

$$\tan \theta = \left| \frac{y}{x} \right|$$

- $\theta = 0$ (في المحور الموجب)
- $\theta = \pi$ (في المحور السالب)
- $\theta = \pi + \theta'$ (في الربع الثاني)
- $\theta = -\theta'$ (في الربع الثالث)

0	30	45	60	90	180	270
0	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	نظري	0	نظري

$$z = -1 - \sqrt{3}i \quad x = -1 \quad y = -\sqrt{3}$$

$$r = \sqrt{1+3} = 2$$

$$\tan \theta = \left| \frac{y}{x} \right| = \sqrt{3}$$

$$\theta = \pi + \frac{\pi}{3} = \frac{4\pi}{3}$$

$$z = 2 \left(\cos \frac{4\pi}{3} + j \sin \frac{4\pi}{3} \right)$$

$$z = -2j \quad x=0 \quad y=-2$$

$$r = \sqrt{0+4} = 2$$

$$\tan \theta = \left| \frac{y}{x} \right| = \frac{2}{2} = 1$$

$$\theta = \frac{3\pi}{2} = -\frac{\pi}{2}$$

$$z = 2 \left(\cos \frac{3\pi}{2} + j \sin \frac{3\pi}{2} \right)$$

مرافقة عدد عقدي

$$z = x + jy \quad \bar{z} = x - jy$$

$$\bar{\bar{z}} = z \quad \text{مرفقة المرفقة}$$

$$\bar{z} = -z \quad \text{مرفقة المرفقة}$$

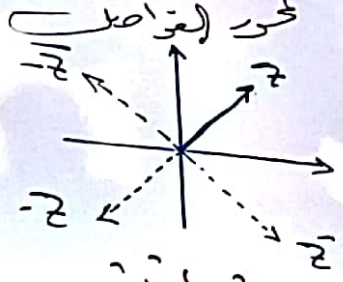
$$z \cdot \bar{z} = x^2 + y^2 = |z|^2$$

$$|z| = 1 \Leftrightarrow \bar{z} = \frac{1}{z}$$

$$z + \bar{z} = 2 \operatorname{Re} z$$

$$z - \bar{z} = 2j \operatorname{Im} z$$

صورة z بالأساس



المركب المثلثي

$$z = r(\cos \theta + j \sin \theta)$$

$$r = |z|$$

العدد العقدي

نوع الجبرية للعدد العقدي $z = x + jy$ حيث x, y حقيقيين.

$$z = x + jy$$

الجزء الحقيقي Re

الجزء التخيلي Im

جميع الأعداد هي أعداد عقديّة

$$z^2 = -1 \quad z^3 = -1$$

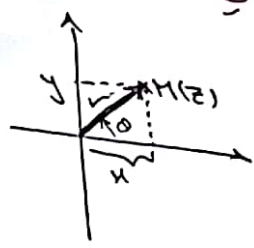
$$z^4 = 1$$

$$z^2 = 1 \Rightarrow z = 1 \text{ or } z = -1$$

$$z^4 = -1 \Rightarrow z = \pm j \text{ or } z = \pm 1$$

$$z^n = \{ -1, +1, -j, +j \}$$

طولية عدد عقدي



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

نقطه بیابی (۳)

$$\frac{x}{2} + y = 5 \Rightarrow y = 5 - \frac{x}{2}$$

$$x^2 + y^2 = 25$$

$$x^2 + \left(5 - \frac{x}{2}\right)^2 = 25$$

$$x^2 + 25 - 5x + \frac{x^2}{4} = 25$$

$$\frac{5x^2}{4} - 5x = 0$$

$$5x \left(\frac{x}{4} - 1\right) = 0$$

$$x = 0 \text{ یا } x = 4$$

$$y = 5 - \frac{0}{2} = 5$$

$$y = 5 - \frac{4}{2} = 3$$

$$x = \frac{3}{\sqrt{2}}, y = \frac{1}{\sqrt{2}}$$

$$x = \frac{-3}{\sqrt{2}}, y = \frac{-1}{\sqrt{2}}$$

$$(r(\cos \theta + j \sin \theta))^n = r^n (\cos n\theta + j \sin n\theta)$$

دستور زیر را

$$\cos \theta = \frac{e^{j\theta} + e^{-j\theta}}{2}$$

$$e^{j\theta} + e^{-j\theta} = 2 \cos \theta$$

$$\sin \theta = \frac{e^{j\theta} - e^{-j\theta}}{2j}$$

$$e^{j\theta} - e^{-j\theta} = 2j \sin \theta$$

ایجاد کنیم که این بیست و سه عدد

حقیقی یا با هم پیوسته

$$z^2 = 4 + 3j$$

این عدد یکدیگر را از بیست و سه

$$z = 4 + 3j$$

بعضی $w = 1 + j$ و بعضی دیگر

از بیست و سه $w^2 = 2$

$$x^2 - y^2 = a = 4$$

$$x^2 + y^2 = \sqrt{a^2 + b^2} = 5$$

$$2x \cdot y = b = 3$$

$$2x^2 = 9 \Rightarrow x^2 = \frac{9}{2}$$

$$x = \frac{3}{\sqrt{2}}$$

... (۳) ...

$$z = r \cdot e^{j\theta}$$

$$z_1 = r_1 \cdot e^{j\theta_1}$$

$$z_2 = r_2 \cdot e^{j\theta_2}$$

$$z = z_1 \cdot z_2$$

$$r = r_1 \cdot r_2$$

$$\theta = \theta_1 + \theta_2$$

$$z = \frac{z_1}{z_2}$$

$$r = \frac{r_1}{r_2}$$

$$\theta = \theta_1 - \theta_2$$

$$z = z_1^n$$

$$r = r_1^n$$

$$\theta = n\theta_1$$

$$1 = e^{j\frac{2\pi}{n}}$$

$$-1 = e^{j\frac{\pi}{2}}$$

$$-1 = e^{j\pi}$$

... دستورات دیگر را

$$(r(\cos \theta + j \sin \theta))^n = r^n (\cos n\theta + j \sin n\theta)$$

... دستورات دیگر را

$$z_1 = \cos \theta - j \sin \theta = \cos(-\theta) + j \sin(-\theta)$$

$$z_2 = -\cos \theta - j \sin \theta = \cos(\pi + \theta) + j \sin(\pi + \theta)$$

$$z_3 = \sin \theta + j \cos \theta = \cos\left(\frac{\pi}{2} - \theta\right) + j \sin\left(\frac{\pi}{2} - \theta\right)$$

$$z_4 = j = \cos\left(\frac{\pi}{2}\right) + j \sin\left(\frac{\pi}{2}\right)$$

$$z_5 = -1 = \cos\left(-\frac{\pi}{2}\right) + j \sin\left(-\frac{\pi}{2}\right)$$

$$z_6 = -1 = \cos \pi + j \sin \pi$$

... دستورات دیگر را

$$\frac{4\pi}{3} = \frac{3\pi + \pi}{3} = \pi + \frac{\pi}{3}$$

$$\frac{5\pi}{4} = \frac{4\pi + \pi}{4} = \pi + \frac{\pi}{4}$$

$$\frac{11\pi}{6} = \frac{12\pi - \pi}{6} = 2\pi - \frac{\pi}{6}$$