

# EQUATIONS IN COMPLEX NUMBERS SYSTEM.

## QUADRATIC EQUATIONS

$$ax^2 + bx + c = 0$$

$a, b, c$  are real numbers,  $a \neq 0$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Ex:  $x^2 - 4x + 11 = 0$

$a=1$ ,  $b=-4$ ,  $c=11$

$$\begin{aligned} x &= \frac{4 \pm \sqrt{16 - 44}}{2} = \frac{4 \pm \sqrt{-28}}{2} \\ &= \frac{4 \pm i\sqrt{4 \cdot 7}}{2} = \frac{4 \pm 2i\sqrt{7}}{2} \\ &= \frac{4}{2} \pm \frac{2\sqrt{7}}{2}i = \begin{cases} 2 + i\sqrt{7} \\ 2 - i\sqrt{7} \end{cases} \end{aligned}$$

$$\text{Ex: } x^2 + 25 = 0$$

$$\sqrt{x^2} = \sqrt{-25}$$

$$x = \pm \sqrt{-25}$$

$$x = \pm 5i \begin{cases} 5i \\ -5i \end{cases}$$

$$a=1, b=0, c=25$$

$$x = \frac{\pm \sqrt{-100}}{2} = \frac{\pm 10i}{2}$$

$$= \pm 5i$$

$$\text{Ex: } x^4 - 81 = 0$$

$$(x^2 - 9)(x^2 + 9) = 0$$

$$(x+3)(x-3)(x^2+9) = 0$$

$$x+3=0 \Rightarrow \underline{x=-3}$$

$$x-3=0 \Rightarrow \underline{x=3}$$

$$x^2 + 9 = 0$$

$$\sqrt{x^2} = \sqrt{-9}$$

$$x = \pm 3i \begin{cases} \underline{3i} \\ \underline{-3i} \end{cases}$$

Ex: FIND THE COMPLEX SOLUTIONS OF THE EQ.

or. FIND THE IMAGINARY SOLUTIONS OF THE EQ.

$$x^4 - 16 = 0$$

$$(x^2 - 4)(x^2 + 4)$$

$$(x-2)(x+2)(x^2+4)$$

$$x^2 + 4 = 0$$

$$x^2 = -4$$

$$x = \pm 2i \begin{cases} 2i \\ -2i \end{cases}$$

$$\text{Ex: } x^3 - 27 = 0$$

$$(x-3)(x^2 + 3x + 9) = 0$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$x-3=0 \Rightarrow x=3$$

$$x^2 + 3x + 9 = 0$$

$$x = \frac{-3 \pm \sqrt{9 - 36}}{2} = \frac{-3 \pm \sqrt{-27}}{2}$$

$$= \frac{-3 \pm i\sqrt{9 \cdot 3}}{2} = \frac{-3 \pm 3i\sqrt{3}}{2}$$

$$= -\frac{3}{2} \pm \frac{3\sqrt{3}}{2}i$$

$\left[ -\frac{3}{2} + \frac{3\sqrt{3}}{2}i \right]$   
 $\left[ -\frac{3}{2} - \frac{3\sqrt{3}}{2}i \right]$

$$\text{Ex: } x^4 + 3x^2 - 4 = 0$$

$$(x^2 - 1)(x^2 + 4) = 0$$

$$(x+1)(x-1)(x^2 + 4) = 0$$

$$x+1=0 \Rightarrow x=-1$$

$$x-1=0 \Rightarrow x=1$$

$$x^2 + 4 = 0 \Rightarrow \sqrt{x^2} = \sqrt{-4}$$

$$x = \pm 2i$$