**Purpose**: To explore graphing of polynomials using a graphing calculator so you can later sketch their graphs and know properties of the graphs without the use of a calculator.

Graph the following third degree equations on your paper.

$f\left(x\right)=x^{3}$ $f\left(x\right)=x^{3}-5x$ $f\left(x\right)=x^{3}-5x+4$

2

4

6

8

-8

-6

-4

-2

2

4

6

8

-2

-4

-6

-8

*x*

*y*

2

4

6

8

-8

-6

-4

-2

2

4

6

8

-2

-4

-6

-8

*x*

*y*

2

4

6

8

-8

-6

-4

-2

2

4

6

8

-2

-4

-6

-8

*x*

*y*

What is the same in all three graphs?

What is different?

How could you make the beginning and end behavior switch?

How many zeros does each graph have?

How many turns (relative min/max) does each graph have?

CONJECTURE: A third degree polynomial has at most \_\_\_\_\_\_\_\_\_\_\_\_\_ zeros and a maximum of \_\_\_\_\_\_\_\_ turns.

Using your calculator, graph the following fourth degree equations on your paper.

$f\left(x\right)=x^{4}$ $f\left(x\right)=x^{4}-3x^{3}+4x$ $f\left(x\right)=x^{4}-3x^{3}+4x-1$

2

4

6

8

-8

-6

-4

-2

2

4

6

8

-2

-4

-6

-8

*x*

*y*

2

4

6

8

-8

-6

-4

-2

2

4

6

8

-2

-4

-6

-8

*x*

*y*

2

4

6

8

-8

-6

-4

-2

2

4

6

8

-2

-4

-6

-8

*x*

*y*

What is the same in all three graphs?

What is different?

How could you make the beginning and end behavior switch?

How many zeros does each graph have?

How many turns (relative min/max) does each graph have?

CONJECTURE: A fourth degree polynomial has at most \_\_\_\_\_\_\_\_\_\_\_\_\_ zeros and a maximum of \_\_\_\_\_\_\_\_ turns.

Before you graph $f\left(x\right)=x^{5}+3x^{4}-5x^{3}-15x^{2}+4x+12$, predict the maximum number of zeros and the maximum number of turns.

Graph of $f\left(x\right)=x^{5}+3x^{4}-5x^{3}-15x^{2}+4x+12$ Graph of $g\left(x\right)=x^{5}$

2

4

6

8

-8

-6

-4

-2

2

4

6

8

-2

-4

-6

-8

*x*

*y*

2

4

6

8

-8

-6

-4

-2

2

4

6

8

-2

-4

-6

-8

*x*

*y*

Why do you think the graphs of f(x) and g(x) are so different in the middle but alike on the right and left hand sides?

An equation of n degree could have at most \_\_\_\_\_\_\_ zeros and at most \_\_\_\_\_\_\_ turns.

**Leading Coefficient Test**:

An \_\_\_\_\_\_\_\_\_\_ degree makes the graph have alike beginning and ending behaviors

An \_\_\_\_\_\_\_\_\_\_ degree makes the graph have opposite beginning and ending behaviors

A \_\_\_\_\_\_\_\_\_\_\_ leading coefficient makes the ending behavior of a graph reach infinity

A \_\_\_\_\_\_\_\_\_\_\_ leading coefficient makes the ending behavior of a graph reach negative infinity.

**Multiplicity**:

If we were to solve the equation$\left(x-1\right)\left(x-1\right)\left(x-3\right)=0$, we would have zeros of x = 1 and 3. We say that x = 1 has a multiplicity of 2 since the zero occurs twice.

Find the zeros of $x^{4}-x^{3}-20x^{2}$.

Comment on their multiplicity.

What is the beginning and end behavior of the graph?

How many turns will the graph have?

Please complete the following assignment for tomorrow: Section 2.2 p. 133: 9-14, 15, 19-28 by 3's, 35-50 by 3's