CCSS Advanced Algebra 4 Introduction to Complex Numbers Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

In the mid 1500s, an Italian mathematician named Gerolamo Cardano posed a simple sounding algebraic problem:

Find two numbers that add to 10 and multiply to 40.

This simple premise lead to the invention of a new set of numbers that have turned out to be interesting and useful in the development of deeper mathematical thought.

1. Let $x$and $y$ be the numbers in Cardano’s problem. Write two equations to represent the problem that he posed.
2. Solve this SYSTEM OF EQUATIONS to find values of $x$and $y$. Is there a problem with the solutions you found? Explain why or why not.
3. Definitions:
* **Imaginary Unit**: $i=\sqrt{-1}$
* **Complex Number**: any number that can be expressed using the Imaginary Unit. For example, $5+2i$, $-3i$, $5-\sqrt{15}i$.
* **Real Part** of a Complex Number: the value of a complex number that does not include $i$.
* **Imaginary Part** of a Complex Number: the value of a complex number that doe include $i$.

 a. Use the Quadratic Formula to solve the equation $x^{2}+x+1=0$. Determine the Real and Imaginary parts of each solution.

 b. Use the Quadratic Formula to solve the equation $6x^{2}-6x+2=0$. Determine the Real and Imaginary parts of each solution.

 c. A quadratic function has complex roots $x=2-i$ and $x=2+i$. Write the function in Standard Form.

 d. The polynomial function $p(x)=x^{3}+4x^{2}+11x + 8$ has a zero at $x= -1$. Find the two complex roots of $p(x)$.

4. Notes to Self:

* How can you use the Quadratic Formula to determine whether or not a quadratic function has complex roots?
* How can you use the Complex Roots of a parabola to write the function in Standard Form?
* If an $n^{th}$ degree polynomial has 2 real roots, how many complex roots must it have? If it has 3 real roots, how many complex roots must it have?

5. Extra Practice:

1. Find all the roots (real and complex) of each polynomial:
	1. $f(x)=x^{2}+x+11$ ii. $g(x)=(x^{2}-4)(x^{2}+x+2)$ iii. $h(x)=(x^{2}-2x-8)(x^{2}+9)$
2. Solve each equation below (find real and complex solutions):
	1. $-5x^{2}=3x+10$ ii. $(x^{2}+3x+5)(x-4)^{2}(2x+1)=0$ iii. $(x^{2}+25)(x^{2}-1)(x^{2}+9)=0$

6. Review (Rational Expressions): Simplify each expression below:

a. $\frac{3x}{x+1}+\frac{3}{x+1}$ b. $\frac{x^{2}}{x+3}-\frac{9}{x+3}$ c. $\frac{1}{x-1}+\frac{1}{x+1}$

d. $\frac{x}{x-3}⋅\frac{(x-3)(x+3)}{x^{2}}$ e. $\frac{(x^{2}-25)(x^{2}+6x+5)(x-1)}{(x^{2}+10x+25)(x^{2}-1)}$