 = \arg(z_1)$ and $\theta_2 = \arg(z_2)$, or $|z_1 + z_2|^2 = |z_1|^2 + |z_2|^2 + 2\text{Re}(z_1 \bar{z}_2)$
- 18 $|z_1 - z_2|^2 = |z_1|^2 + |z_2|^2 - 2|z_1||z_2|\cos(\theta_1 - \theta_2)$, where $\theta_1 = \arg(z_1)$ and $\theta_2 = \arg(z_2)$, or $|z_1 - z_2|^2 = |z_1|^2 + |z_2|^2 - 2\text{Re}(z_1 \bar{z}_2)$

Complex Numbers Unit Guide

N Noddings



Complex Numbers Unit Guide:

The Top Books of the Year Complex Numbers Unit Guide The year 2023 has witnessed a remarkable surge in literary brilliance, with numerous captivating novels enthraling the hearts of readers worldwide. Lets delve into the realm of bestselling books, exploring the fascinating narratives that have captivated audiences this year. The Must-Read : Colleen Hoover's "It Ends with Us" This touching tale of love, loss, and resilience has captivated readers with its raw and emotional exploration of domestic abuse. Hoover expertly weaves a story of hope and healing, reminding us that even in the darkest of times, the human spirit can succeed. Uncover the Best : Taylor Jenkins Reids "The Seven Husbands of Evelyn Hugo" This captivating historical fiction novel unravels the life of Evelyn Hugo, a Hollywood icon who defies expectations and societal norms to pursue her dreams. Reids absorbing storytelling and compelling characters transport readers to a bygone era, immersing them in a world of glamour, ambition, and self-discovery. Discover the Magic : Delia Owens "Where the Crawdads Sing" This mesmerizing coming-of-age story follows Kya Clark, a young woman who grows up alone in the marshes of North Carolina. Owens crafts a tale of resilience, survival, and the transformative power of nature, entrancing readers with its evocative prose and mesmerizing setting. These top-selling novels represent just a fraction of the literary treasures that have emerged in 2023. Whether you seek tales of romance, adventure, or personal growth, the world of literature offers an abundance of engaging stories waiting to be discovered. The novel begins with Richard Papen, a bright but troubled young man, arriving at Hampden College. Richard is immediately drawn to the group of students who call themselves the Classics Club. The club is led by Henry Winter, a brilliant and charismatic young man. Henry is obsessed with Greek mythology and philosophy, and he quickly draws Richard into his world. The other members of the Classics Club are equally as fascinating. Bunny Corcoran is a wealthy and spoiled young man who is always looking for a good time. Charles Tavis is a quiet and reserved young man who is deeply in love with Henry. Camilla Macaulay is a beautiful and intelligent young woman who is drawn to the power and danger of the Classics Club. The students are all deeply in love with Morrow, and they are willing to do anything to please him. Morrow is a complex and mysterious figure, and he seems to be manipulating the students for his own purposes. As the students become more involved with Morrow, they begin to commit increasingly dangerous acts. The Secret History is a masterful and suspenseful novel that will keep you guessing until the very end. The novel is a warning tale about the dangers of obsession and the power of evil.

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