

**13.2: Absolute Value Functions**  
**Transformations Caused by "a"**

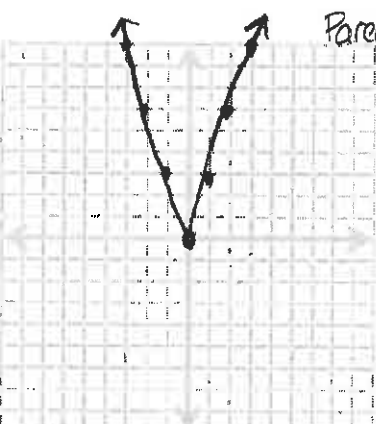
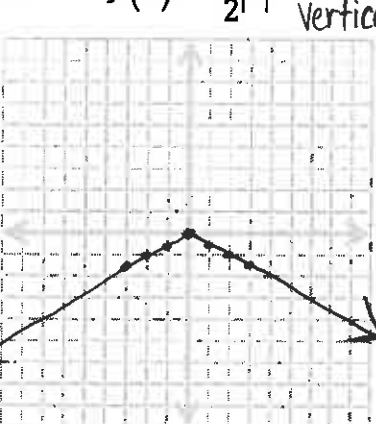
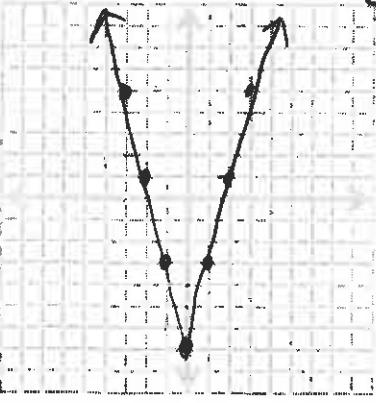
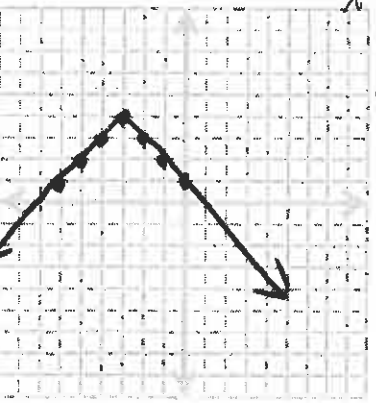
Recall from our Module 13 introduction activity that the "a" in the function  $y = a|x - h| + k$  may cause the following transformations to the parent absolute value function:

- If  $|a| > 1$ , then  $y = |x|$  is stretched vertically by a factor of a
- If  $|a| < 1$ , then  $y = |x|$  is compressed vertically by a factor of a
- If a is negative, then  $y = |x|$  is reflected over the x-axis

"a" always affects the y-coordinates of the parent function only. This means you will always need to multiply the y-coordinates of the parent function by "a"

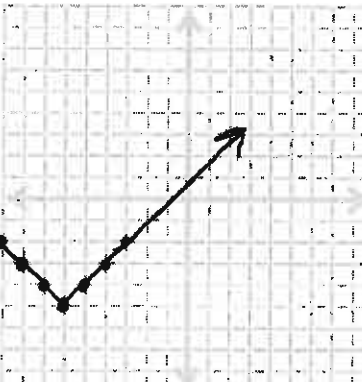
"a" and "k" both affect the y coordinates of the parent function. According to the order of operations, should we perform the transformation caused by "a" or by "k" first? Do "a" transformations first because multiplication comes before addition

In each of the following, describe the transformation(s) to the parent function, complete the table of values, and graph the function.

<p>1. <math>f(x) = 3 x </math> Vertically stretch by 3</p>  <p>Parent</p> <table border="1" data-bbox="454 1092 779 1512"> <thead> <tr> <th>x</th> <th>y</th> </tr> </thead> <tbody> <tr><td>-3</td><td>9</td></tr> <tr><td>-2</td><td>6</td></tr> <tr><td>-1</td><td>3</td></tr> <tr><td>0</td><td>0</td></tr> <tr><td>1</td><td>3</td></tr> <tr><td>2</td><td>6</td></tr> <tr><td>3</td><td>9</td></tr> </tbody> </table>	x	y	-3	9	-2	6	-1	3	0	0	1	3	2	6	3	9	<p>2. <math>f(x) = -\frac{1}{2} x </math> Reflect over x-axis; Vertically compress by <math>\frac{1}{2}</math></p>  <table border="1" data-bbox="1185 1092 1542 1512"> <thead> <tr> <th>x</th> <th><math>\frac{1}{2}y</math></th> </tr> </thead> <tbody> <tr><td>-3</td><td>-1.5</td></tr> <tr><td>-2</td><td>-1</td></tr> <tr><td>-1</td><td>-0.5</td></tr> <tr><td>0</td><td>0</td></tr> <tr><td>1</td><td>-0.5</td></tr> <tr><td>2</td><td>-1</td></tr> <tr><td>3</td><td>-1.5</td></tr> </tbody> </table>	x	$\frac{1}{2}y$	-3	-1.5	-2	-1	-1	-0.5	0	0	1	-0.5	2	-1	3	-1.5
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<p>3. <math>h(x) = 4 x  - 7</math> Vertically Stretch by 4. Shift down 7 units.</p>  <table border="1" data-bbox="454 1596 779 1995"> <thead> <tr> <th>x</th> <th><math>\frac{1}{4}y - 7</math></th> </tr> </thead> <tbody> <tr><td>-3</td><td>5</td></tr> <tr><td>-2</td><td>1</td></tr> <tr><td>-1</td><td>-3</td></tr> <tr><td>0</td><td>-7</td></tr> <tr><td>1</td><td>-3</td></tr> <tr><td>2</td><td>1</td></tr> <tr><td>3</td><td>5</td></tr> </tbody> </table>	x	$\frac{1}{4}y - 7$	-3	5	-2	1	-1	-3	0	-7	1	-3	2	1	3	5	<p>4. <math>p(x) = - x+3  + 4</math> Reflect over x-axis. Shift up 4 units. Shift left 3 units.</p>  <table border="1" data-bbox="1185 1596 1542 1995"> <thead> <tr> <th>x-3</th> <th>-y+4</th> </tr> </thead> <tbody> <tr><td>-6</td><td>1</td></tr> <tr><td>-5</td><td>2</td></tr> <tr><td>-4</td><td>3</td></tr> <tr><td>-3</td><td>4</td></tr> <tr><td>-2</td><td>3</td></tr> <tr><td>-1</td><td>2</td></tr> <tr><td>0</td><td>1</td></tr> </tbody> </table>	x-3	-y+4	-6	1	-5	2	-4	3	-3	4	-2	3	-1	2	0	1
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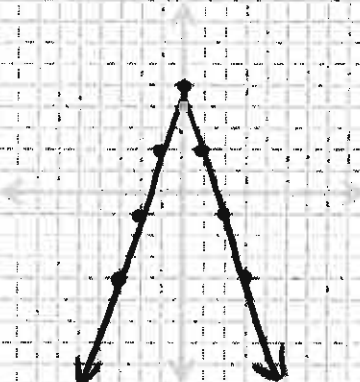
**Homework:** In each of the following, describe the transformation(s) to the parent function, complete the table of values, and graph the function.

1.  $f(x) = |x+6| - 5$  Shift left 6 units  
Shift down 5 units



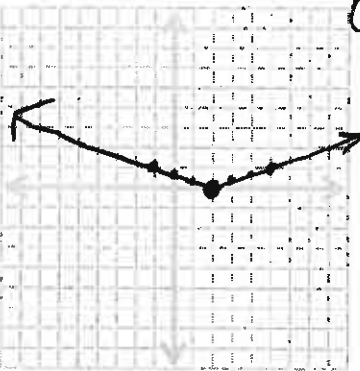
$x-6$	$y-5$
-9	-2
-8	-3
-7	-4
-6	-5
-5	-4
-4	-3
-3	-2

2.  $f(x) = -3|x| + 5$  Vertically stretch by 3. Reflect over x-axis. Shift up 5 units.



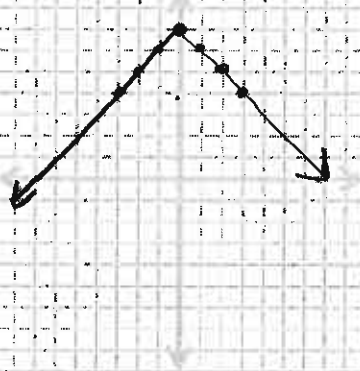
$x$	$-3y+5$
-3	-4
-2	-1
-1	2
0	5
1	2
2	-1
3	-4

3.  $f(x) = \frac{1}{3}|x-2|$  Vertically compress by  $\frac{1}{3}$ . Shift right 2.



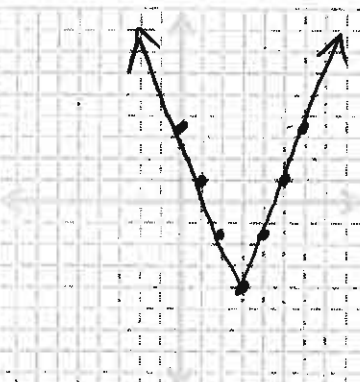
$x+2$	$\frac{1}{3}y$
-1	1
0	2/3
1	1/3
2	0
3	1/3
4	2/3
5	1

4.  $f(x) = -|x| + 7$  Reflect over x-axis. Shift up 7 units.



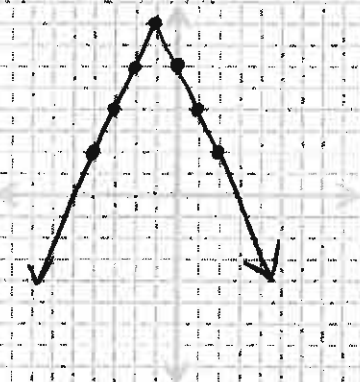
$x$	$-y+7$
-3	4
-2	5
-1	6
0	7
1	6
2	5
3	4

5.  $f(x) = \frac{5}{2}|x-3| - 4$  Vertically stretch by  $\frac{5}{2}$  and shift down 4. Shift right 3.



$x+3$	$\frac{5}{2}y-4$
0	3.5
1	1
2	-1.5
3	-4
4	-1.5
5	1
6	3.5

6.  $f(x) = -2|x+1| + 8$  Vertically stretch by 2, reflect over x-axis, shift up 8. Shift left 1.



$x-1$	$-2y+8$
-4	2
-3	4
-2	6
-1	8
0	6
1	4
2	2

7.  $f(x) = -\frac{2}{3}x + 7$  Wait a second...how do I graph this?

Vertically compress by  $\frac{2}{3}$ , reflect over x-axis.  
Shift up 7 units

