Complex numbers

$a + bi$

$\underbrace{a}_{\text{Real part}} + \underbrace{bi}_{\text{imaginary part}}$

Imaginary i Definition

The imaginary unit i can be used to write the square root of any negative number.

$i = \sqrt{-1}$ AND $i^2 = -1$

If r is a positive real number, then

$\sqrt{-r} = i\sqrt{r}$

Examples

① $\sqrt{-3} = i\sqrt{3}$

② $\sqrt{-24} = i\sqrt{24} = 2i\sqrt{6}$

2 | 24
2 | 12
2 | 6
3 | 3
1

③ $(i\sqrt{5})^2 = i^2 \cdot 5 = -5$

WHEN WILL I SEE THESE???

"OFTEN" when solving a QUADRATIC equation, the solution will contain an imaginary number.

example:

$5x^2 + 33 = 3$

$5x^2 = -30$

$x^2 = -6$

$\sqrt{x^2} = \sqrt{-6}$

$x = \pm\sqrt{-6}$

$x = \pm i\sqrt{6}$

Look for negatives INSIDE square roots! $\sqrt{-\#}$

COMPLEX CONJUGATES

$a + bi$ and $a - bi$

When multiplied, complex conjugates will always be a REAL #

ADDING & SUBTRACTING & Examples

HOW TO: Add / Subtract their real parts and their imaginary parts s e p a r a t e l y

$(8 - i) + (5 + 4i)$ Add separately

$8 + 5 \quad -i + 4i$

$13 + 3i$

$(7 - 6i) - (3 - 6i)$

$7 - 3 \quad -6i - (-6i)$

$4 + 0i$ OR 4

MULTIPLYING & DIVIDING & EXAMPLES

multiply using the distributive property. $(9 - 2i)(-4 + 7i)$

$-36 + 63i + 8i - 14i^2$

$-36 + 71i - 14(-1)$

$-36 + 71i + 14$

$= -22 + 71i$

To divide, multiply top & bottom on the complex conjugate of denom.

$$\frac{7+5i}{1-4i} = \frac{(7+5i)\cdot(1+4i)}{(1-4i)\cdot(1+4i)} = \frac{7+28i+5i+20i^2}{1+4i-4i-16i^2}$$

$$\text{Simplify} = \frac{-13+33i}{17} = \frac{-13}{17} + \frac{33i}{17}$$

Ms. Blue