The Complex Number System

DEFINITION of *i*

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

*If there is a negative inside the radical take it OUT of the radical as "*i*"

$$\sqrt{-8} = \sqrt{8}i = \sqrt{4*2}i = 2\sqrt{2}i$$

$i^2 = -1$

*If you ever get an i^2 in your problem, always replace it with a (-1)

$$3i^2 = 3(-1) = -3$$

STANDARD FORM

$$a + bi$$

Real number part

Imaginary number part

**Always break apart into the two pieces

$$\frac{4-6i}{4} = \frac{4}{4} - \frac{6i}{4} = 1 - \frac{3}{2}i$$

ADD

$$(a+bi)+(c+di) = a+bi+c+di$$

$$= (a+c)+(b+d)i$$

*Add real number pieces and imaginary number pieces

$$(3+2i)+(5-6i) = 3+2i+5-6i$$

$$= (3+5)+(2-6)i$$

$$= 8-4i$$

SUBTRACT

$$(a+bi)-(c+di)$$

$$= a+bi-c-di$$

$$= (a-c)+(b-d)i$$

*Distribute the negative to the second term and then combine like pieces

$$(3+5i)-(7-8i)$$

$$= 3+5i-7+8i$$

$$= (3-7)+(5+8)i$$

$$= -4+13i$$

MULTIPLY

* Replace all i^2 with a (-1)

*Always simplify to Standard Form

$$(3-4i)(2+5i)$$

$$= 3(2)+3(5i)+2(-4i)+(-4i)(5i)$$

$$= 6+15i-8i-20i^2$$

$$= 6+7i-20(-1)$$

$$= 6+7i+20$$

$$= 26+7i$$

COMPLEX CONJUGATES

$(a+bi)$ **complex conjugate is** $(a-bi)$

$$(a+bi)(a-bi) = a^2+b^2$$

$$(3-2i)(3+2i) = 3^2+2^2 = 9+4 = 13$$

DIVIDE

1. Find complex conjugate of denominator
2. Multiply top & bottom by the complex conjugate
3. Simplify to Standard Form

$$\frac{2+4i}{5-2i} * \frac{(5+2i)}{(5+2i)}$$

$$= \frac{10+4i+20i+8i^2}{5^2+2^2}$$

$$= \frac{10+24i-8}{29}$$

$$= \frac{2}{29} + \frac{24}{29}i$$

SIMPLIFY POWERS OF *i*

$i^n = i$ *for* $n = 1,5,9,\ldots$

$i^n = -1$ *for* $n = 2,6,10,\ldots$

$i^n = 1$ *for* $n = 4,8,12,\ldots$

$i^n = -i$ *for* $n = 3,7,11,\ldots$

*Divide exponent by 4 and see how many times 4 goes into it evenly and find the remainder. The remainder value becomes new exponent to find the value of *i*

$i^{39} = ?$

$\frac{39}{4} = 9$ *remainder of* 3 *so use* $i^3 = -i$