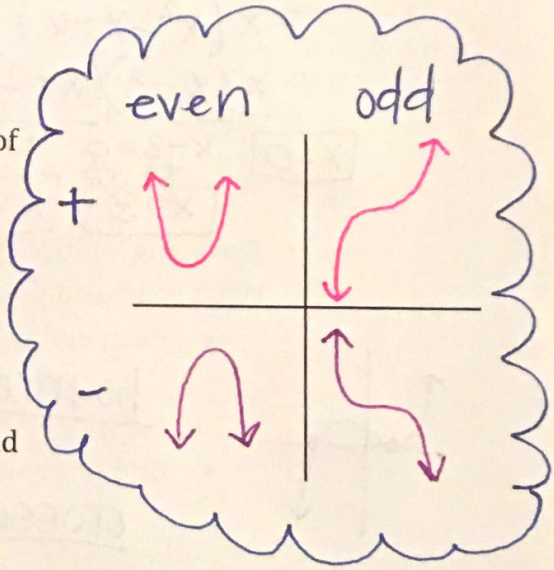
Name: _____

Secondary 3 Honors
2-4 Notes: Polynomial Functions of Higher Degree

- **Group Graphing Activity**: everyone needs to choose 2 functions to graph on your calculator. Then draw a rough sketch of the graph in the space provided below the function. When everyone is finished lay out all 8 functions so you can see them and answer the following questions.
  - What do you notice about the "end behavior" of functions with ...
    - even powers?
      same direction
    - odd powers?
      opposite directions
    - with negative leading coefficients?
      finishes down
    - with positive leading coefficients?
      finishes up



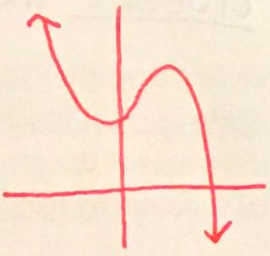
- What conclusion can we make about the "end behavior" of polynomial functions?
  end behavior is determined by leading coefficient AND power

- Graph the following functions in a viewing window that shows all of its extrema and x-intercepts. Describe the end behavior using limits.

$f(x) = -x^3 + 5x^2 + 6$

$\lim_{x \to -\infty} f(x) = \infty$

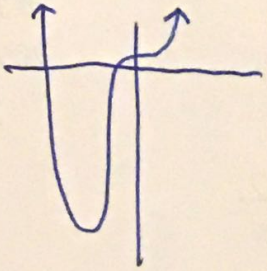
$\lim_{x \to \infty} f(x) = -\infty$



$f(x) = x^4 + 5x^3 + 8$

$\lim_{x \to -\infty} f(x) = \infty$

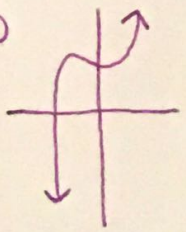
$\lim_{x \to \infty} f(x) = \infty$



$f(x) = x^5 + 6x^3 + 2x^2 + 4$

$\lim_{x \to -\infty} f(x) = -\infty$

$\lim_{x \to \infty} f(x) = \infty$



- Finding Zeros (X-intercepts) of a polynomial algebraically.
  - Steps to factoring:

    1. find any GCF ~~$f(x) = 3x^3 - x^2 - 2x$~~
    2. use a factoring method
       - Guess and check
       - Grouping
       - AC Method
       - special patterns
    3. SIMPLIFY!! set factored parts each equal to zero, solve for x.

  - See if you can find the zeros by using the factoring methods above.

$f(x) = x^3 - x^2 - 6x$

$= x(x^2 - x - 6)$

$= x(x-3)(x+2)$

$\boxed{x=0}$ $\quad x-3=0$, $+3\ +3$, $\boxed{x=3}$ $\quad x+2=0$, $-2\ -2$, $\boxed{x=-2}$

$f(x) = 2x^3 + 20x^2 + 42x$

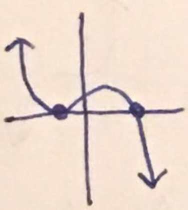
$= 2x(x^2 + 10x + 21)$

$= 2x(x+7)(x+3)$

$\frac{2x}{2} = \frac{0}{2}$, $\boxed{x=0}$ $\quad \boxed{x=-7}$ $\quad \boxed{x=-3}$

- Exploring Multiplicity: How many times a factor occurs.
- What conclusions can we make about the multiplicity of a factor?
  - Even multiplicity:

    bounces of the x-axis at its zero.



  - Odd multiplicity:

    crosses the x-axis at its zero.

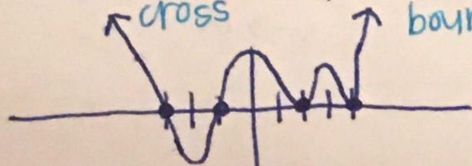
- In the following examples state the degree and list the zeros of the polynomial function. State the multiplicity of each zero and whether the graph crosses or bounces the x-axis at the corresponding x-intercept. Then sketch the graph of the polynomial function by hand.

$f(x) = (x-4)^2(x+3)^3(x+1)^5(x-2)^2$

degree: 12 even, +

zeros: x=4, −3, −1, 2

4 mult. 2 (bounce), −3 mult. 3 (cross),
−1 mult. 5 (cross), 2 mult. 2 (bounce)



$f(x) = (x-2)^3(x+3)^2$

degree: 5 odd, +

zeros: 2, −3

2 mult. 3 (cross), −3 mult. 2 (bounce)