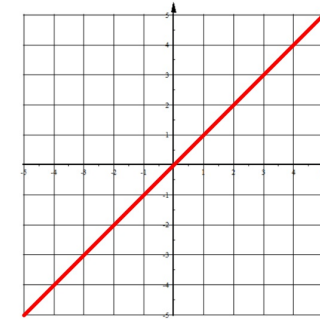Given the equation   y = (x + 3)(x - 2)

Give four names for -3 and 2:

- Zeros of the function
- Solutions to the equation
- x-intercepts of the graph
- Roots of the function
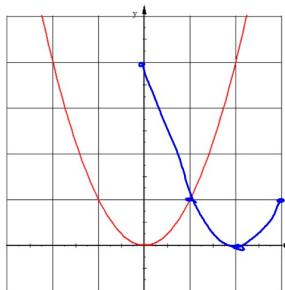
What does the graph
of this look like?

y = x

Just a line
that passes right
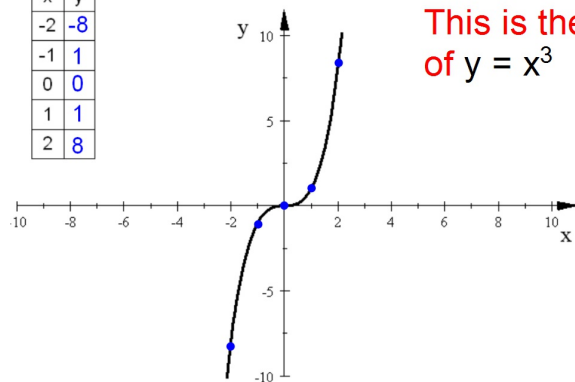through the x-axis

What does the graph
of this look like?

$y = x^2$

$y = (x-2)^2$

A parabola
whose vertex is
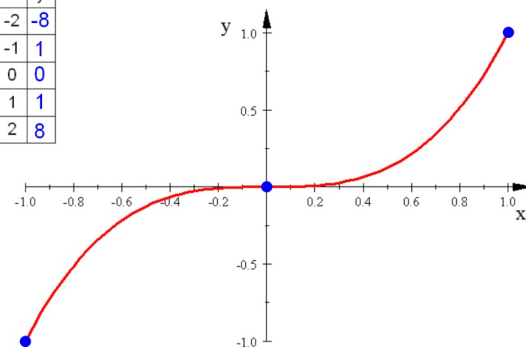on the x-axis

What does the graph of $y = x^3$ look like?

x	y
-2	-8
-1	1
0	0
1	1
2	8

This is the graph
of $y = x^3$

A closer look at $y = x^3$

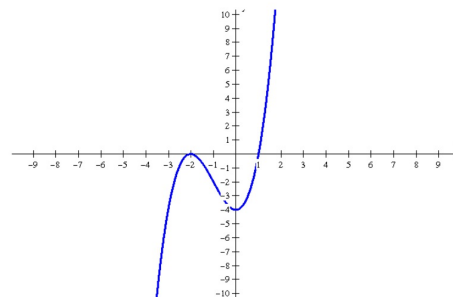| x	y
-2	-8
-1	1
0	0
1	1
2	8

This graph passes
through the x-axis
like a line does
but
flattens out
as it passes
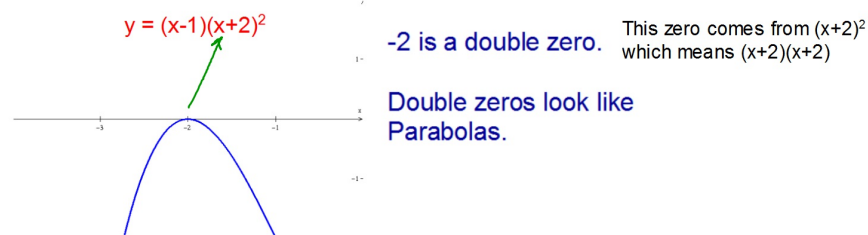through the x-axis.

Shapes of Zeros Exploration

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1. Graph $y = (x - 1)(x + 2)^2$ in a Standard Window and sketch it below:

2. Investigate the graph around each zero

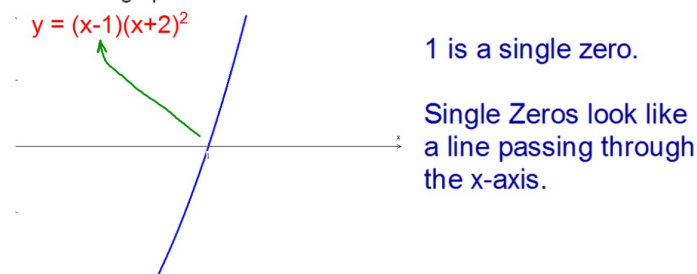Around -2: Use the following window: $x : [-4,0]$ & $y : [-2,2]$

Sketch the graph below:

$y = (x-1)(x+2)^2$

-2 is a double zero. This zero comes from $(x+2)^2$ which means $(x+2)(x+2)$

Double zeros look like Parabolas.

Describe what the graph looks like in this window.

a parabola whose vertex is on the x-axis.

Around 1: Use the following window: $x : [0,2]$ & $y : [-2,2]$

Sketch the graph below:

$y = (x-1)(x+2)^2$

1 is a single zero.

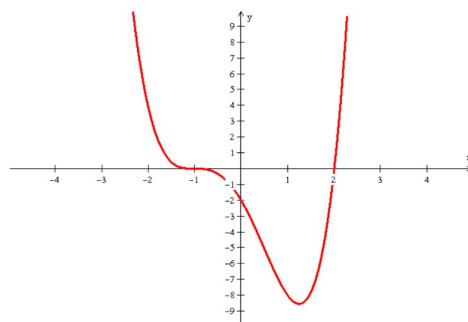Single Zeros look like a line passing through the x-axis.

Describe what the graph looks like in this window.

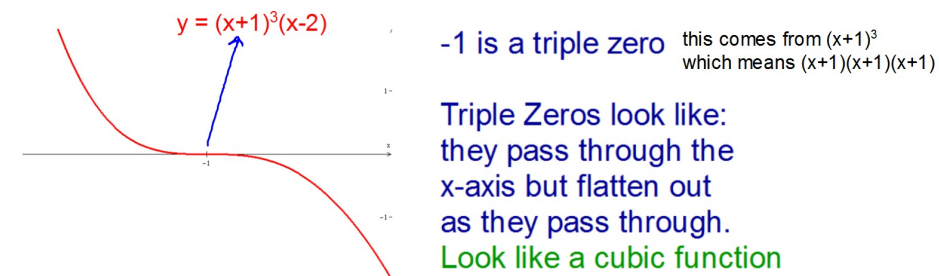A line that passes right through the x-axis

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3. Graph $y = (x+1)^3(x-2)$ in the following window and sketch it below:

Window: $x : [-5,5]$ & $y : [-10,10]$

Around -1: Use the following window: $x : [-2,0]$ & $y : [-2,2]$

Sketch the graph below:

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

-1 is a triple zero. this comes from $(x+1)^3$ which means $(x+1)(x+1)(x+1)$

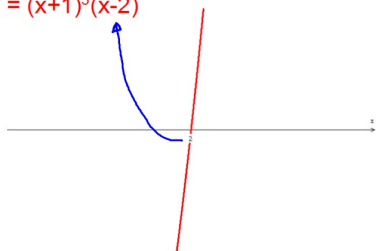Triple Zeros look like: they pass through the x-axis but flatten out as they pass through.
Look like a cubic function

Describe what the graph looks like in this window.

A cubic, the graph flattens out as it passes through the x-axis

Panel 1 (top-left)

Around **2**: Use the following window: $x : [1,3]$ & $y : [-2,2]$

Sketch the graph below:

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

2 is a single zero.

Single Zeros look like a line passing through the x-axis.

Describe what the graph looks like in this window.

a line that passes right through the x-axis

Panel 2 (top-right)

Shapes of Zeros (graphs at x-intercepts)

	Factor	Zero	Possible Shape
Single Zeros:	$(x+3)$	-3	... -3 or ... -3
Double Zeros:	$(x-1)^2$	$)$	... 1 or ... 1
Triple Zeros:	$(x+7)^3$	-7	... -7 or ... -7

Panel 3 (bottom-left)

Sketch a graph of this function:

$y = (x+2)^2(x-5)^3(x+7)$

1. Find the Degree and LC
   EVEN   POS
2. Determine End Behavior
   Starts in the 3rd Quad and ends in the 1st Quad. $(\uparrow , \uparrow)$
3. Find zeros and what kind

-2 - Double   +5 - Triple   -7 - Single

4. Place dots on the x-axis for the zeros.
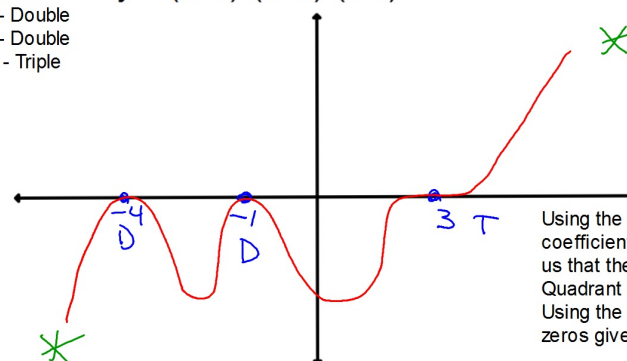5. Connect Left End to Right End making sure the shape of each zero is correct.

Panel 4 (bottom-right)
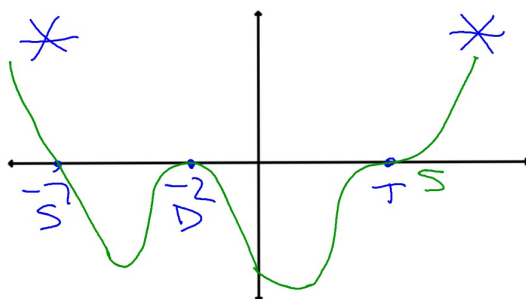
Sketch this function using the shapes of the zeros and the end-behavior

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

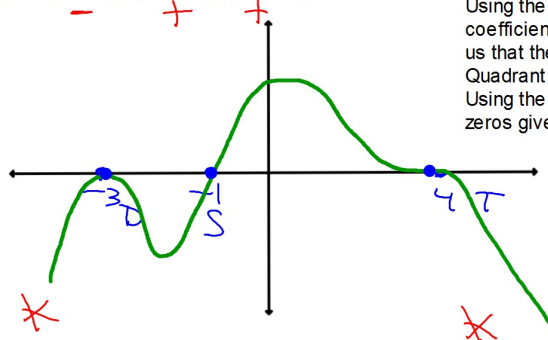POS ODD

Zeros:
-4 - Double
-1 - Double
+3 - Triple

Using the degree and leading coefficient the end behavior tells us that the graph starts in the 3rd Quadrant and ends in the 1st Quadrant. Using the location and shapes of the three zeros gives us the following graph.

Sketch this function using the shapes of the zeros and the end behavior.

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

NOT EVEN

Zeros:
+4 - Triple
-3 - Double
-1 - Single

Using the degree and leading coefficient the end behavior tells us that the graph starts in the 3rd Quadrant and ends in the 4th Quadrant. Using the location and shapes of the three zeros gives us the following graph.