Honors Advanced Algebra **DATE:** 9/22

Complex Numbers

Target 2A. Perform arithmetic operations, including adding, subtracting, and multiplying with complex numbers

Please read this information on ***imaginary numbers*** *(yes, imaginary numbers do exist!)...*

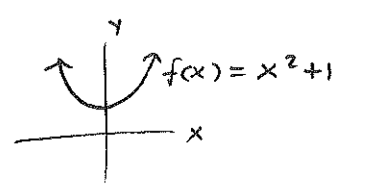
Up until now, you've been told that you can't take the square root of a negative number. That's because you had no numbers which were negative after you'd squared them (so you couldn't "go backwards" by taking the square root).

Now, however, you can take the square root of a negative number, but it involves using a new number to do it. This new number was invented (discovered?) around the time of the Reformation. At that time, nobody believed that any "real world" use would be found for this new number, other than easing the computations involved in solving certain equations, so the new number was viewed as being a pretend number invented for convenience sake.

(But then, when you think about it, aren't all numbers inventions? It's not like numbers grow on trees! They live in our heads. We made them all up! Why not invent a new one, as long as it works okay with what we already have?)

Anyway, this new number was called "i", standing for "**imaginary**", because "everybody knew" that i wasn't "real". (That's why you couldn't take the square root of a negative number before: you only had "real" numbers; that is, numbers without the "i" in them.) The imaginary is defined to be:

$$i = \sqrt{-1}$$



Then,

$$i^2 = \left(\sqrt{-1}\right)^2 = -1$$

motivation behind complex numbers... how do you solve $x^2+1=0$?

Complex Number: any number that can be written in the form $a + bi$.

$a, b \in \mathbb{R}$

Note: ***In your computations, you will deal with*** i ***just as you would with*** x***, except for the fact that*** x^2 ***is just*** x^2***, but*** i^2 ***is*** -1***. And, when you work with*** i***, the term with*** i ***is written last.***

Add and Subtract Complex Numbers

Addition Examples: When adding complex numbers, you simply combine like terms and think of the i just as you would an x.

1. $(6-4i)+(1+3i) = \boxed{7+i}$

2. $(3+5i)+(2-7i)+(-1+9i) = \boxed{4+7i}$

Subtraction Examples: Subtracting complex numbers is very similar to adding complex numbers; however, for subtracting, you need to remember to distribute the negative inside the parenthesis.

3. $(3-2i)-(5-4i) = 3-2i-5+4i = \boxed{-2+2i}$

4. $(4-6i)-(3-7i)-(1+i) = 4-6i-3+7i-1-i = \boxed{0}$

Multiply Complex Numbers

Multiplication Examples: When multiplying complex numbers you must use distributive property. The extra step you must remember is that when you get an i^2, you must change it to -1 (since $i^2=-1$) and simplify as much as possible.

5. Multiply: $(2+4i)(3-2i) = 6-4i+12i+8$

$= \boxed{14+8i}$

* $4i\cdot(-2i)$
$=-8i^2$
$=-8(-1)$
$=8$

$i^2=-1$

6. Multiply: $(5+i)(-2+3i) = -10+15i-2i-3$

$= \boxed{-13+13i}$

* $i\cdot 3i$
$=3i^2$
$=3(-1)$
$=-3$

7. Multiply: $(7+2i)^2 = (7+2i)(7+2i)$

$= 49+14i+14i-4$

$= \boxed{45+28i}$

* $2i\cdot 2i$
$=4i^2$
$=4(-1)$
$=-4$