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

End Behavior

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

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

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

End Behavior

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

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

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

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

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

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

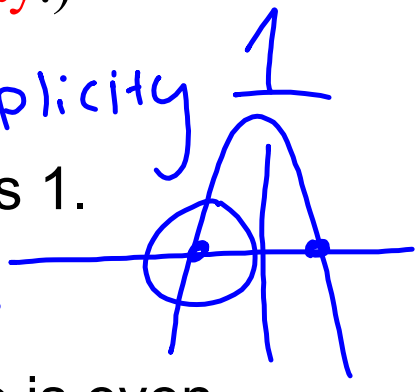
$x = -1, -3$

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

Multiplicity

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

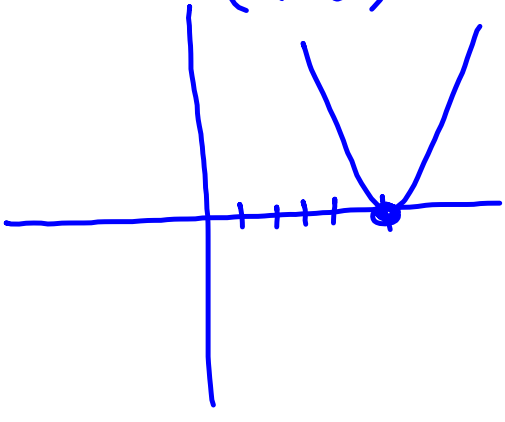
Straight intersection: Multiplicity 1
$(x - a)^1$ The power of the zero is 1.



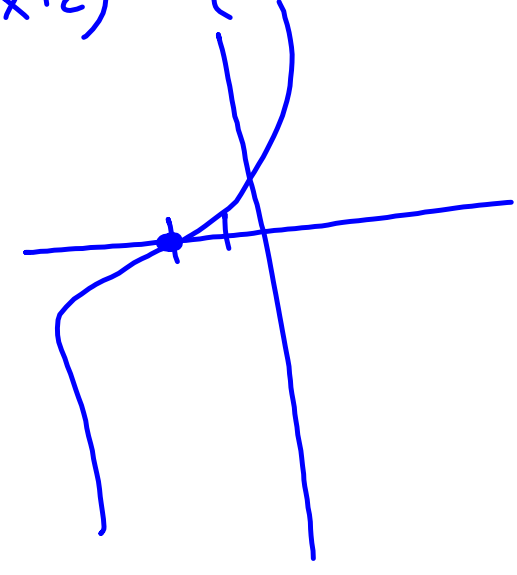
Tangent intersection : Bounce
$(x - a)^{\text{even}}$ The power of the zero is even.

Inflection intersection: **(like a slide through)**
$(x - a)^{\text{odd}}$ The power of the zero is odd.

Tangent
Bounce
$(x-5)^{2,4,6\ldots}$



Inflection
$(x+2)^{3,5,7\ldots}$ (slide)

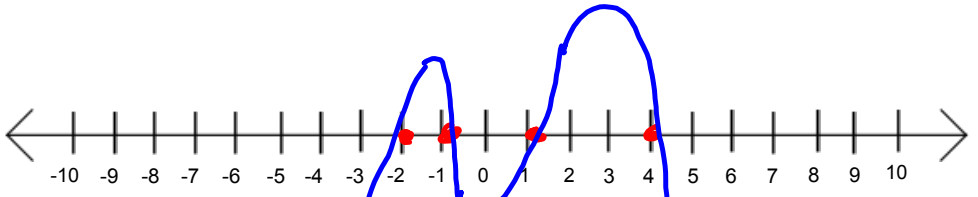


$$f(x) = x(x+2)(x-3)$$

ZEROS	MULTIPLICITY
-2	1 - STRAIGHT
3	1 - ST
0	1 ST

EB: x^3

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



Zeros	Mult
4	1 - ST
1	1 - ST
-1	1 ST
-2	1 ST

EB: $-x^4$

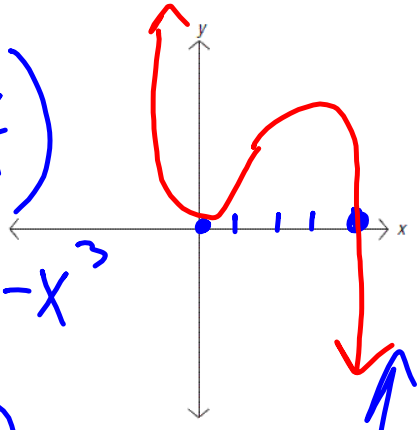
Ex. 8 Find the zeros, the multiplicity, end behavior and graph the following:

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

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

ZEROS	MULT
0	2 - TAN. B.
4	1 - ST

EB: $-x^3$

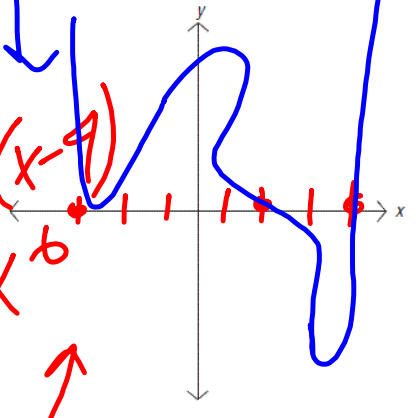


b. $f(x)=(x+3)^2(x-2)^3(x-4)$

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

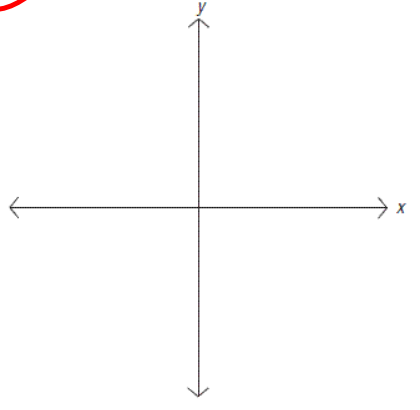
ZEROS	MULT
-3	2 - TAN B
2	3 - SLIDE INF
4	1 - ST

EB: x^6



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

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



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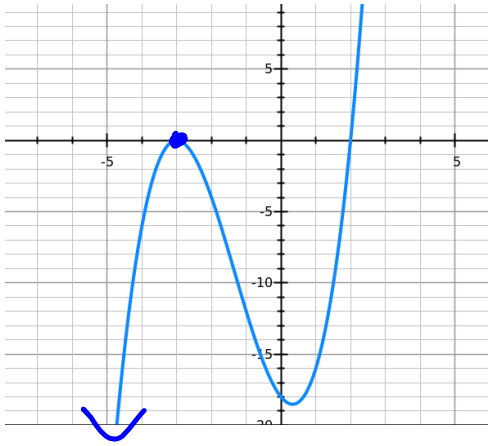
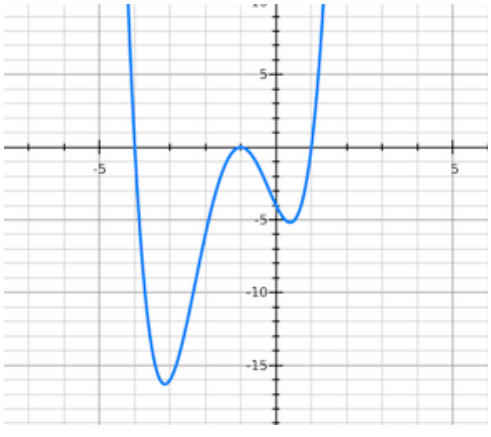
Write a function in intercept form for the given graphs whose intercepts are integers. Assume the constant factor of a is either 1 or -1.





ZEROS	MULT
-3	2 B TAN
2	1 ST

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

ZEROS	MULT
-4	1 ST
-1	2 B
1	1 ST

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