13. $x^3-4x^2-11x+2$

$$\begin{array}{r|rrrr} -2 & 1 & -4 & -11 & 2 \\ & \downarrow & -2 & 12 & -2 \\ \hline & 1 & -6 & 1 & ☺ \end{array}$$

$x^2 \quad x \quad \#$

$(x+2)(x^2-6x+1)$

$a=1$
$b=-6$
$c=1$

$\sqrt{32}$, $2 \wedge 16$, $4 \cdot 4$

$$x=\frac{6\pm\sqrt{(-6)^2-4(1)(1)}}{2(1)} \quad 36-4$$

$$=\frac{6\pm\sqrt{32}}{2}$$

$$\frac{6}{2}\pm\frac{4\sqrt{2}}{2}$$

$x=3\pm2\sqrt{2}$

$$\boxed{\begin{array}{l} x=-2 \\ x=3+2\sqrt{2} \\ x=3-2\sqrt{2} \end{array}}$$

14. x^3-4x^2+2x+4

$$\begin{array}{r|rrrr} 2 & 1 & -4 & 2 & 4 \\ & \downarrow & 2 & -4 & -4 \\ \hline & 1 & -2 & -2 & ☺ \end{array}$$

$x^2 \quad x \quad \#$

$(x-2)(x^2-2x-2)$

-2, $1 \wedge 2$

$x=2$

$x= \qquad \pm\sqrt{}$

$$\frac{2\pm2\sqrt{3}}{2}$$

$$\frac{2}{2}\pm\frac{2\sqrt{3}}{2}$$

3-2 Graphing Polynomial Functions

(Book 5.4 pg. 293-306)

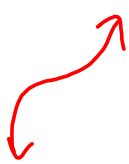
Objectives:

- I can graph a polynomial function by hand and using technology
- I can find end behavior of a polynomial function
- I can identify zeros, x-intercepts, and factors of a polynomial function
- I can determine the multiplicity of a polynomial function

Graphing Polynomials Task

$x^3 \rightarrow$ opposite

$+$



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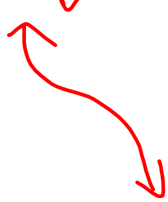
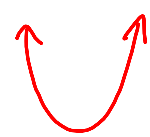


$x^4 \rightarrow$ same

$+$



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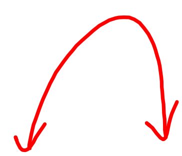


$f(x) = (x+3)(x-2)$

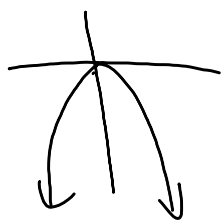
$x = -3, 2$

End Behavior

Using a graphing calculator find the end behavior of the following functions. Where do the ends go?

Function	Domain	Range	End Behavior
$f(x)=x^2$	$(-\infty,\infty)$	$[0,\infty)$	R As $x\to+\infty$, $f(x)$ y $\to$ ∞. L As $x\to-\infty$, $f(x)$ y $\to$ ∞.
$f(x)=x^4$	$(-\infty,\infty)$	$(0,\infty)$	As $x\to+\infty$, $f(x)\to$ ∞. As $x\to-\infty$, $f(x)\to$ ∞.
$f(x)=x^6$	$(-\infty,\infty)$	$[0,\infty)$	As $x\to+\infty$, $f(x)\to$ ∞. As $x\to-\infty$, $f(x)\to$ ∞.

Does it change if I have a negative coefficient? How?



D: $(-\infty,\infty)$ same

R: $(-\infty, 0]$

As $x\to-\infty$, $f(x)\to-\infty$

As $x\to\infty$, $f(x)\to-\infty$

End Behavior

Using a graphing calculator find the end behavior of the following functions. Where do the ends go?

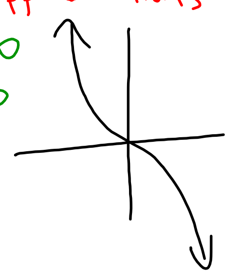
Function	Domain	Range	End Behavior
$f(x)=x$	$(-\infty,\infty)$	$(-\infty,\infty)$	As $x\to+\infty$, $f(x)\to$ ∞. As $x\to-\infty$, $f(x)\to$ $-\infty$
$f(x)=x^3$	$(-\infty,\infty)$	$(-\infty,\infty)$	As $x\to+\infty$, $f(x)\to$ ∞. As $x\to-\infty$, $f(x)\to$ $-\infty$
$f(x)=x^5$	$(-\infty,\infty)$	$(-\infty,\infty)$	As $x\to+\infty$, $f(x)\to$ ∞. As $x\to-\infty$, $f(x)\to$ $-\infty$

Does it change if I have a negative coefficient? How?

ODD Deg: End Behavior in opp. Directions

Pos LC: R→∞ L→$-\infty$

Neg LC: R→$-\infty$ L→∞



Zeros, x-intercepts, and factors

Find the factors of $f(x) = x^2 + 4x + 3$

$(x+1)(x+3)$

Now find the x-intercepts of $f(x) = x^2 + 4x + 3$

$(-1,0)$ $(-3,0)$

Lastly find the zeros of $f(x) = x^2 + 4x + 3$

$x = -1, -3$

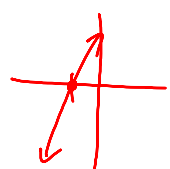
What is the same between the factors, x-intercepts, and zeros of this function?

Multiplicity

$(x-1)^1(x+2)^2(x+1)^5$

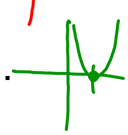
The **power** of the factor determines the nature of the intersection at the point $x = a$.
(This is referred to as the multiplicity.)

Straight intersection:
$(x - a)^1$ The power of the zero is 1.



$(x+1)$

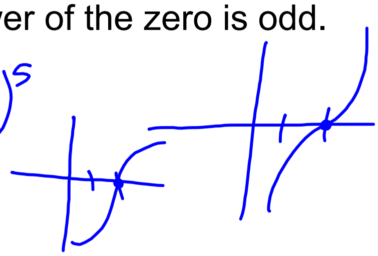
Tangent intersection : (bounce)
$(x - a)^{even}$ The power of the zero is even.



$(x-1)^2$ or $(x-1)^4$

Inflection intersection: **(like a slide through)**
$(x - a)^{odd}$ not 1 The power of the zero is odd.

$(x-2)^3$ $(x-2)^5$



October 02, 2014

(A) Use a graphing calculator to graph the cubic functions $f(x) = x^3$, $f(x) = x^2(x - 2)$, and $f(x) = x(x - 2)(x + 2)$. Then use the graph of each function to answer the questions in the table.

Function	$f(x) = x^3$	$f(x) = x^2(x - 2)$	$f(x) = x(x - 2)(x + 2)$
How many distinct factors does $f(x)$ have?			
What are the graph's x-intercepts?			
Is the graph tangent to the x-axis or does it cross the x-axis at each x-intercept?			
How many turning points does the graph have?			
How many global maximum values? How many local?			
How many global minimum values? How many local?			

(If time)

(B) Use a graphing calculator to graph the quartic functions $f(x) = x^4$, $f(x) = x^3(x - 2)$, $f(x) = x^2(x - 2)(x + 2)$, and $f(x) = x(x - 2)(x + 2)(x + 3)$. Then use the graph of each function to answer the questions in the table.

Function	$f(x) = x^4$	$f(x) = x^3(x - 2)$	$f(x) = x^2(x - 2)(x + 2)$	$f(x) = x(x - 2)(x + 2)(x + 3)$
How many distinct factors?				
What are the x-intercepts?				
Tangent to or cross the x-axis at x-intercepts?				
How many turning points?				
How many global maximum values? How many local?				
How many global minimum values? How many local?				

Reflect

2. What determines how many x-intercepts the graph of a polynomial function in intercept form has?

3. What determines whether the graph of a polynomial function in intercept form crosses the x-axis or is tangent to it at an x-intercept?

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Graphing a Polynomial from factors

(B) $f(x) = -(x-4)(x-1)(x+1)(x+2)$

Identify the end behavior.

As $x \to +\infty$, $f(x) \to$ □.

As $x \to -\infty$, $f(x) \to$ □.

Identify the graph's x-intercepts, and then use the sign of $f(x)$ on intervals determined by the x-intercepts to find where the graph is above the x-axis and where it's below the x-axis.

The x-intercepts are $x =$ □, $x =$ □, $x =$ □, $x =$ □.

Interval	Sign of the Constant Factor	Sign of $x-4$	Sign of $x-1$	Sign of $x+1$	Sign of $x+2$	Sign of $f(x) = -(x-4)(x-1)(x+1)(x+2)$
$x <$ □	−		−		−	
□ $< x <$ □	−		−		+	
□ $< x <$ □	−		+		+	
□ $< x <$ □	−		+		+	
$x >$ □	−		+		+	

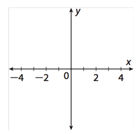
So, the graph of $f(x)$ is above the x-axis on the intervals

□ $< x <$ □ and □ $< x <$ □, and

it's below the x-axis on the intervals $x <$ □, □ $< x <$ □,

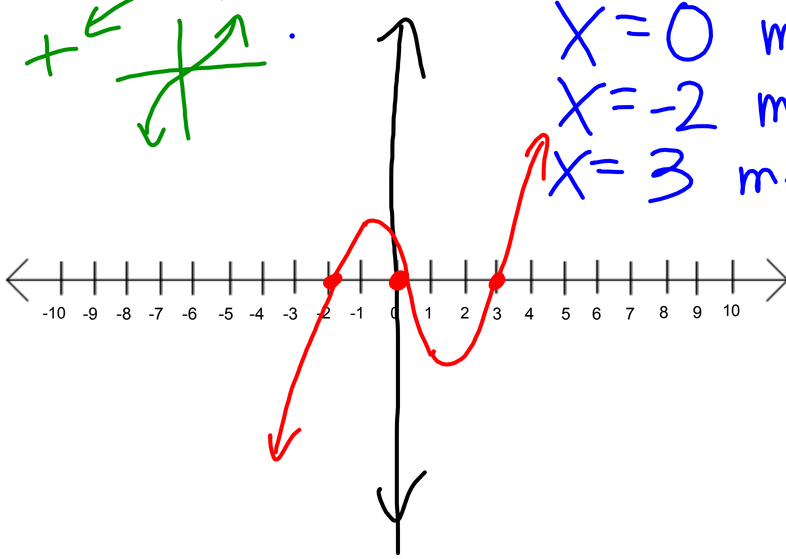
and $x >$ □.

Sketch the graph.



$$f(x) = x\overset{=0}{(x+2)}\overset{=0}{(x-3)}^{=0}$$

$x^3 +$



X=0 m:1 (straight)

X=-2 m:1 " "

X=3 m:1 " "

$$f(x) = -(x-4)(x-1)(x+1)(x+2)$$

$X = 4$ m: 1

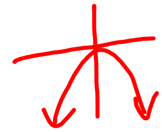
$X = 1$ m: 1

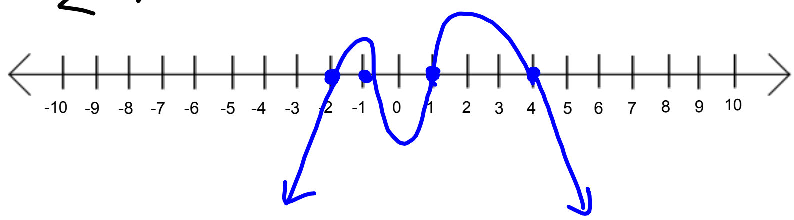
$X = -1$ m: 1

$X = -2$ m: 1

X^4 even

$-$





Ex. 8 Find the zeros, the multiplicity, end behavior and graph the following:

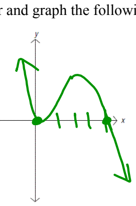
a. $f(x) = -x^2(x-4)$

$-x^2(x-4)$

$X = 0$ m: 2 tangen/bounce

$X = 4$ m: 1 Straight

X^3 $-$



$-x^2 = 0$

$\frac{-x^2}{-1} = \frac{0}{-1}$

$\sqrt{x^2} = \sqrt{0}$

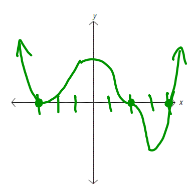
$x = 0$

b. $f(x) = (x+3)^2(x-2)^3(x-4)$

$X = -3$ m: 2 bounce

$X = 2$ m: 3 inflection

$X = 4$ m: 1 Straight



c. X^6 even $+$

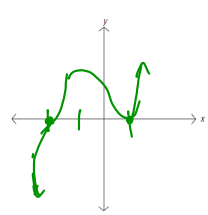
$f(x) = (x+2)^3(x-1)^2$

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

$X = -2$ m: 3 inflec.

$X = 1$ m: 2

X^5 $+$



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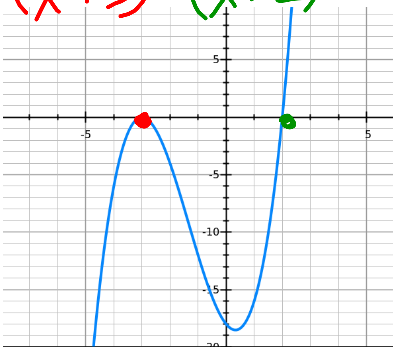
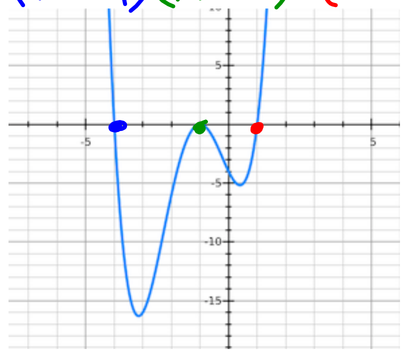
Write a function in intercept form for the given graphs whose intercepts are integers. Assume the constant factor of a is either 1 or -1.

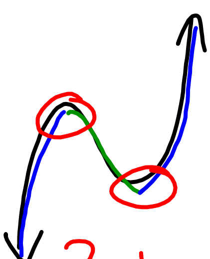
$(x+3)^2(x-2)$



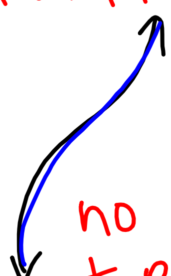
$(x+4)(x+1)^2(x-1)$



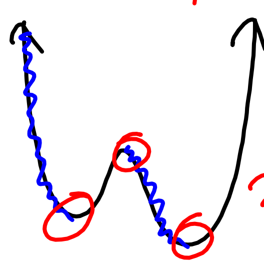
Turning Point → switch inc/dec



2 turning points



no t.p.



3 t.p.

global/absolute: WHOLE graph

local/relative: part of the graph