

## 2.3 Polynomial Functions of Higher Degree

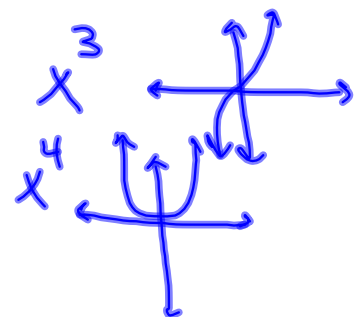
- Obj: 1. Graph polynomial fncs.  
2. Predict End Behavior  
3. Find real zeros.

Last time:

poly. deg 0	constant fnc.
deg 1	linear fnc.
deg 2	quadratic fnc.

Today:

deg 3	cubic
deg 4	quartic



## Vocabulary

each monomial is a "term"

$$\underline{x^2} + \underline{x} - \underline{6} \quad 3 \text{ terms}$$

Standard Form: written w/ degrees in descending order.

$$3x^4 + x^3 - 2x^2 + x + 27$$

$$3x^4 - 2x^2 + 27$$

$$\underline{-2x^2 + x + x^3} \quad \text{not standard form}$$

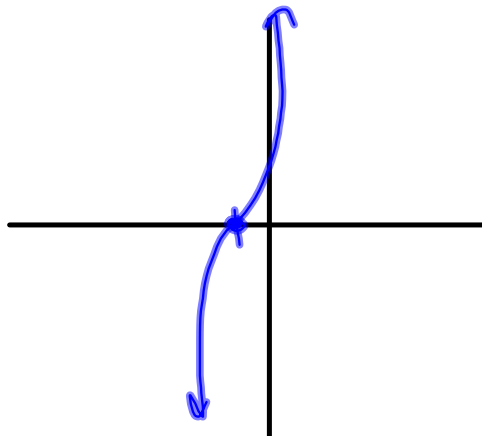
## Graphing transformations:

$$g(x) = \underline{4}(x + \underline{1})^3$$

v. str. by 4

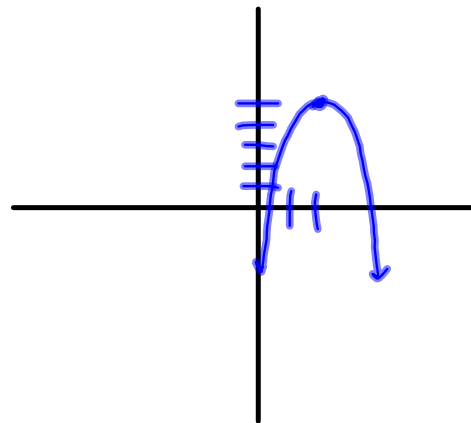
left 1

$$f(x) = x^3$$



Graph:  $h(x) = -(x-2)^4 + 5$

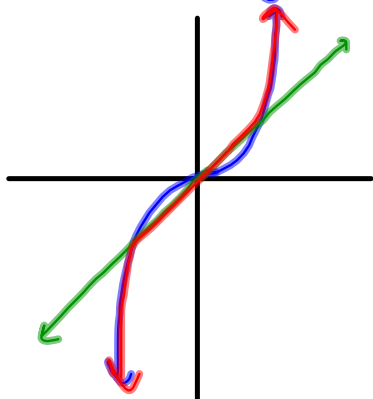
refl. over x-axis  
right 2  
up 5



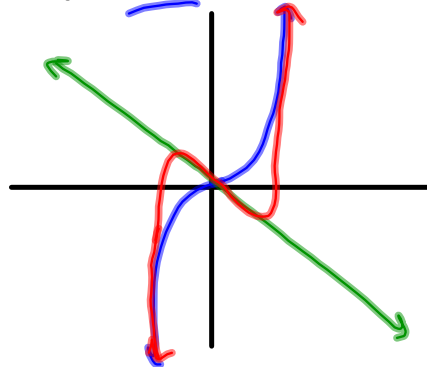
# Graphing Combinations of Monomials

$$f(x) = \underline{x^3} + \textcircled{\underline{x}} \text{ around origin}$$

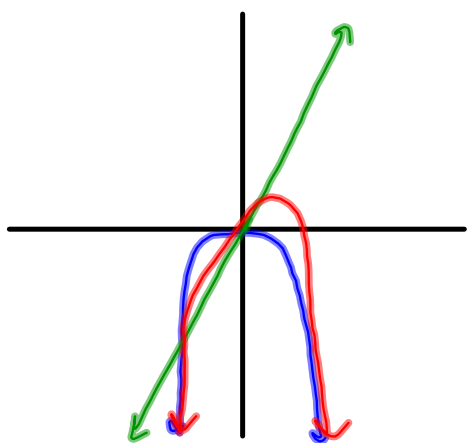
Deg 3



$$f(x) = \underline{x^3} - \underline{x}$$



$$f(x) = \underline{-x^4} + \underline{2x}$$



\* A polynomial fnc. of degree:  $n$   
has at most  $n$  real zeros.

### End Behavior Big Picture

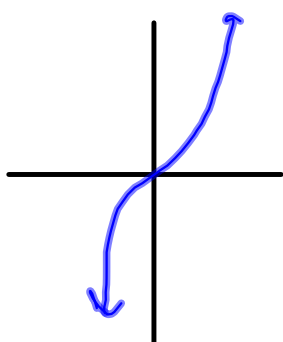
Graph:  $f(x) = \underline{x^3} - 4x^2 - 5x - 3$  deg 3  
 $g(x) = \underline{x^3}$  deg 3

Zoom Out: window

1.  $[-7, 7]$  by  $[-25, 25]$

2.  $[-14, 14]$  by  $[-200, 200]$

3.  $[-56, 56]$  by  $[-128,000, 128,000]$



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

"The limit of  $f(x)$  as  $x$  approaches  $\infty$ "

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

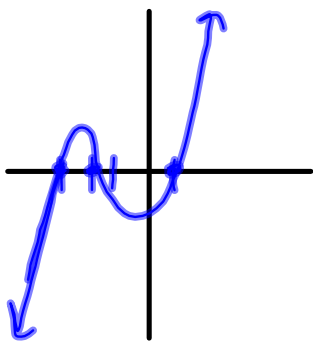
$$f(x) = (x-1)(x+2)(x+3)$$

Graph in a window that shows all extrema & x intercepts. Describe end behavior using limits. Find the zeros by hand

$$(x-1)(x+2)(x+3) = 0$$

$$x-1=0 \quad x+2=0 \quad x+3=0$$

$$x=1 \quad x=-2 \quad x=-3$$



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

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



$$f(x) = (x-2)^{\textcircled{3}} (x+1)^{\textcircled{2}} \quad \text{deg } 5$$

Zeros:  $x-2=0$   
 $x=2$

multiplicity: repeated  
 3 times

3

odd

func crosses  
 x-axis

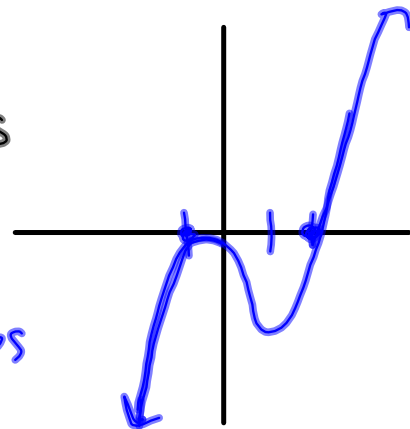
$x+1=0$   
 $x=-1$

repeated  
 2 times

2

even

func. touches  
 x-axis



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

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

Find zeros, state the multiplicity of each zero,  
Sketch by hand.

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

Zeros:  $x = -2$  mult. 3 cross

$x = 1$  mult. 2 touch

