NOTES: SECONDARY 2 HONORS
TRANSFORMATIONS ON QUADRATIC AND ABSOLUTE VALUE FUNCTIONS (3.3, 3.4)

Vocabulary

- The **parent function** is the basic function used to create the more complicated functions.
- The graph of a quadratic function is in the shape of a **parabola**. This is generally described as being "u" shaped.
  - The vertex form is $f(x) = a(x-h)^2 + k$ where the vertex is at (h,k) and the axis of symmetry is at $x = h$.
- The **absolute value function** is actually a piecewise-defined function consisting of two linear equations.
  - The vertex form is $f(x) = a\,|x-h| + k$ where the vertex is at (h,k) and the axis of symmetry is at $x = h$.

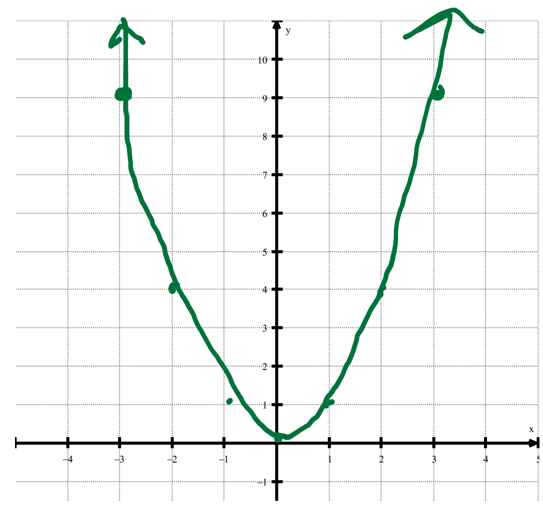
QUADRATIC PARENT FUNCTION

Equation: $y = x^2$

Table

x	y
-3	9
-2	4
-1	1
0	0
1	1
2	4
3	9

Graph



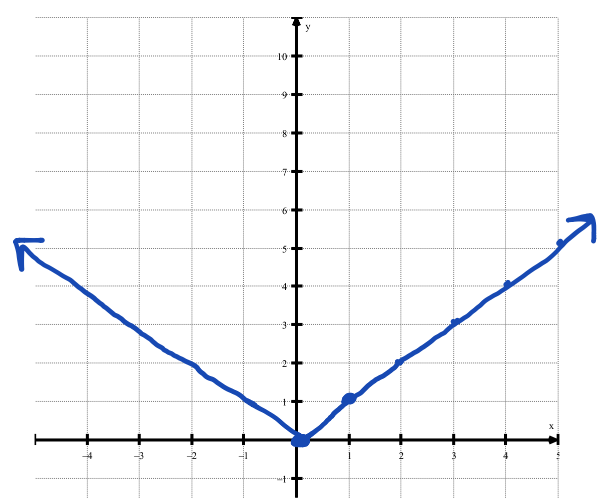
ABSOLUTE VALUE PARENT FUNCTION

Equation: $y = |x|$

Table

x	y
-3	3
-2	2
-1	1
0	0
1	1
2	2
3	3

Graph



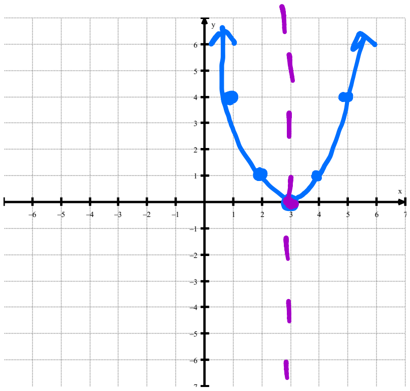
General Formula - Quadratic

$$f(x) = a(x - h)^2 + k$$

Examples: Describe the transformations performed on $f(x) = x^2$ to make it the following:

a. $f(x) = (x - 3)^2$

Transformation(s): Horizontal shift right 3.



Axis of symmetry: $x = 3$

Vertex: $(3, 0)$

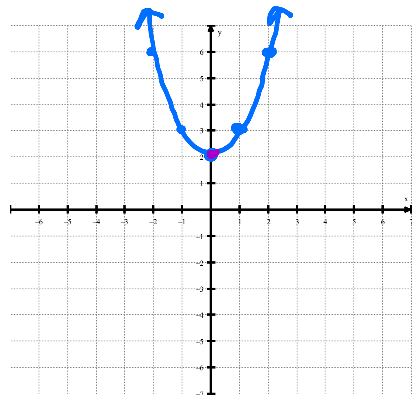
Domain: $(-\infty, \infty)$

Range: $[0, \infty)$

Max/Min value: min value at 0 when x is 3.

b. $f(x) = x^2 + 2$

Transformation(s): vertical shift up 2.



Axis of symmetry: $x = 0$

Vertex: $(0, 2)$

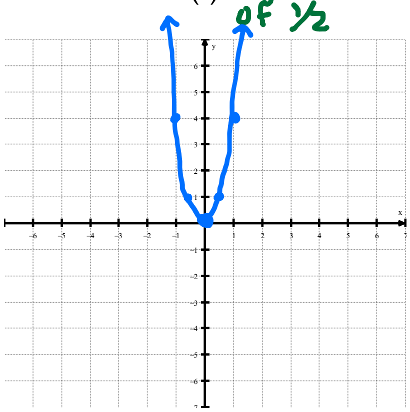
Domain: $(-\infty, \infty)$

Range: $[2, \infty)$

Max/Min value: min value at 2 when x is 0.

c. $f(x) = (2x)^2$

Transformation(s): Horizontal stretch by a factor of ½



Axis of symmetry: $x = 0$

Vertex: $(0, 0)$

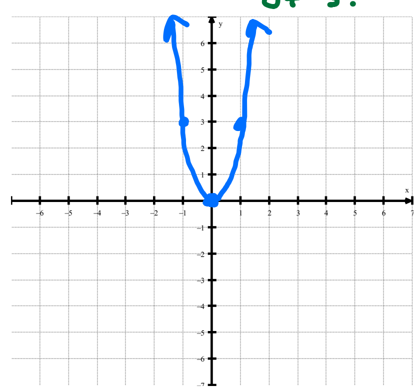
Domain: $(-\infty, \infty)$

Range: $[0, \infty)$

Max/Min value: min value at 0 when x is 0.

d. $f(x) = 3x^2$

Transformation(s): vertical stretch by a factor of 3.



Axis of symmetry: $x = 0$

Vertex: $(0, 0)$

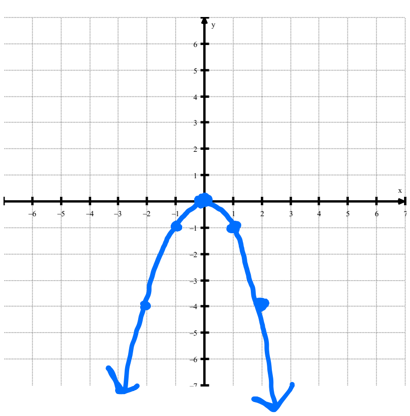
Domain: $(-\infty, \infty)$

Range: $[0, \infty)$

Max/Min value: min value at 0 when x is 0.

e. $f(x) = -x^2$

Transformation(s): reflected across the x-axis.



Axis of symmetry: $x = 0$

Vertex: $(0, 0)$

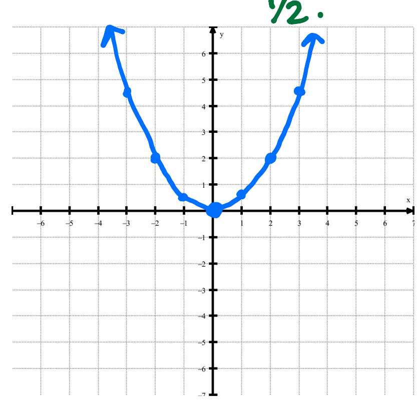
Domain: $(-\infty, \infty)$

Range: $(-\infty, 0]$

Max/Min value: max value at 0 when x is 0.

f. $f(x) = \frac{1}{2}x^2$

Transformation(s): vertical stretch by a factor of ½.



Axis of symmetry: $x = 0$

Vertex: $(0, 0)$

Domain: $(-\infty, \infty)$

Range: $[0, \infty)$

Max/Min value: min value at 0 when x is 0.

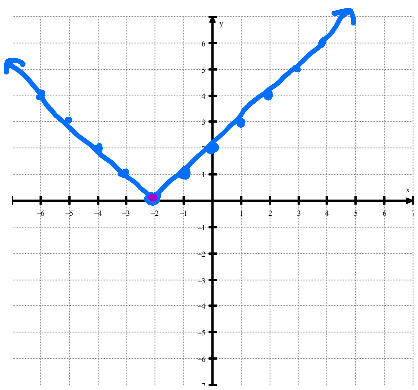
General Formula – Absolute Value

$$f(x) = a|x - h| + k$$

Examples: Describe the transformations performed on $f(x) = x^2$ to make it the following:

a. $f(x) = |x + 2|$

Transformation(s): Horizontal shift left 2.



Axis of symmetry: $x = -2$

Vertex: $(-2, 0)$

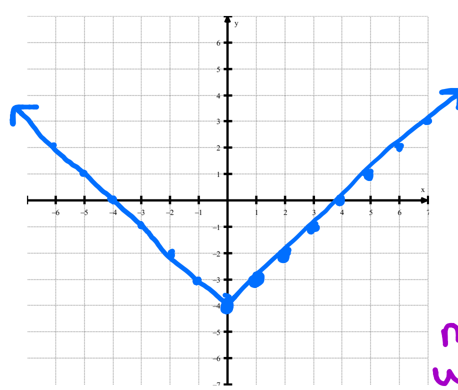
Domain: $(-\infty, \infty)$

Range: $[0, \infty)$

Max/Min value: min value at 0 when x is -2.

b. $f(x) = |x| - 4$

Transformation(s): vertical shift down 4



Axis of symmetry: $x = 0$

Vertex: $(0, -4)$

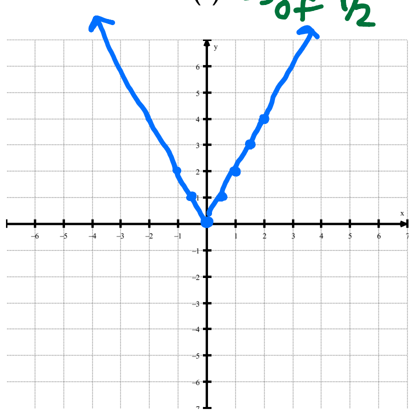
Domain: $(-\infty, \infty)$

Range: $[-4, \infty)$

Max/Min value: min value at -4 when x is 0.

c. $f(x) = |2x|$

Transformation(s): Horizontal stretch by a factor of ½



Axis of symmetry: $x = 0$

Vertex: $(0, 0)$

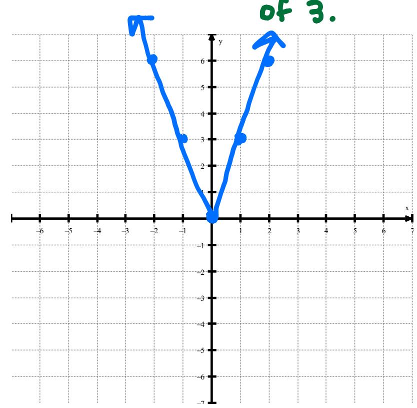
Domain: $(-\infty, \infty)$

Range: $[0, \infty)$

Max/Min value: min value at 0 when x is 0.

d. $f(x) = 3|x|$

Transformation(s): vertical stretch by a factor of 3.



Axis of symmetry: $x = 0$

Vertex: $(0, 0)$

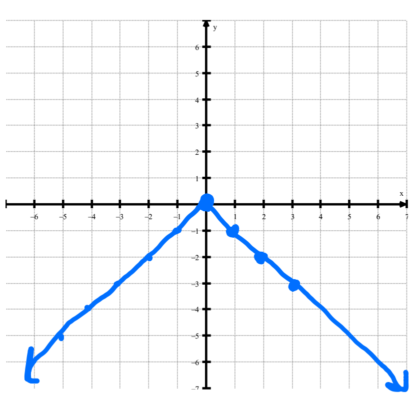
Domain: $(-\infty, \infty)$

Range: $[0, \infty)$

Max/Min value: min value at 0 when x is 0.

e. $f(x) = -|x|$

Transformation(s): reflecting across the x-axis



Axis of symmetry: $x = 0$

Vertex: $(0, 0)$

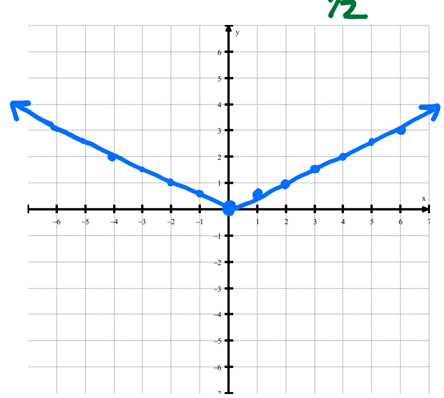
Domain: $(-\infty, \infty)$

Range: $(-\infty, 0]$

Max/Min value: max value at 0 when x is 0.

f. $f(x) = \frac{1}{2}|x|$

Transformation(s): vertical stretch by a factor of ½



Axis of symmetry: $x = 0$

Vertex: $(0, 0)$

Domain: $(-\infty, \infty)$

Range: $[0, \infty)$

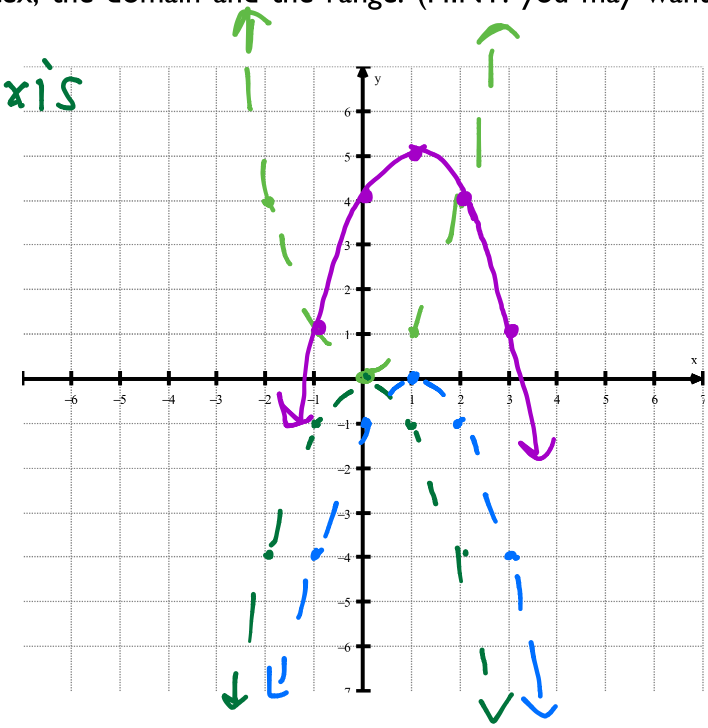
Max/Min value: min value at 0 when x is 0.

When graphing multiple translations it is best to **StReSS**. StReSS is an acronym to help you remember the order to perform transformations. Always begin with the parent graph for the function, you then perform the **St** or the stretch; this refers to the a in the general formula, and could be a shrink or a stretch. After completing the stretch you reflect (**Re**) your graph. On quadratic functions, reflections are always across the x-axis. Once you have completed the **StRe** you finish with **SS**, this refers to shift-shift, or a vertical shift and a horizontal shift.

Example: Describe the transformations on $f(x) = x^2$ to make it $f(x) = -(x-1)^2 + 5$. Then graph the function and identify the axis of symmetry, the vertex, the domain and the range. (HINT: you may want to graph the equation)

- Reflects across the x-axis
- Horizontal shift right 1
- vertical shift up 5.

axis of symmetry: x=1
vertex: (1,5)
domain: (-∞,∞)
range: (-∞, 5]
max value at 5 when x is 1.

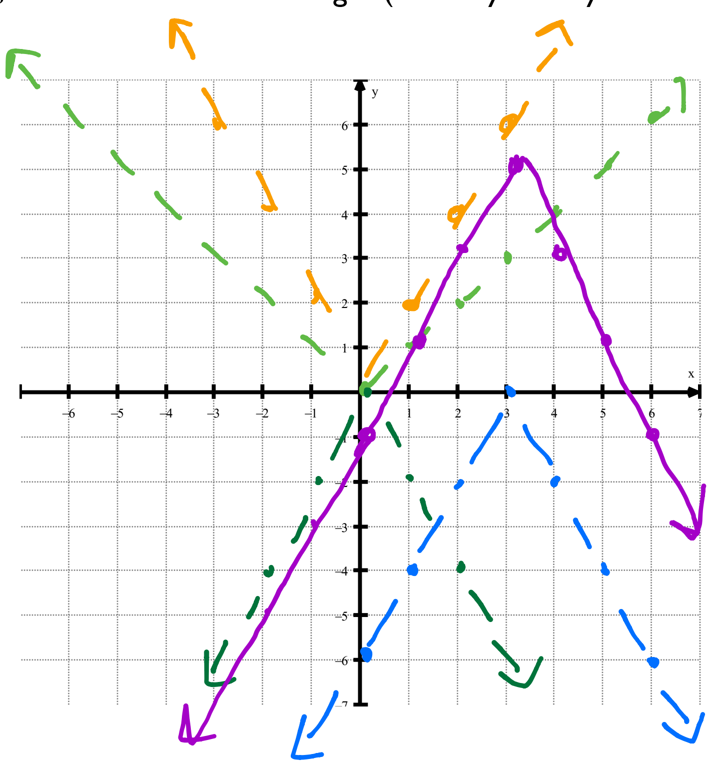


Example: Describe the transformations on $f(x) = |x|$ to make it $\boxed{f(x) = -2|x-3| + 5.}$ Then graph the function and identify the axis of symmetry, the vertex, the domain and the range. (HINT: you may want to graph the equation)

- vertical stretch by a factor of 2.
- reflection across the x-axis.

Horizontal shift right 3.
vertical shift up 5.

axis of symmetry: x=3
Vertex: (3,5)
Domain: (-∞,∞)
Range: (-∞, 5]
max value at 5 when x is 3.



HW: pg. 281: 1-12
pg. 289: 1-12