Success Center
Directed Learning Activity (DLA)

Transformations Using Parent Graphs

M111.1

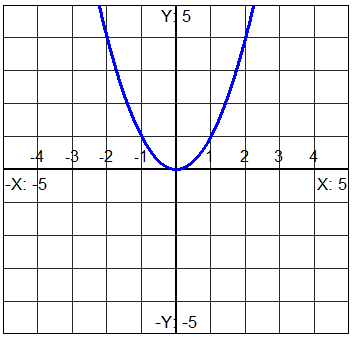
Directed Learning Activity – Transformations Using Parent Graphs

Description: In this Directed Learning Activity (DLA), you will learn how to graph transformations of functions – such as vertical shrinking/stretching, horizontal/vertical shifting, and reflecting – using the parent graphs.

Prior Knowledge: You will need to know the parent graphs of parabola, square root, cubic, and absolute value graphs.

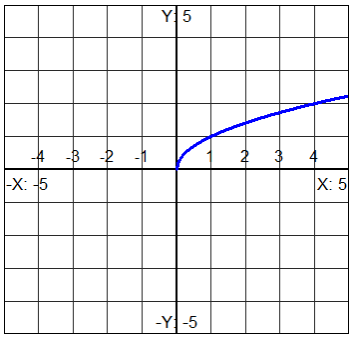
Parent Graphs

x	$y = x^2$
0	0
-1	1
1	1
-2	4
2	4



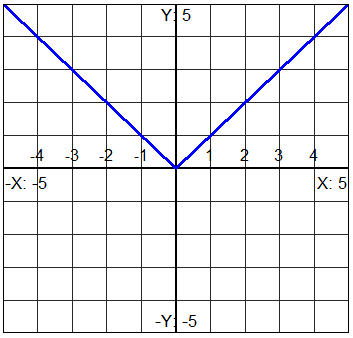
Parabola

x	$y = \sqrt{x}$
0	0
1	1
4	2



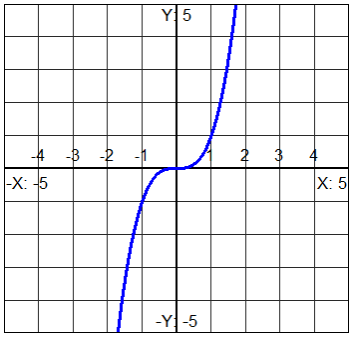
Square Root

x	$y = \lvert x \rvert$
0	0
-1	1
1	1
-2	2
2	2



Absolute Value

x	$y = x^3$
0	0
-1	-1
1	1



Cubic

Part One: Vertical Stretching and Shrinking Using Parent Graphs

Graphing functions in the form $y = a\,f(x)$. $f(x)$ could be x^2, $\sqrt{x}$, $|x|$, or x^3.

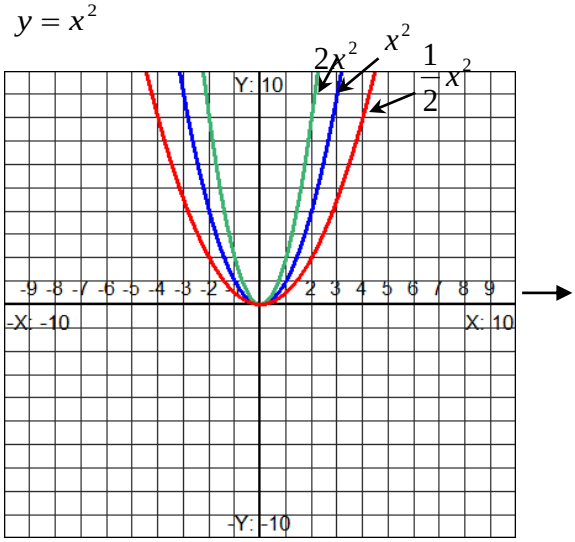
If a is a positive number greater than 1 $(a > 1) \rightarrow$ *vertical stretching*

If a is a positive number between 0 and 1 $(0 < a < 1) \rightarrow$ *vertical shrinking*

From the parent graph, multiply each y-coordinate by a to help you graph $y = a\,f(x)$.

Example 1:

a) $y = x^2$



Parabola

Parent Table

x	$y = x^2$
0	0
-1	1
1	1
-2	4
2	4

Multiplied by 2 from the y-coordinates

x	$y = 2x^2$
0	0
-1	2
1	2
-2	8
2	8

Multiplied by ½ from the y-coordinates

x	$y = \frac{1}{2}x^2$
0	0
-1	1/2
1	1/2
-2	2
2	2

$y = 2x^2 \rightarrow$ Multiplied parent y-coordinates by 2 (y-coordinates doubled)

$y = \frac{1}{2}x^2 \rightarrow$ Multiplied parent y-coordinates by $\frac{1}{2}$ (y-coordinates were divided by 2)

Part Two: Reflection About the *x*-axis Using Parent Graphs

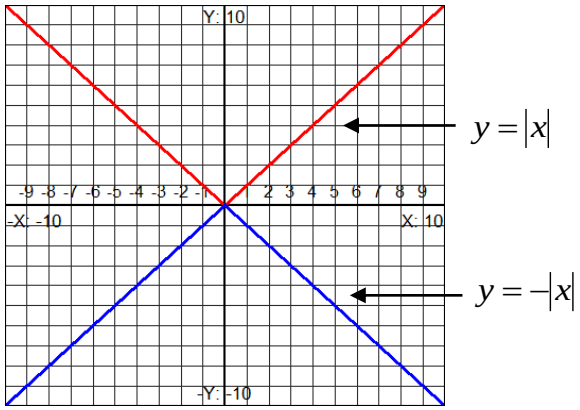
Graphing functions in the form $y = -f(x)$. $f(x)$ could be x^2, $\sqrt{x}$, $|x|$, *or* x^3.

If the function is $y = -f(x)$, then the function is reflected about the *x*-axis.

The negative sign in front of the function reverses the sign of every *y*-coordinate.

Example 2:

b) $y = -|x|$



Absolute Value

Reversed the signs of every y-coordinate

x	$y = \lvert x \rvert$
0	0
-1	1
1	1
-2	2
2	2

x	$y = -\lvert x \rvert$
0	0
-1	-1
1	-1
-2	-2
2	-2

Part Three: Horizontal Shifts Using Parent Graphs

Graphing functions in the form $y = f(x+h)$. $f(x)$ could be x^2, $\sqrt{x}$, $|x|$, *or* x^3.

If the function is $y = f(x+h)$, then the function is shifted *h* units to the left.

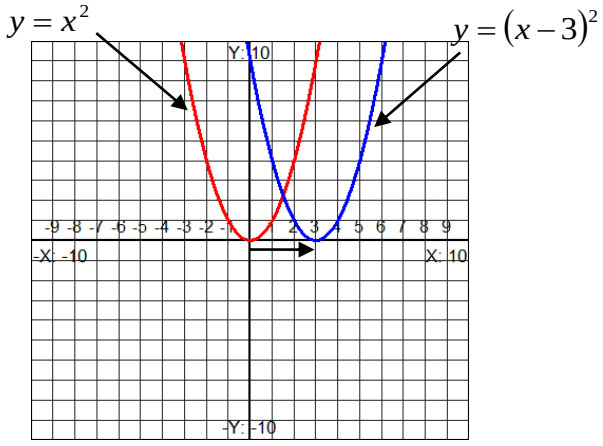
Subtract *h* units from the *x*-coordinates.

If the function is $y = f(x-h)$, then the function is shifted *h* units to the right.

Add *h* units to the *x*-coordinates.

Example 3:

c) $y = (x-3)^2 \rightarrow$ *shifted right* 3 *units*

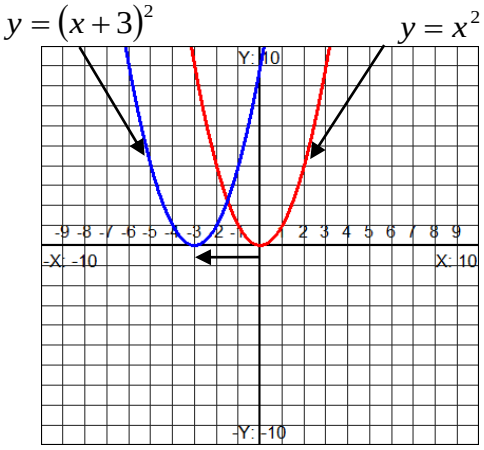


Added 3 units to the *x*-coordinates

x	$y = x^2$
0	0
-1	1
1	1
-2	4
2	4

x	$y = (x-3)^2$
3	0
2	1
4	1
1	4
5	4

d) $y = (x+3)^2 \rightarrow$ *shifted left* 3 *units*



Subtracted 3 units from the *x*-coordinates

x	$y = x^2$
0	0
-1	1
1	1
-2	4
2	4

x	$y = (x+3)^2$
-3	0
-4	1
-2	1
-5	4
-1	4

Part Four: Vertical Shifts Using Parent Graphs

Graphing functions in the form $y = f(x) + k$. $f(x)$ could be x^2, $\sqrt{x}$, $|x|$, or x^3.

If the function is $y = f(x) + k$, then the function is shifted *k* units up.

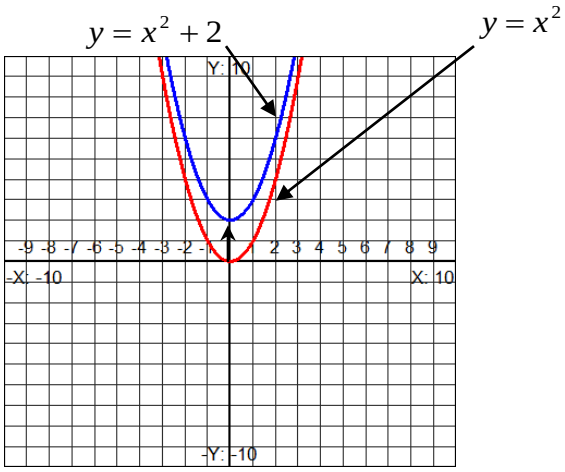
Add *k* units to the *y*-coordinates.

If the function is $y = f(x) - k$, then the function is shifted *k* units down.

Subtract *k* units from the *y*-coordinates.

Example 4:

e) $y = x^2 + 2 \rightarrow$ *shifted up 2 units*

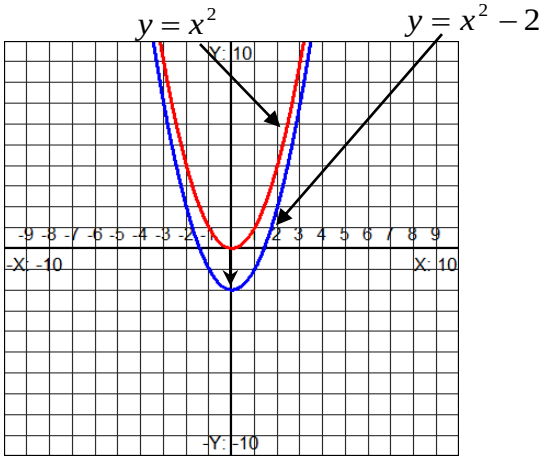


Added 2 units to the *y*-coordinates

x	$y = x^2$
0	0
-1	1
1	1
-2	4
2	4

x	$y = x^2 + 2$
0	2
-1	3
1	3
-2	6
2	6

f) $y = x^2 - 2 \rightarrow$ *shifted down 2 units*



Subtracted 2 units from the *y*-coordinates

x	$y = x^2$
0	0
-1	1
1	1
-2	4
2	4

x	$y = x^2 - 2$
0	-2
-1	-1
1	-1
-2	2
2	2

Part Five: Graphing Functions in the Form $y = -a\,f(x-h)+k$ Using the Parent Graphs

$f(x-h)$ could be $(x-h)^2$, $\sqrt{x-h}$, $|x-h|$, *or* $(x-h)^3$.

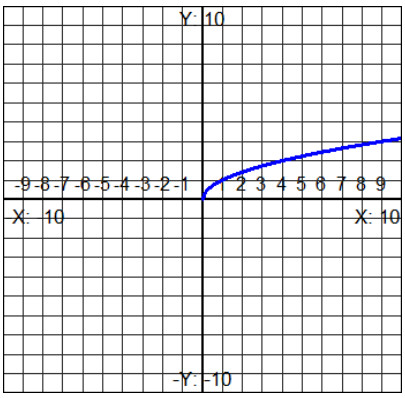
When graphing functions with several transformations, it's helpful to carry them out using the order of operations (PEMDAS). The following examples show this in five steps, since the given functions include all the transformations explained previously. First, you start with the parent graph. Second, you do the horizontal shift. Third, you do the vertical stretching/shrinking. Fourth, you do the reflection. Fifth, you do the vertical shift. If a function does not include all the transformations, simply carry out the given transformations in the order described above.

Example 5:

Graph $y = -2\sqrt{x+3}-1$

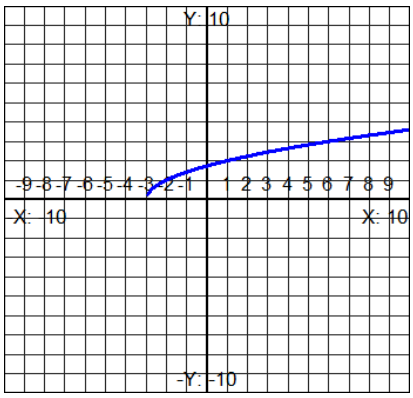
Step 1)

Parent graph $y = \sqrt{x}$



Step 2)

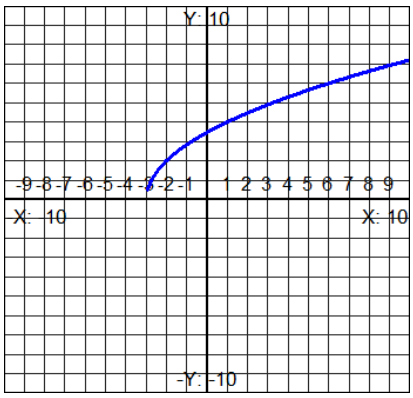
$y = \sqrt{x+3}$ → Shifted to the left 3 units



Subtracted 3 from the parent *x*-coordinates

Step 3)

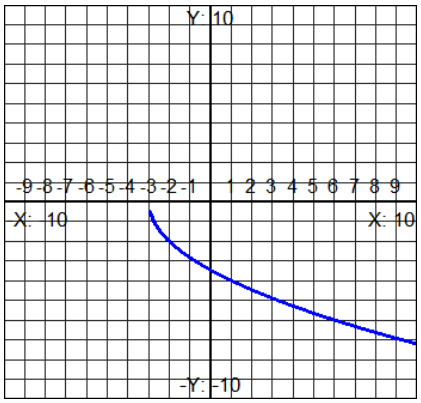
$y = 2\sqrt{x+3}$ → Vertically stretched by a factor of 2



Multiplied by 2 from the *y*-coodinates
(the y-coordinates doubled)

Step 4)

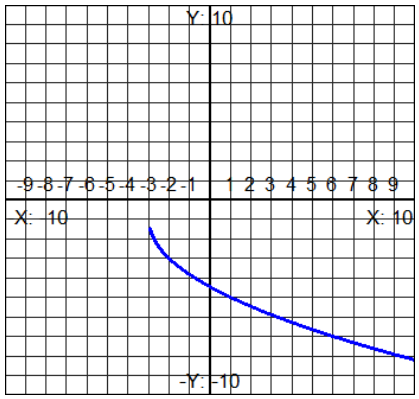
$y = -2\sqrt{x+3} \rightarrow$ Reflected about *the x -axis*



Reversed the signs of the *y*-coordinates

Step 5)

$y = -2\sqrt{x+3} - 1 \rightarrow$ Shifted down 1 unit



Final answer

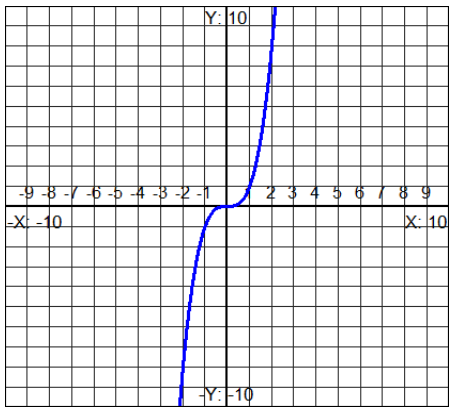
Subtracted 1 from the *y*-coordinates

Example 6:

Graph $-\frac{1}{2}(x-4)^3 + 3$

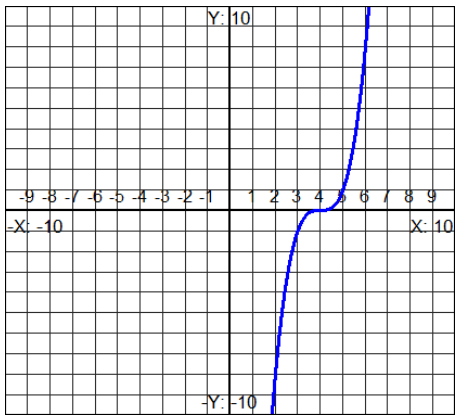
Step 1)

Parent graph $y = x^3$



Step 2)

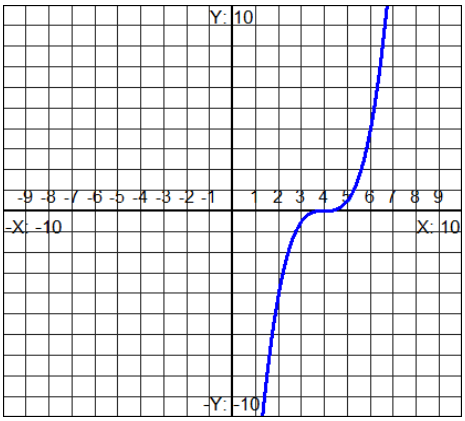
$y = (x-4)^3 \rightarrow$ Shifted to the right 4 units



Added 4 to the parent's *x*-coordinates

Step 3)

$y = \frac{1}{2}(x-4)^3 \rightarrow$ Vertically shrunk by a factor of $\frac{1}{2}$

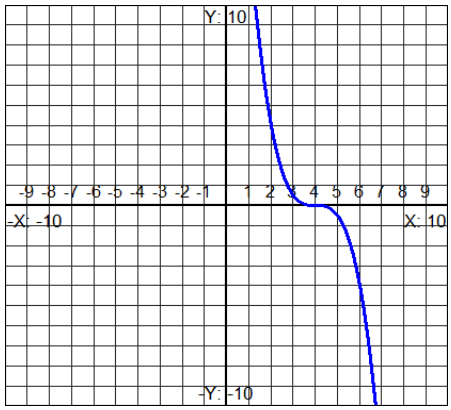


Multiplied the *y*-coodinates by $\frac{1}{2}$.

(the y-coordinates were divided by 2)

Step 4)

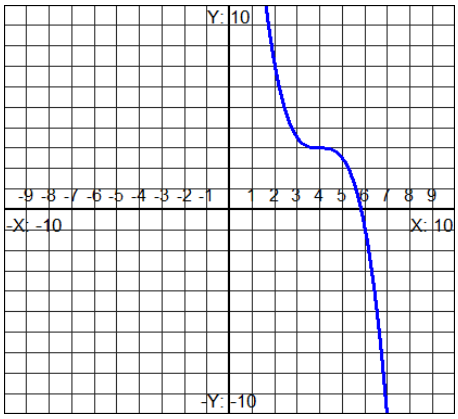
$y = -\frac{1}{2}(x-4)^3 \rightarrow$ Reflected about the *x*-axis



Reversed the signs of the *y*-coordinates

Step 5)

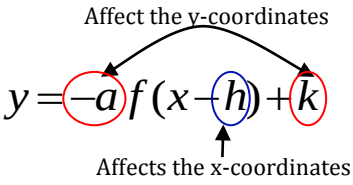
$y = -\frac{1}{2}(x-4)^3 + 3 \rightarrow$ Shifted up 3 units



Final Answer

Added 3 to the *y*-coordinates

Before you move on, briefly review which transformations affect the *x* and *y*-coordinates:

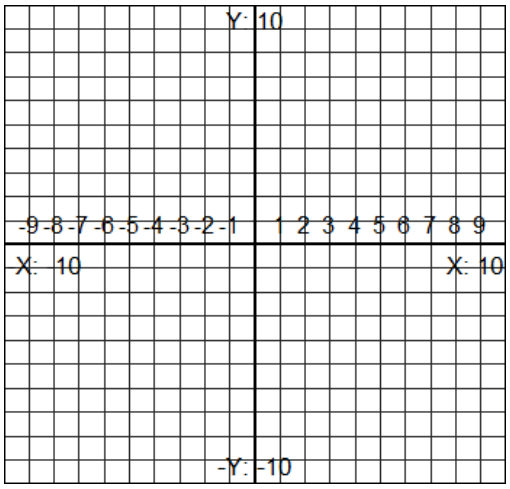


Now, that you know all the transformations performed on functions of the form $y = -a\,f(x-h)+k$ in which $f(x-h)$ could be $(x-h)^2$, $\sqrt{x-h}$, $|x-h|$, *or* $(x-h)^3$, you should be able to graph the following functions.

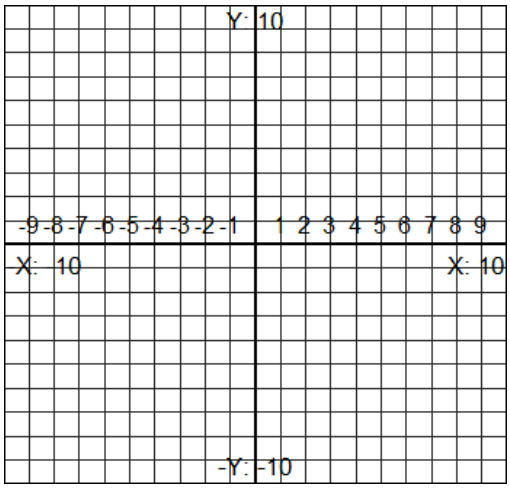
Part Six: Applying What You Have Learned

Graph the following functions using the parent graph.

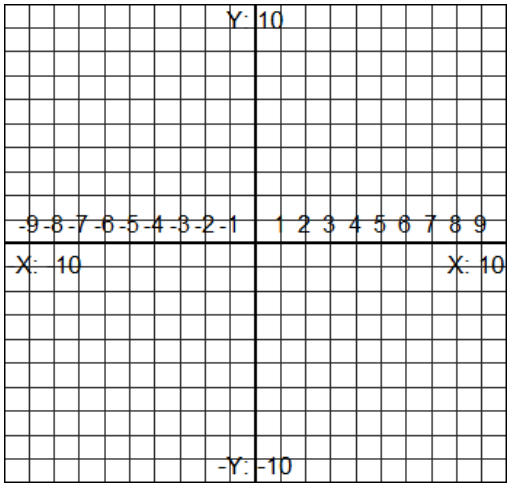
1) $y = 3(x+1)^2$



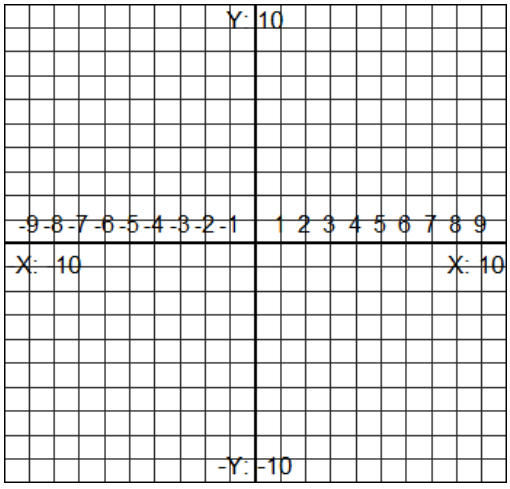
2) $y = -\frac{1}{2}\sqrt{x-5}$



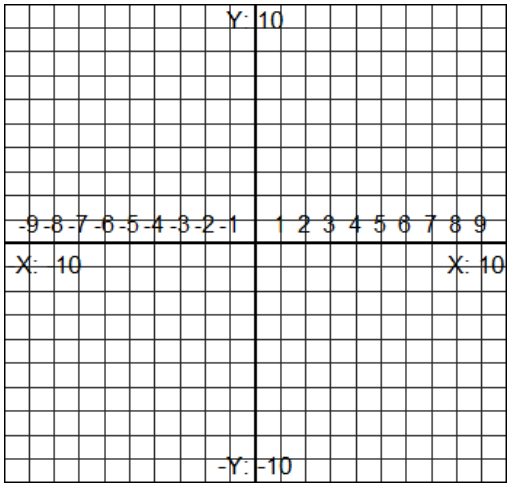
3) $y = \frac{1}{2}|x+2|-3$



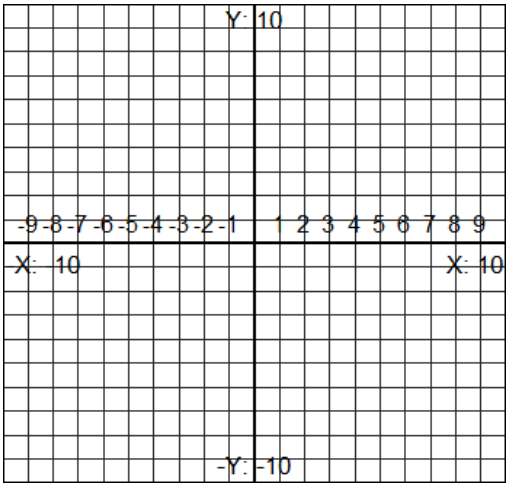
4) $y = 2(x+3)^2$



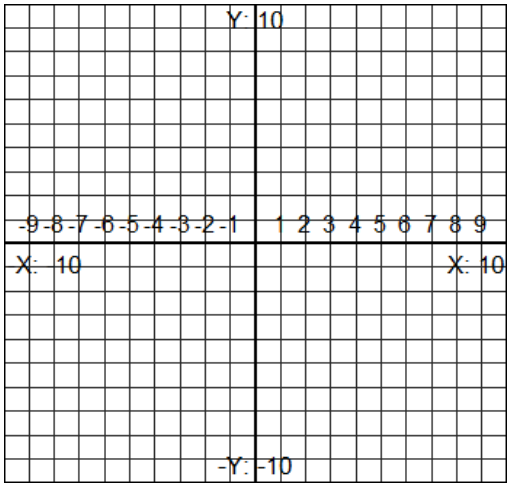
5) $y = 4|x-2|$



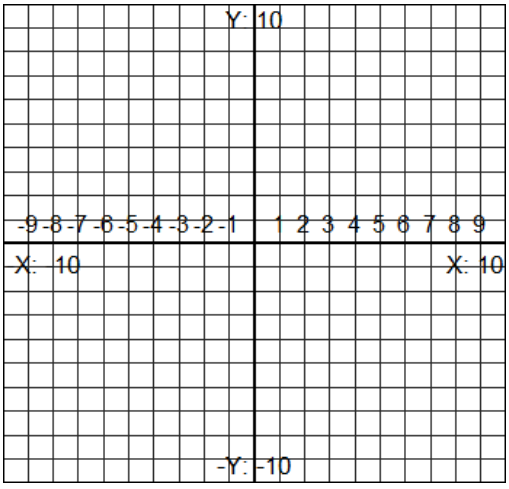
6) $y = \frac{1}{4}x^2$



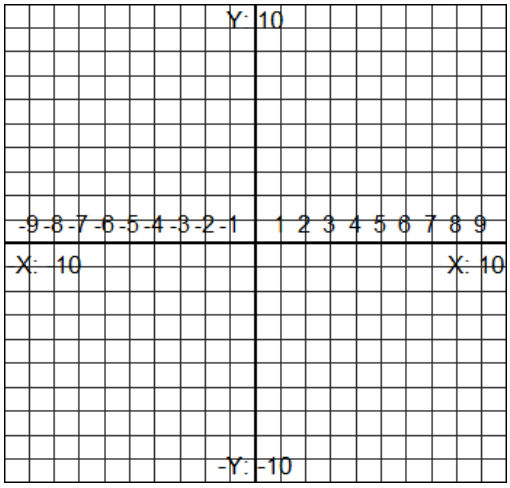
7) $y = -\frac{1}{2}|x+2|-3$



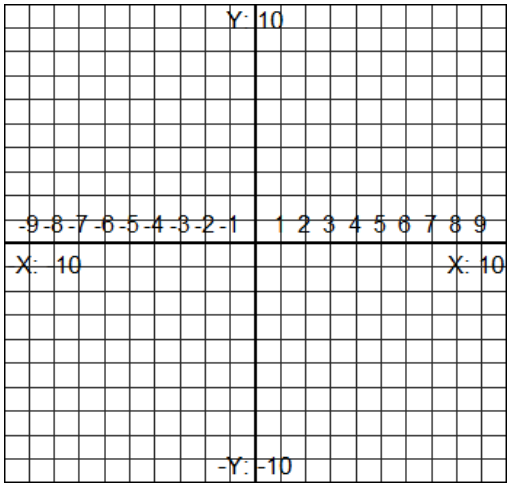
8) $y = -\frac{1}{3}(x-1)^3$



9) $y = -3|x-2|+4$



10) $y = -\sqrt{x-2}+4$



Part Seven: Reflecting on What You Have Learned

Name one thing that you understand better about graphing transformations of functions using parent graphs as a result of completing this activity.

Name one thing that you still do not understand about graphing transformations of functions.

Give at least two suggestions to improve this activity.

STOP. Please go over your work with a tutor at this time.

_____ _____

PRINT STUDENT NAME **STUDENT #**

For Follow-Up:

_____The student completed the entire activity.

_____The student attempted to answer every question.

_____The student demonstrated an understanding of the process of graphing transformations of functions – such as vertical shrinking/stretching, horizontal/vertical shifting, and reflecting – using the parent graphs.

Additional Comments:

_____

_____

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_____ _____

PRINT INSTRUCTOR/TUTOR NAME **DATE**

_____

INSTRUCTOR/TUTOR SIGNATURE

STUDENT – DO NOT FORGET TO TURN THIS SHEET IN AT THE FRONT DESK!

You may not get credit for completing this DLA if you fail to leave this sheet with the front desk receptionist.