3.1-3.2: Complex Numbers and Quadratic Functions

***NOTE: DURING OUR WORK IN CHAPTER 3, WE **WILL** DEAL WITH COMPLEX NUMBERS. (During most of the course, we'll only deal with real numbers.)

A **quadratic function** is one that can be written in the form

$$f(x) = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ .$$

When dealing with a new function, the first question to ask is "what's the domain?" (Remember, the domain is all numbers that ____.)

The **domain of a quadratic function** is ____.

Another question we usually ask about functions is "what inputs make the output = 0?" (that is, "what x-values make $f(x) = 0$?" These inputs are called the **zeros of the function** (or sometimes the roots of the function).

Finding the zeros of a quadratic function:
In general, there are 3 ways to find zeros of a quadratic function (that is, solve $f(x) = 0$).

1. Factoring
2. Quadratic Formula
3. Completing the Square (we'll do this in section 3.3)

Factoring: You should remember how to do this from earlier classes. If you can't factor easily, the quadratic formula or completing the square will always work, but often factoring is quicker and easier if you can see how to do it.
Example: Find the zeros of $f(x) = x^2 - 5x - 14$ by factoring.

The key idea that makes this work is that whenever (….)(…..)(….) = 0, then some factor(s) in there must be =0. So if you can factor the function and set each factor =0, that gives all possible zeros of the function.

Quadratic formula: This will always work, but can be messy. First put the quadratic function into the form $f(x) = ax^2 + bx + c$. (Note that a is always next to the x^2, whatever order the terms are in, b is always with x, etc.) Then the quadratic formula says that the zeros of the function are

$$x =$$

(memorize this if you haven't already!) Note that this usually gives 2 x-values, one using + and one using - . You need to simplify the expression as much as possible.

What if you can't factor, and the quadratic formula has the square root of a negative number? Then there are no **real** zeros (so there won't be any x-intercepts on the graph), but there are complex zeros.

Complex Numbers: We let the letter $i = \sqrt{-1}$. This isn't a real number, it's *imaginary*, but it works just like a real number in terms of addition, subtraction, etc. The only thing to remember is that

$$\boxed{i^2 = -1}$$

A **complex number** is any number of the form $a + bi$, where a and b are real numbers. For example, $3 + 2i$, $5 - i$, $\sqrt{7} + \frac{4}{5}i$ are all complex numbers.

Sometimes you have to simplify to get them in standard $a + bi$ form.

Examples:

1. $\sqrt{-9} =$

2. $\frac{10 \pm \sqrt{-12}}{2} =$

3. $3 + 2i - (4 - 7i) =$

4. $(2 + i)(-1 - 4i) =$