**5.6 The Fundamental Theorem of Algebra**

Objectives: To use the Fundamental Theorem of Algebra to solve polynomial equations with and without complex solutions.

You can always factor any polynomial of degree n into n linear factors (n solutions), but sometimes the factors will involve imaginary numbers.

are easy to see that they only cross the x-axis in one place (one zero/root/solution).

are not as easy to see where they cross the x-axis because they can have three different outcomes.

Two real zeros One real zero No real zero

(multiplicity of 2)

This concept above is what lead to the discovery of the Fundamental Theorem of Algebra.

**The Fundamental Theorem of Algebra**

If f(x) is a polynomial of degree n where , then the equation has exactly n roots, including multiple and complex roots.

In other words: Any nth degree polynomial function has exactly n zeros

Example of Using the Fundamental Theorem of Algebra

What are the roots for the following equation?

There are 5 zeros (solutions) because the degree is 5.

Step1: It is already in standard form so now we just need the possible rational roots (sections 5.5)

Step2: Since P(1)=0 we know it is a root (Remainder Thm) and therefore x-1 is a factor. Use synthetic division to factor out x-1.

Step 3: Continue Factoring until you have 5 linear factors. (Or until you get to quadratics so you can use the Quadratic Formula).

Step 4: Find the roots. . These are the only roots based on the Fundamental Theorem of Algebra.

Example 2: How could you use a graphing calculator to help you solve the following? What are the zeros?

Example 3: How could you use a graphing calculator to help you solve the following? What are the zeros?

HMWK: pg 322 #1-7, 9-19 (odd), 38-40, 44