# 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

*zeros: x-int ($y=0$)
touch x axis

# End Behavior

Even functions

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

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

Negative even

# End Behavior

ODD FUNCTIONS

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?

Negative ODD

# Zeros, x-intercepts, and factors

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

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

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

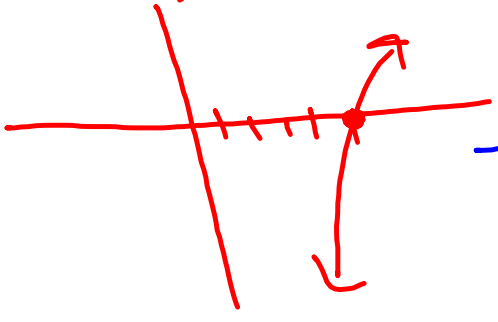
The **power** of the factor determines the nature of the intersection at the point $x = a$.
(This is referred to as the multiplicity.)

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

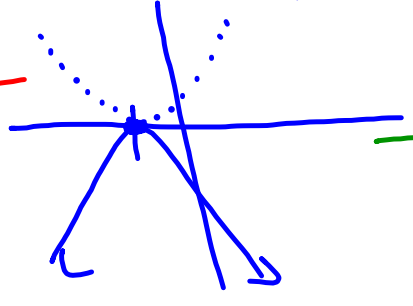
**Tangent intersection :** Bounce
$(x - a)^{\text{even}}$ The power of the zero is even. (2)

**Inflection intersection:** **(like a slide through)** (3)
$(x - a)^{\text{odd}}$ The power of the zero is odd.

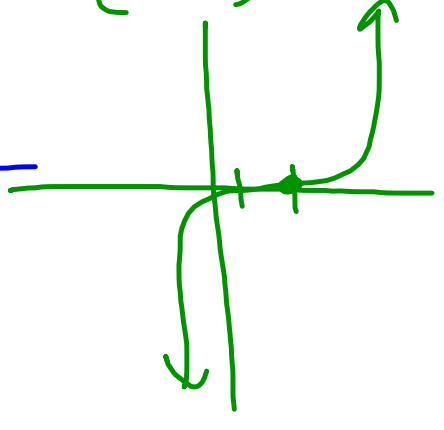
STRAIGHT $(x-5)$



Tangent B. $(x+1)^2$



Inflection (SLIDE) $(x-2)^3$



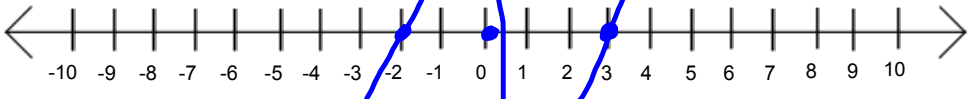
(A) Use a graphing calculator to graph the cubic functions $f(x) = x^3$, $f(x) = x^2(x - 2)$, and $f(x) = x(x - 2)(x + 2)$. Then use the graph of each function to answer the questions in the table.

| 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? | | | |

# Sign Chart

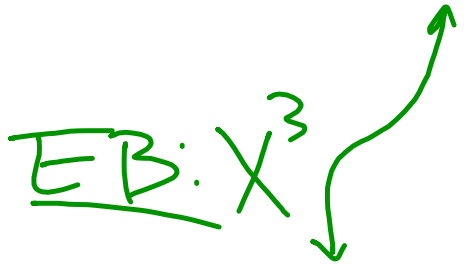
$$f(x) = x^1(x+2)^1(x-3)^1$$

(x+0)



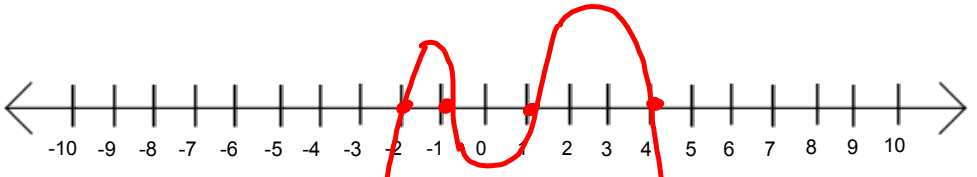

| ZERO | MULT | INTERSECTION |
|---|---|---|
| -2 | 1 | SIR. |
| 3 | 1 | STR |
| 0 | 1 | STR |
| | 3 | |

EB: $x^3$



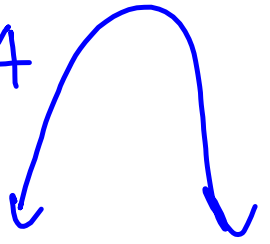
## Sign Chart

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




| ZERO | MULT | INT |
|---|---|---|
| 4 | 1 | STP |
| 1 | 1 | |
| -1 | 1 | |
| -2 | 1 | |
| | | = 4 |

EB: $-x^4$



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# Graphing a Polynomial from factors

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

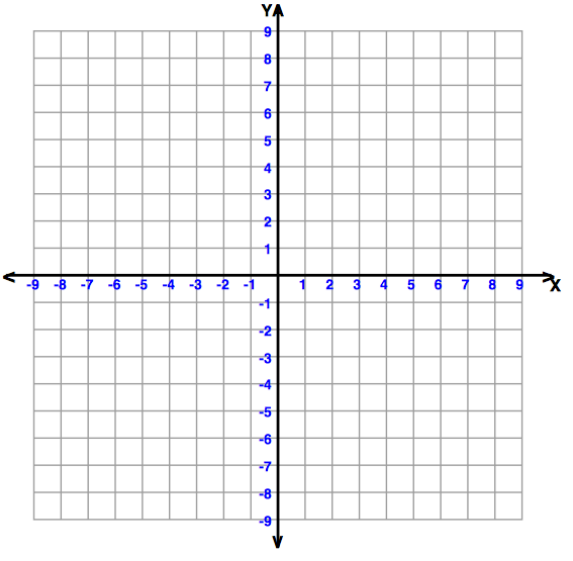
Identify the end behavior.

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 $x =$ ☐, $x =$ ☐, $x =$ ☐, $x =$ ☐.

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**Ex. 8** Find the zeros, the multiplicity, end b[illegible]ving:

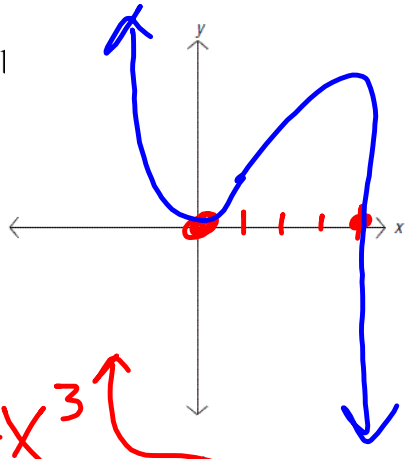
a. $f(x)=-x^2(x-4)$

$(X+0)^2$

$-X^2(X-4)^1$

| ZERO | MULT | INT |
|---|---|---|
| 0 | 2 | TanB |
| 4 | 1 | STR |

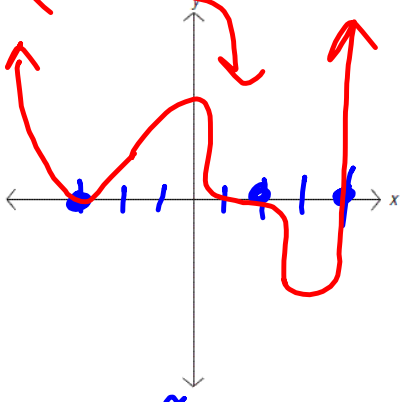
EB: $-X^3$




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

$(X+3)^2(X-2)^3(X-4)$

| ZERO | MULT | INT |
|---|---|---|
| -3 | 2 | TANB |
| 2 | 3 | ISLIDE |
| 4 | 1 | STR |

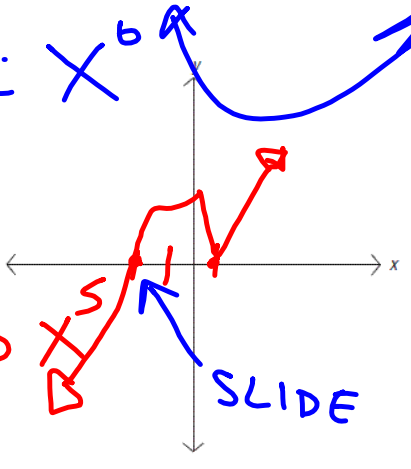



EB: $X^6$

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

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

| ZERO | MULT | INT |
|---|---|---|
| -2 | 3 | Tslide |
| 1 | 2 | TanB |




EB $X^5$

SLIDE

EB:

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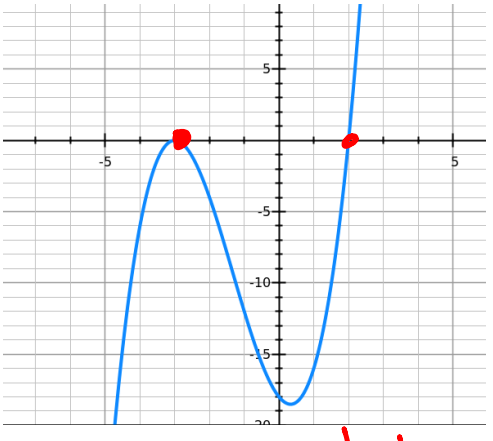
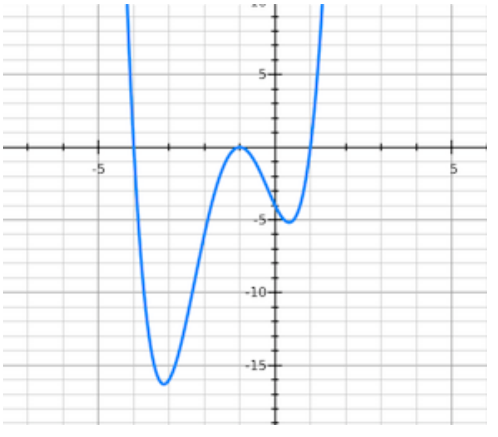
Write a function in intercept form for the given graphs whose intercepts are integers. Assume the constant factor of a is either 1 or -1.




| ZERO | MULT | INT |
|---|---|---|
| -3 | 2 | TANB |
| 2 | 1 | STR |

EB: $x^3$

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

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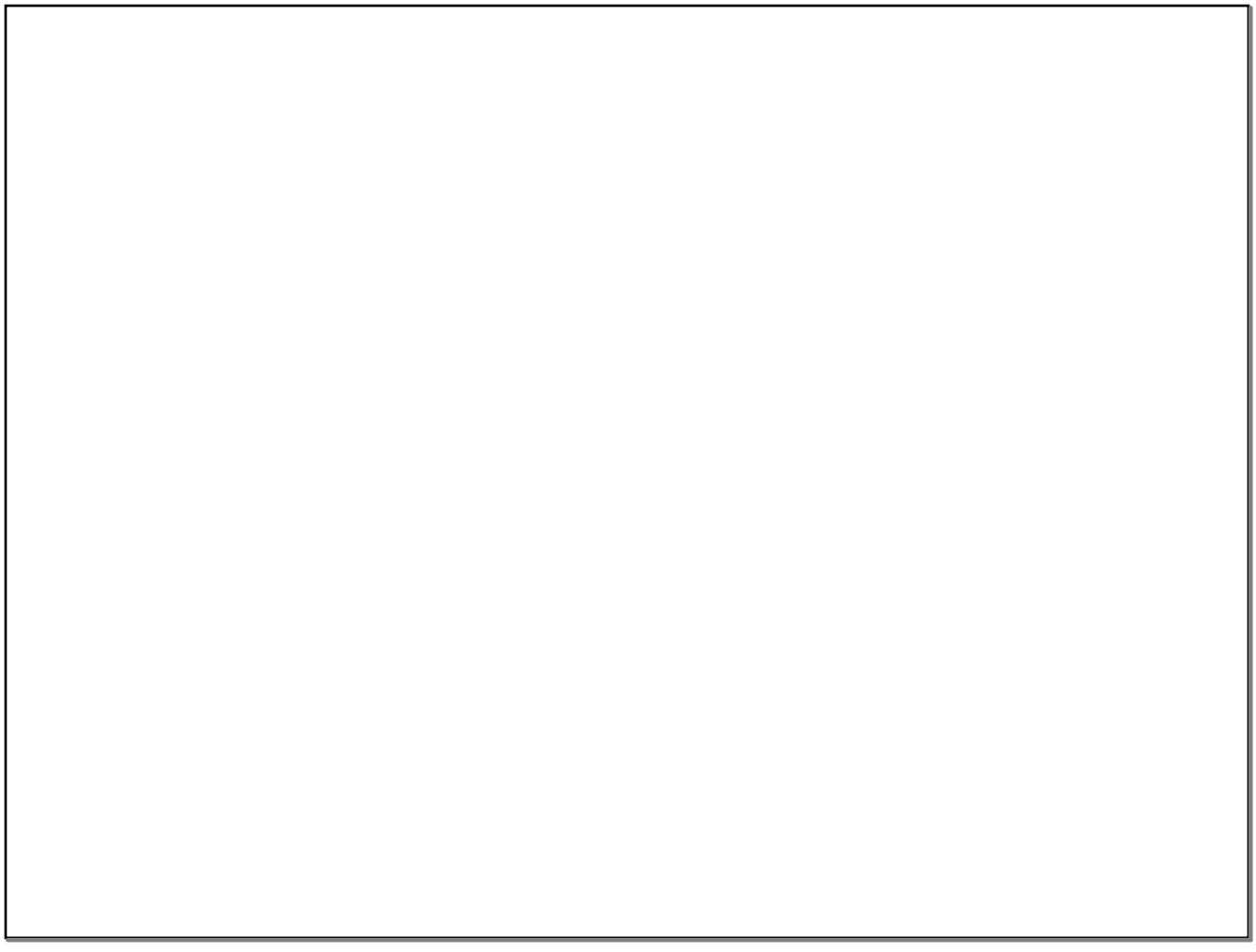
Graphing Polynomials Task

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