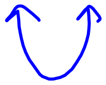
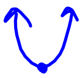
Sec. 4.1 Quadratic Functions and Transformations

Vocabulary

- parabola: the graph of a quadratic function
- quadratic function: $f(x) = ax^2 + bx + c$, $a \neq 0$



- vertex form: $f(x) = a(x-h)^2 + k$, $a \neq 0$.
- axis of symmetry: a line that divides the parabola into two mirror images. $x = h$
- vertex of the parabola: (h, k), the intersection of the parabola and the axis of symmetry.
- minimum value: y-coordinate of the vertex, k, when $a > 0$



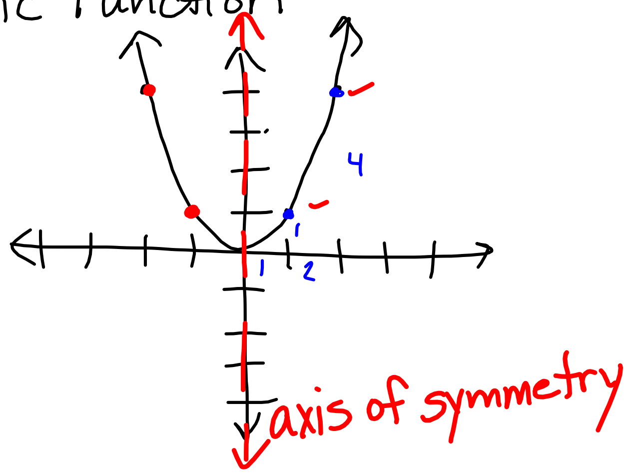
- maximum value: y-coordinate of the vertex, k, when $a < 0$

Parent Quadratic Function

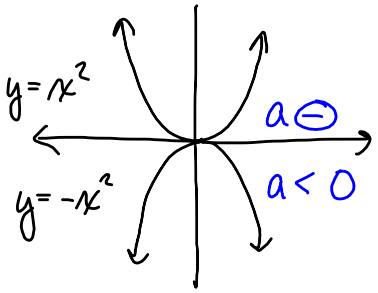
$f(x) = x^2$

v: $(0,0)$

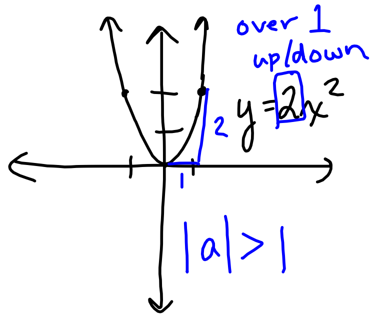
x	y	
1	1	1^2
2	4	2^2



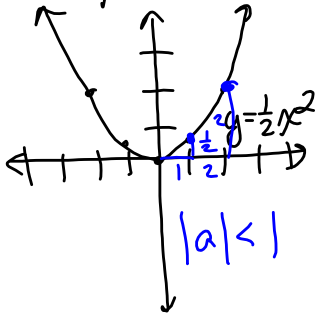
Reflection:



V. Stretch:



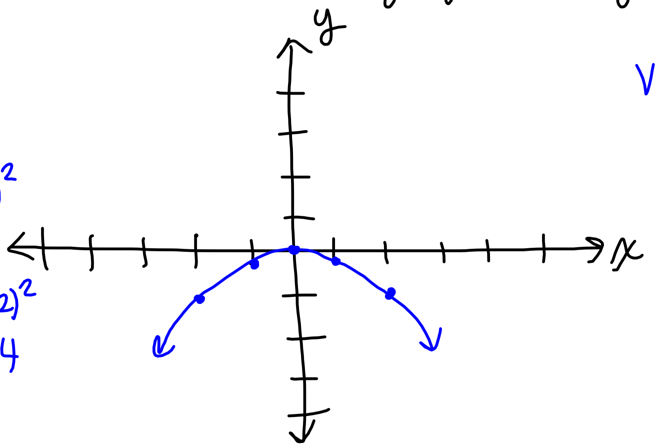
V. Compression:



Problem 1: What is the graph of $y=-\frac{1}{4}x^2$?

V: (0,0)

x	y	
1	$-\frac{1}{4}$	$-\frac{1}{4}(1)^2$
2	-1	$-\frac{1}{4}(2)^2$ $-\frac{1}{4}\cdot 4$



V: (0,0)

over	up/down
1	$a=-\frac{1}{4}$
2	$4a=4(-\frac{1}{4})$ $=-1$

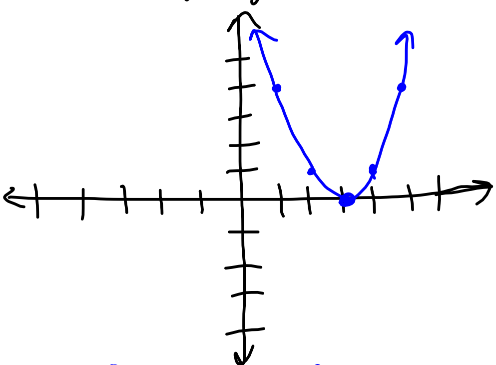
Problem 2: Graph each function. How is each graph a translation of $f(x)=x^2$?

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

V: (3,0)

a: 1

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

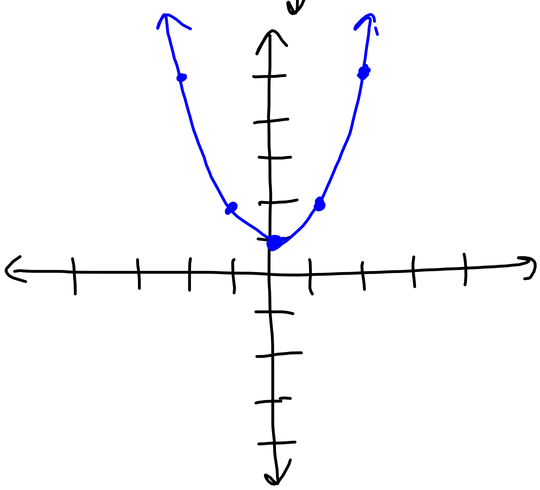


b. $h(x)=x^2+1$

V: (0,1)

a = 1

x	y	
1	2	1^2+1
2	5	2^2+1



Problem 3: For $y = \frac{1}{2}(x - \underline{3})^2 \underline{-5}$, what are the vertex, the axis of symmetry, the minimum or maximum value, the domain, and the range?

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

v: $(h, k) = (3, -5)$

aos: $x = h$ $\quad x = 3$

min/max: -5

$a = \frac{1}{2} > 0$ open up

Domain: $\underline{\text{ARN}}$

Range: $y \overset{min}{\geq} k / y \overset{max}{\leq} k$

$y \geq -5$

Problem 4: What is the graph of $f(x) = -3(x+5)^2 + 2$?

v: $(-5, 2)$

$1 \to a = -3$

$2 \to 4a = -12$

x	y
-4	-1
-3	-10

$-3(-4+5)^2+2$

$-3(1)^2+2$

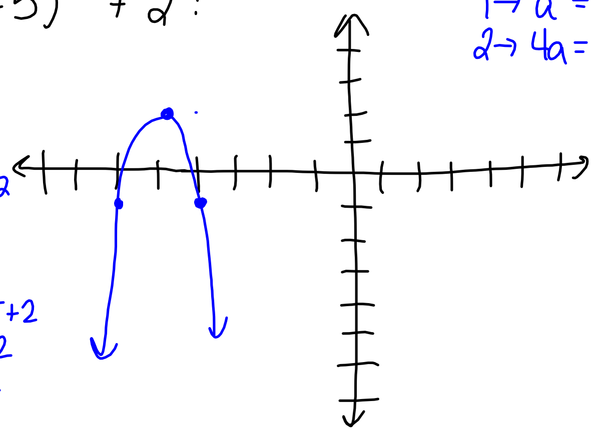
$-3+2$

$-3(-3+5)^2+2$

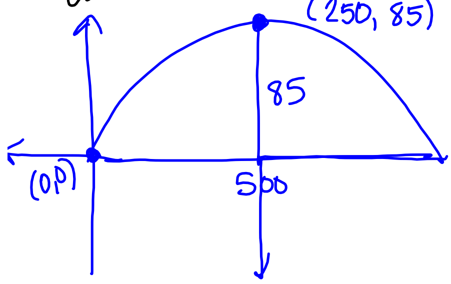
$-3(2)^2+2$

$-3 \cdot 4+2$

-10



Problem 5: The arch of the Sidney Harbor Bridge is approximately 500 meters long and 85 meters high. What quadratic function models the curve of the arch? Assume the arch starts at (0,0).



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

$y = a(x-250)^2 + 85$

$0 = a(0-250)^2 + 85$

$\frac{-85}{625{,}000} = \frac{625{,}000a}{625{,}000}$

$y = -\frac{17}{12{,}500}(x-250)^2 + 85$