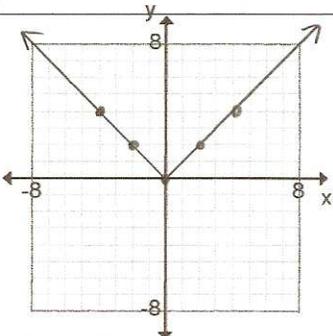


Algebra 2 Notes

Name: Key

Section 2.9 - Absolute Value Functions

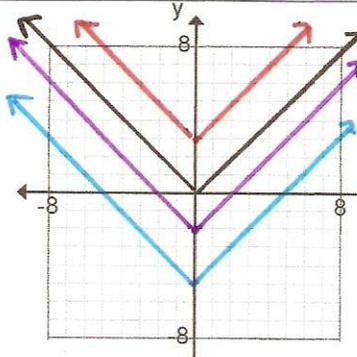
An absolute-value function is a function whose rule contains an absolute-value expression. The graph of the parent absolute-value function $f(x) = |x|$ has a ∨ shape with a minimum point or vertex at (0,0).

The Absolute-Value Parent Function $f(x) = x $														
Domain: \mathbb{R}	<table border="1" style="margin: auto;"> <thead> <tr> <th>x</th> <th>$y = x$</th> </tr> </thead> <tbody> <tr><td>-4</td><td>4</td></tr> <tr><td>-2</td><td>2</td></tr> <tr><td>0</td><td>0</td></tr> <tr><td>2</td><td>2</td></tr> <tr><td>4</td><td>4</td></tr> </tbody> </table>	x	$y = x $	-4	4	-2	2	0	0	2	2	4	4	
x	$y = x $													
-4	4													
-2	2													
0	0													
2	2													
4	4													
Range: $y \geq 0$														
Vertex: $(0,0)$														

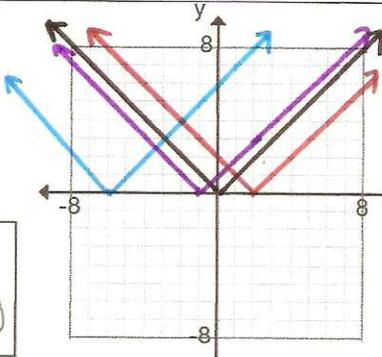
The absolute-parent function is composed of two linear pieces, one with a slope of +1 and one with a slope of -1. We can transform absolute-value functions, which means we can translate, reflect, stretch, and compress the parent graph. We will try to "discover" what happens to the parent graph as we complete various transformations by using our graphing calculator to speed up the process. To do this, we will use our graphing calculators to graph quickly. HOWEVER, you will need to know how to graph by hand for your homework! To graph $f(x) = |x|$ in your calculator, you will press



Discovery 1: Graph the following on the same graph. What do you notice?

$y = x $ $y = x + 3$ up 3 $y = x - 2$ down 2 $y = x - 5$ down 5	
Summarize: $y = x + k$ shifts the graph k units vertically (moves graph up or down)	

Discovery 2: Graph the following on the same graph. What do you notice?

$y = x $ $y = x - 2 $ right 2 $y = x + 1 $ left 1 $y = x + 6 $ left 6	
Summarize: $y = x - h $ shifts the graph h units horizontally (moves graph left or right)	

Discovery 3: Graph the following on the same graph. What do you notice?

$y = x $ $y = 2 x $ $y = \frac{1}{2} x $	$y = x $ $y = 2x $ $y = \left \frac{1}{2}x\right $
<p>Summarize:</p> <p>Vertical stretch/Compression by <u>same</u> factor</p>	<p>Summarize:</p> <p>horizontal stretch/Compression by <u>reciprocal</u> of factor</p>

Discovery 4: Graph the following on the same graph. What do you notice?

$y = x+3 $ $y = - x+3 $	$y = x-2 $ $y = -(x-2)$
<p>Summarize:</p> <p>reflected across the x-axis</p>	<p>Summarize:</p> <p>Reflected across y-axis</p>

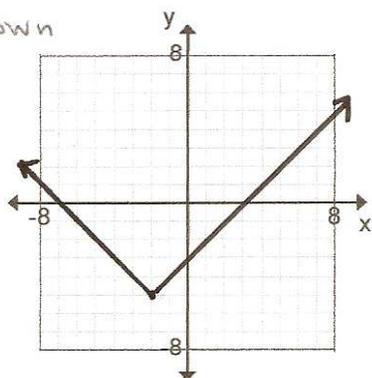
Summarize:

$y = a b(x-h) + k$			
a	$a < 0 \rightarrow$ reflection across x-axis a : vertical stretch/compression by factor of a	h	horizontal translation \longleftrightarrow of h units
b	$b < 0 \rightarrow$ reflection across y-axis b : horiz. stretch/compression by factor of $\frac{1}{b}$	k	vertical translation \updownarrow of k units

Example 1: Graph the following WITHOUT the graphing calculator.

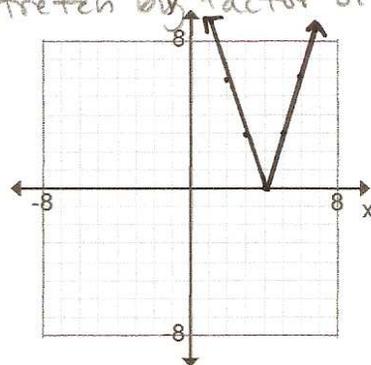
a. $y = |x+2| - 5$

2 units left
5 units down



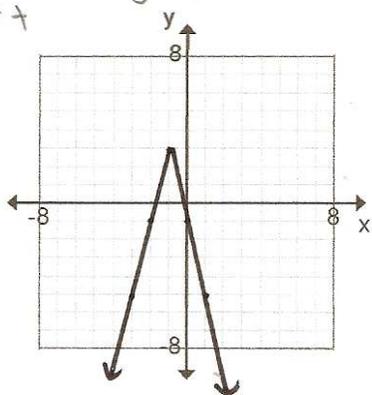
b. $y = 3|x-4|$

4 units right
Vertical stretch by factor of 3



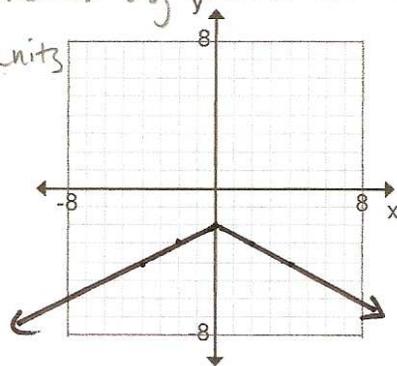
c. $y = -4|x+1| + 3$

reflected across x-axis
vertical stretch by factor of 4
1 unit left
3 units up



d. $y = -\frac{1}{2}|x| - 2$

reflected across x-axis
horiz. stretch by factor of $\frac{1}{2}$ = 2
down 2 units



Example 2: Let $g(x)$ be the indicated transformation of $f(x)$. Write the rule for $g(x)$.

a. $f(x) = |x|$ translated down 3 units and right 4 units

$$g(x) = |x-4| - 3$$

b. $f(x) = |x|$ translated so the vertex is $(-4, -5)$

$$g(x) = |x+4| - 5$$

c. $f(x) = |x| + 2$ reflected across the x-axis

$$g(x) = -(|x| + 2)$$

$$g(x) = -|x| - 2$$

d. $f(x) = |x-2|$ reflected across the y-axis AND stretched vertically by a factor of 2

$$g(x) = 2|-(x-2)|$$

$$g(x) = 2|-x+2|$$

e. $f(x) = |x| + 1$ compressed horizontally by a factor of $\frac{1}{3}$

$$f(x) = \left|\frac{1}{3}x\right| + 1$$

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

f. $f(x) = 5|x+3|$ reflected across the x-axis and translated 4 units down

$$f(x) = -(5|x+3|) - 4$$

$$f(x) = -5|x+3| - 4$$