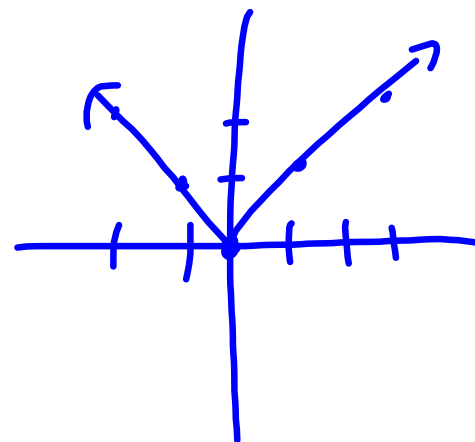


Absolute Value Functions and Graphs

Objective:

I can graph an absolute value function by performing transformations on the parent function $f(x) = |x|$.

x	$ x $	y
-2	$ -2 $	2
-1	$ -1 $	1
0	$ 0 $	0
1	$ 1 $	1
2	$ 2 $	2

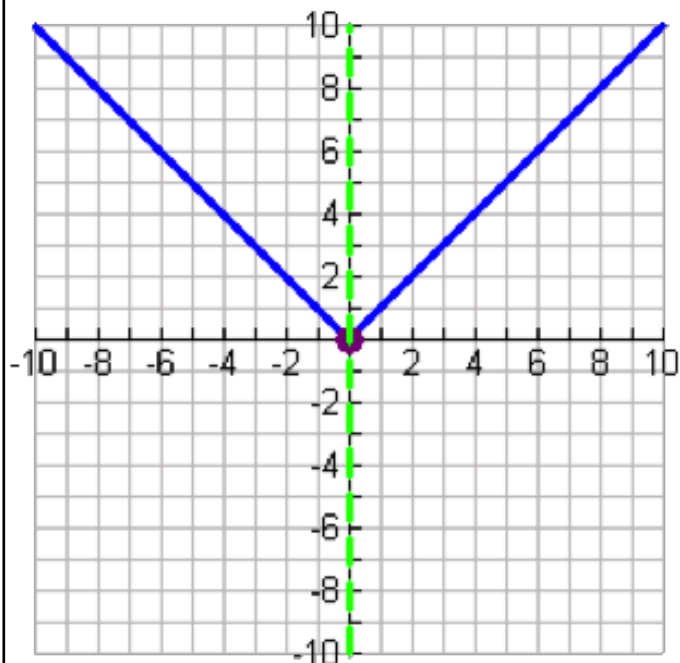


Vocabulary

- The function $f(x) = |x|$ is an **absolute value function**.
- The **highest** or **lowest** point on the graph of an absolute value function is called the **vertex**.
- An **axis of symmetry** of the graph of a function is a vertical line that divides the graph into mirror images.

An absolute value graph has one axis of symmetry that passes through the vertex.

Absolute Value Function



- **Absolute Value Function**

- **Vertex** $(0, 0)$

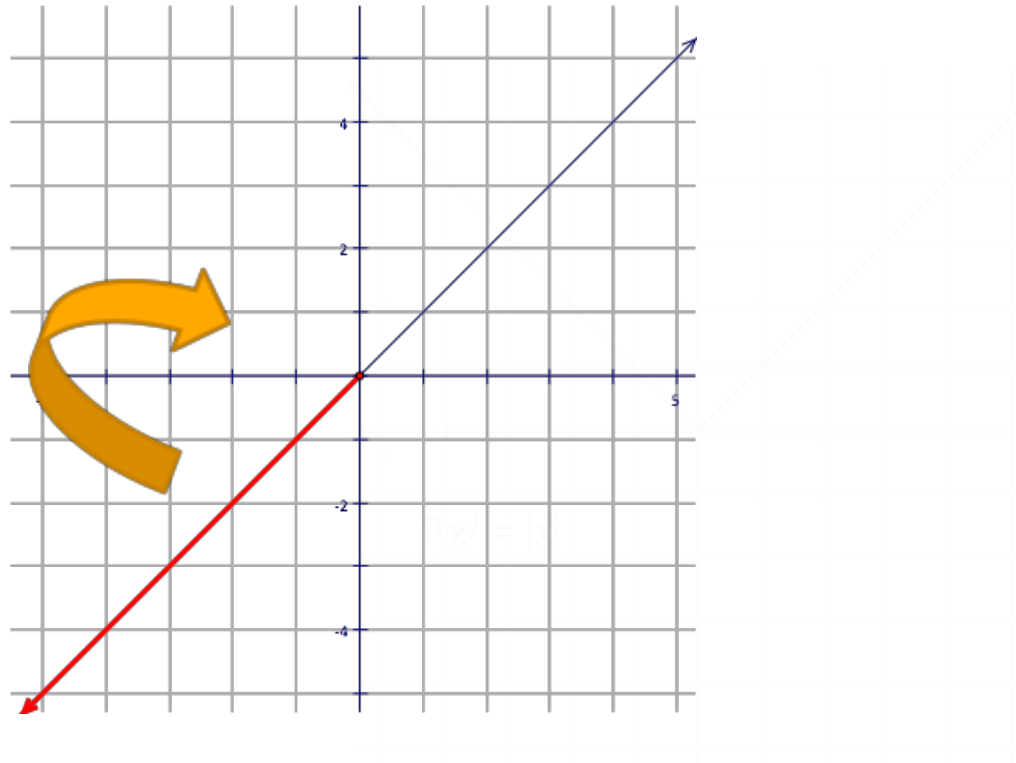
- **Axis of Symmetry**

$$x = 0$$

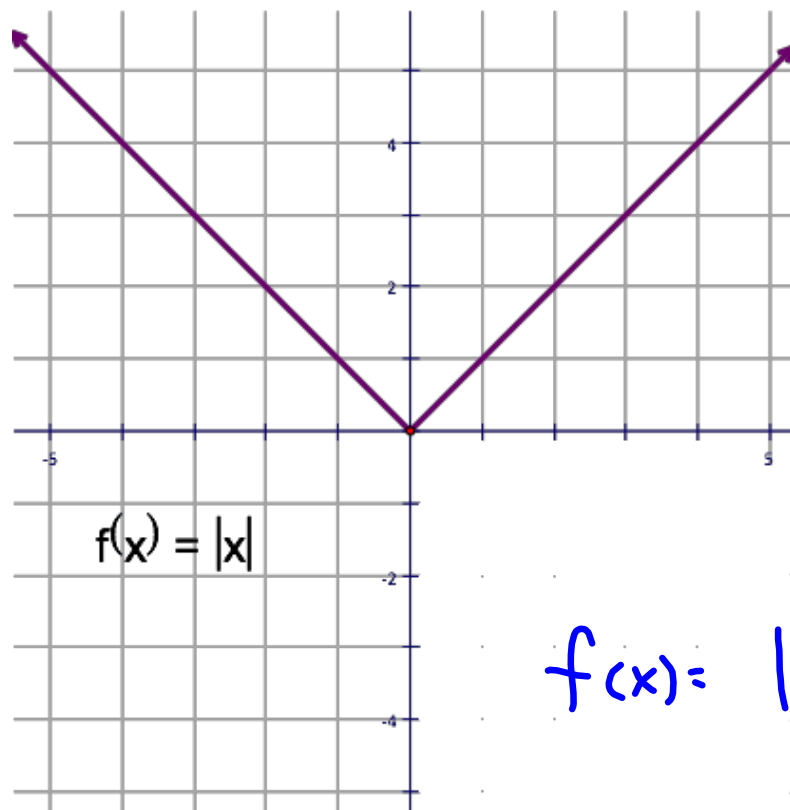
Building the Absolute Value Function

The absolute value function is defined by $f(x) = |x|$.

$$y = x$$



This is the absolute value **parent function**.

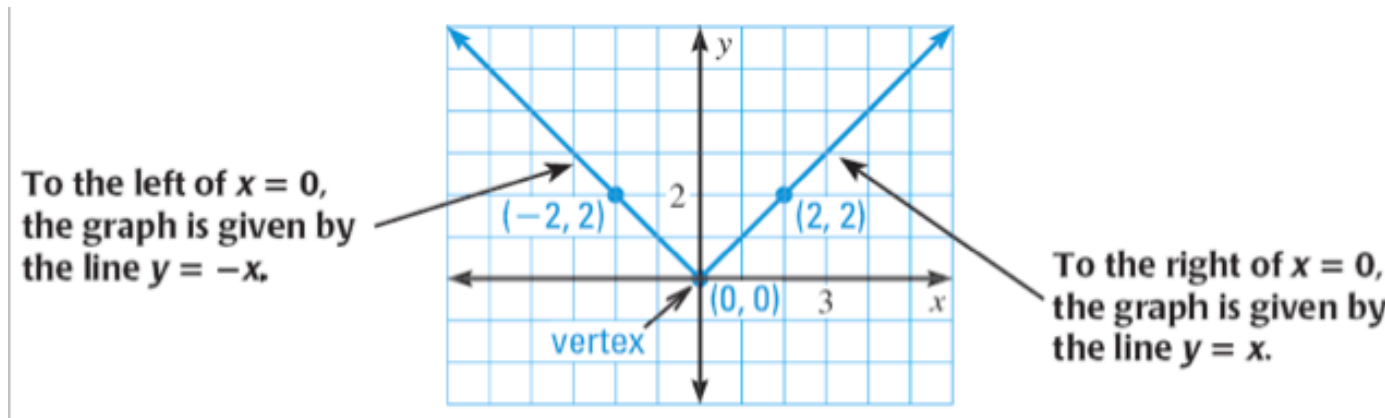


Table

x	f(x)= x	y

$$f(x) = |x| \begin{cases} x & x > 0 \\ -x & x < 0 \end{cases}$$

Parent Function



$$x = 0$$

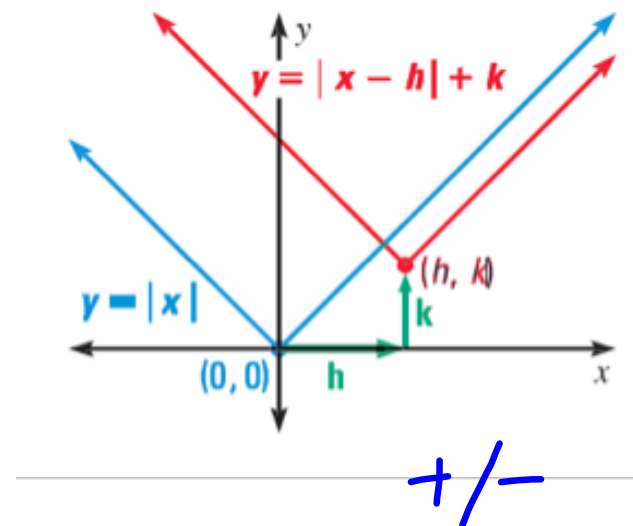
- V-shape
- It is symmetric about the y -axis (Axis of Symmetry)
- The **vertex** is the minimum point on the graph

Translation

A **translation** is a transformation that shifts a graph **horizontally** or **vertically**, but doesn't change the overall shape or orientation.

$$y = \boxed{x} + \text{up/down}$$

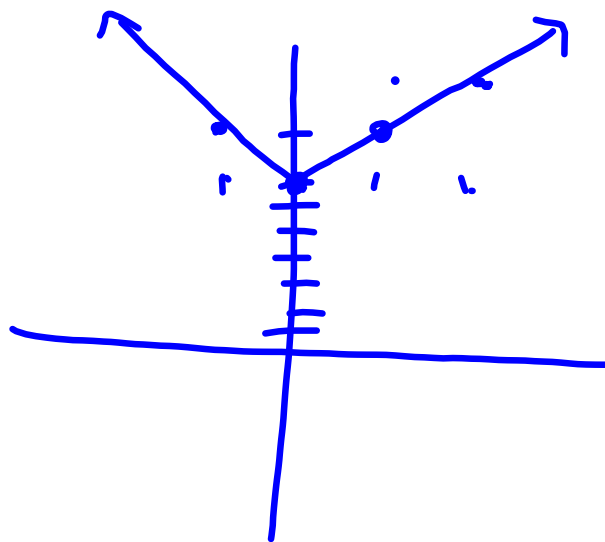
L.R



$$y = |x| + 7$$

up 7

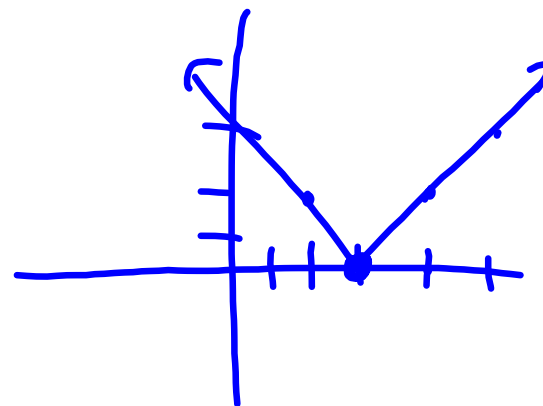
$(0, 0)$
 $(0, 7)$
 vertex



$$y = |x - 3| + 0$$

R3

$(0, 0)$
 $(3, 0)$



$y = |x+2| + 3$

$\begin{matrix} |x-2| \\ \wedge \\ |x+2| + 3 \\ \downarrow \quad \uparrow \\ L_2 \quad \text{up } 3 \end{matrix}$

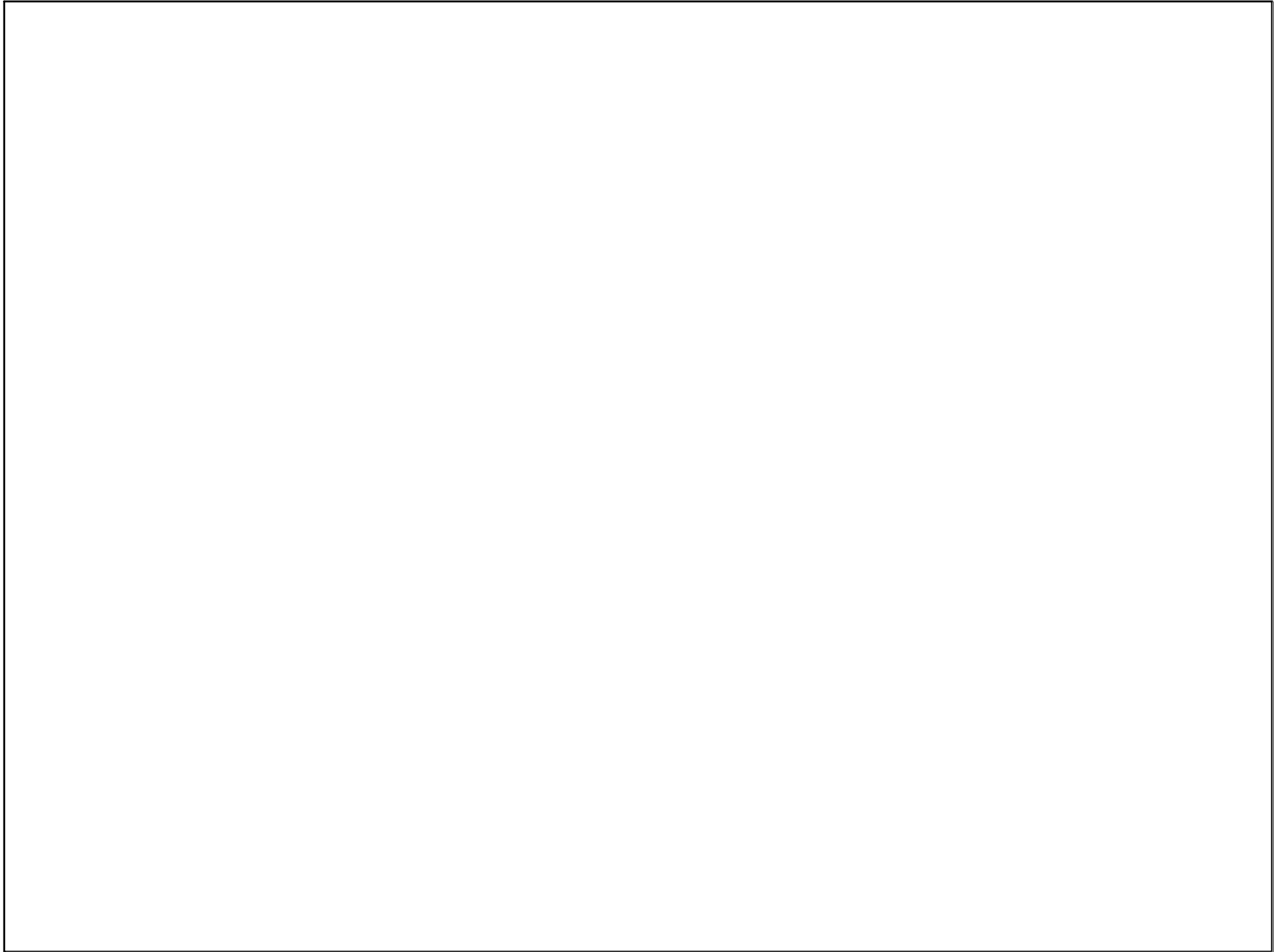
(0,0)
Vertex (-2, 3)

x	y
-2	2 -2+2 +3 2+3 0+3
(-2, 3)	

$2|x+2| + 3$

(0,0)
(-2, 3)
(2, 2)
(1, 1)
(-1, 1)

-1	2 -1+2 +3	5
	2 1	
	2+3	



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$$y = |x+3| - 2$$

$(0, 0)$
 $(-3, -2)$

L_3 D_2

Stretching and Compression

$$2|x|$$

$$\frac{1}{2}|x|$$

The graph of $y = a|x|$ is graph of $y = |x|$ vertically stretched or compressed depending on the $|a|$.

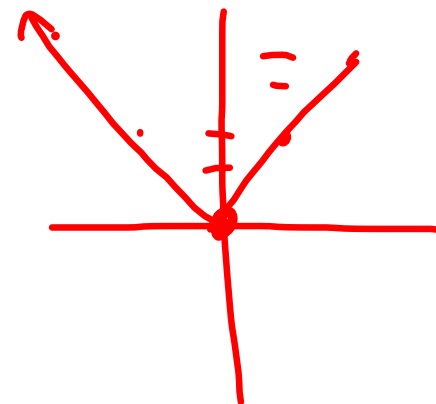
For $ a > 1$	For $ a < 1$
<ul style="list-style-type: none">• The graph is vertically <i>stretched</i>, or elongated.• The graph of $y = a x$ is <i>narrower</i> than the graph of $y = x$.	<ul style="list-style-type: none">• The graph is vertically <i>shrunk</i>, or compressed.• The graph of $y = a x$ is <u><i>wider</i></u> than the graph of $y = x$.

The value of a acts like the slope.

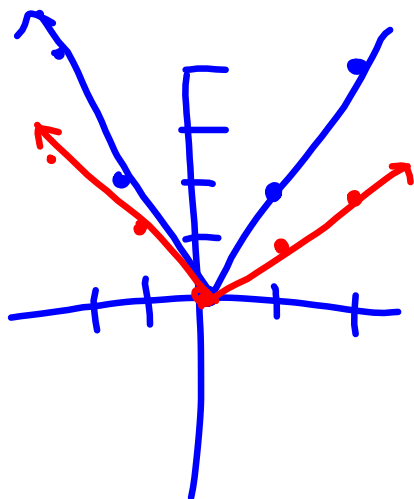
$$y = \underline{2}|x|$$

$(0, 0)$ $(1, 1)$ $(2, 2)$

$(0, 0)$ $(1, 2)$ $(2, 4)$



$|x|$



Compression

L₃ D₄

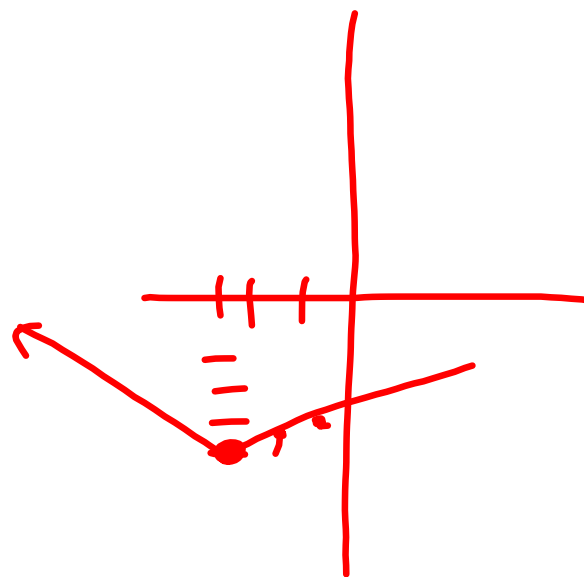
$$y = \frac{1}{2} |x + 3| - 4 \quad (-3, -4)$$

$$(0, 0) \rightarrow (-3, \overset{-4}{\cancel{0}})$$

$$(1, 1) \rightarrow (-2, \overset{-3\frac{1}{2}}{\cancel{\frac{1}{2}}})$$

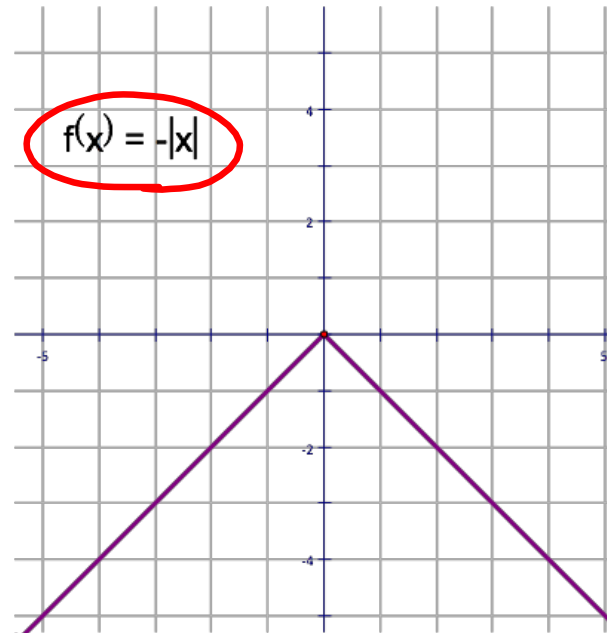
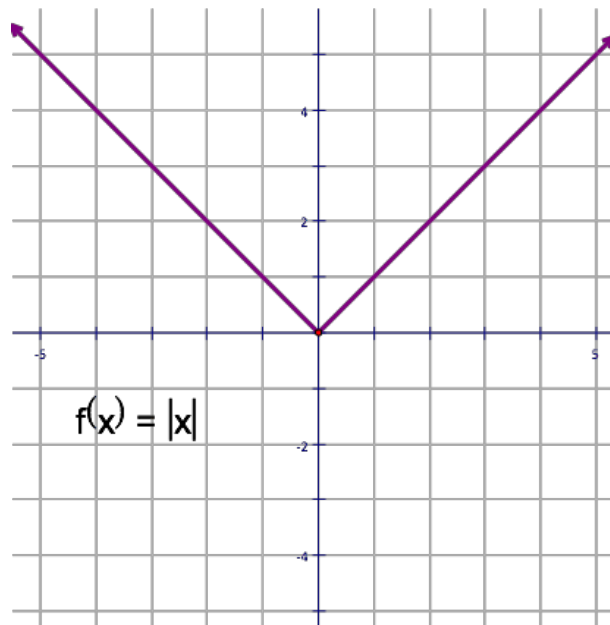
$$(2, 2) \rightarrow (-1, \overset{-3}{\cancel{\frac{1}{2}}})$$

$$\frac{1}{2} - 4$$



Reflection

The graph of $y = a|x|$ is graph of $y = |x|$ reflected across the x-axis.



$y = -a |x - h| + k$

reflects over y

L/R

up/down

$|a| > 1$ stretch

$|a| < 1$ compression

Multiple Transformations

In general, the graph of an absolute value function of the form $y = a|x - h| + k$ can involve translations, reflections, stretches or compressions.

To graph an absolute value function, start by **identifying the vertex**

Graphing Absolute Value Functions

Graphing $y = a|x - h| + k$ is straight forward:

1. Plot the vertex (h, k) . (note...if $+h$ inside that means h is negative(to the left); if $-h$ inside that means h is positive (to the right))
2. Use the a value as slope to plot more points.
Remember you have to do positive and negative slope to get points on both sides of the V
3. Connect the dots in a V-shape.

Example 1

Graph the following function without making a table.

$(0, 0)$
 $(2, 3)$

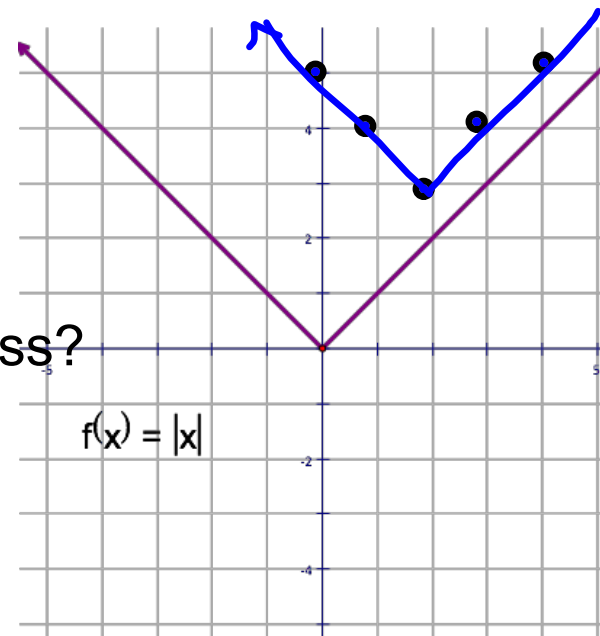
$$y = |x - 2| + 3$$

R_2 U_3

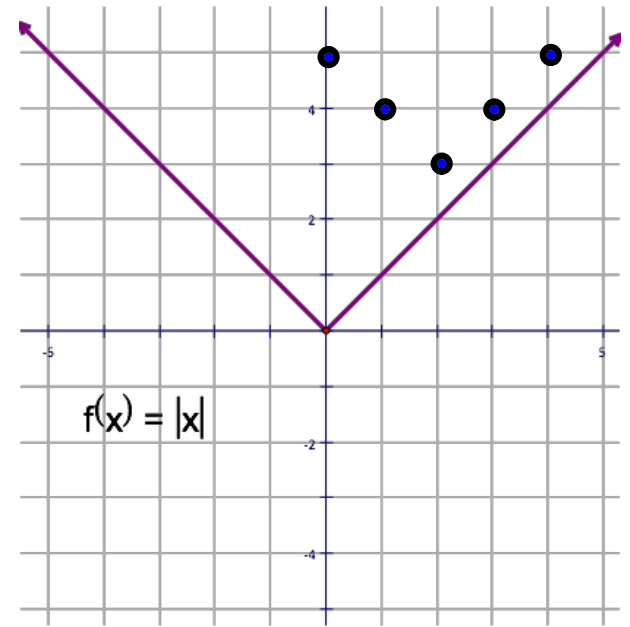
Vertex

How does this graph move?

Did this graph stretch or compress?



$(0, 0) \rightarrow (2, 3)$ (slope of 1)
 $(1, 1) \rightarrow (3, 4)$
 $(2, 2) \rightarrow (4, 5)$



Example 2

Graph the following function.

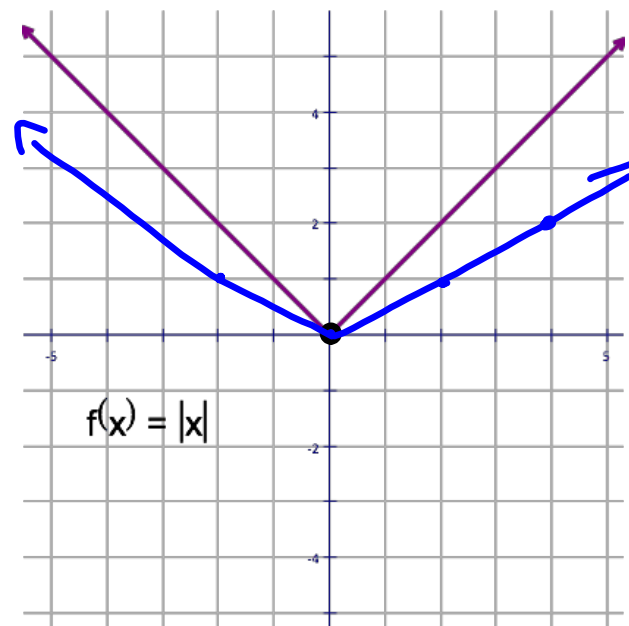
$$y = (1/2)|x|$$

$\frac{1}{2}|x|$
 $(0, 0)$

Vertex

How does this graph move?

Did this graph stretch or compress?



Your turn:

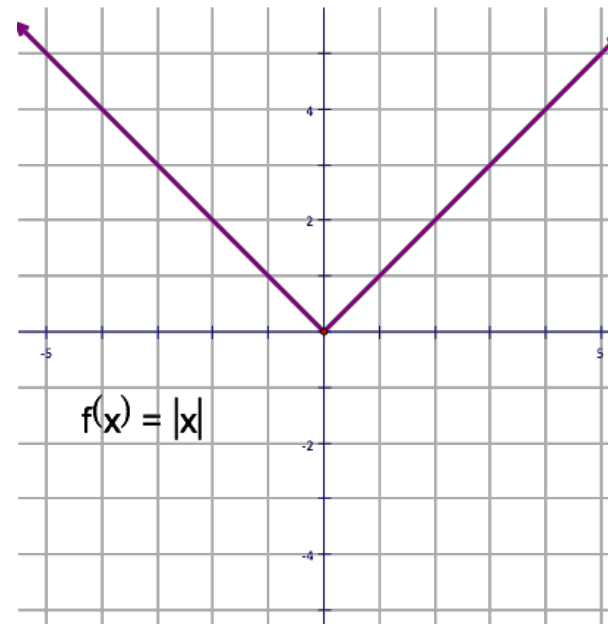
$$y = (3/2)|x|$$

Vertex (,)

Translations

Slope

-
-
-
-
-



Your turn:

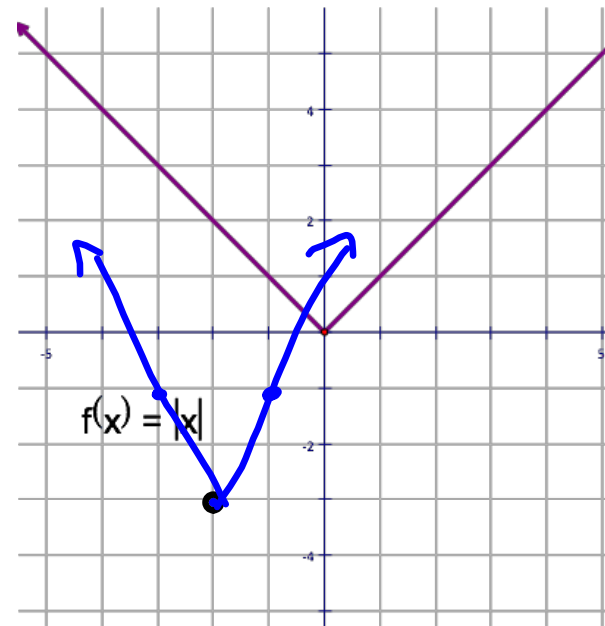
$$y = 2|x + 2| - 3$$

Vertex $(-2, -3)$

Translations

Stretches

Slope



write an abs value function that...

- that stretches by 3
- Reflects over x-axis
- Moves 3 left ←
And 2 down

$$-3|x + 3| - 2$$

