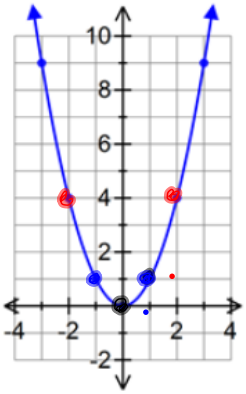
Section: 7.2 **Objective:** Graph quadratic formulas using the vertex and value of a.

The graph of $y = x^2$:



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

Vertex: (0,0)

Axis of Symmetry: $x = 0$

Direction of Opening: a is positive up

***y*-intercept:** (0, 0)

Pattern: start a vertex → 1, ↑ 1, → 2, ↑ 4

1. Find the vertex of the parabola.
2. Then use the pattern of the parent graph to find 4 more points, 2 on each side of the vertex. If a isn't 1, the pattern is a little different (see next page).

Examples: Fill in the requested information for each function. Then draw the graph.

a) $f(x) = x^2 + 4x + 3$ Form of the equation: Standard $a = 1$ $b = 4$ $c = 3$

Vertex: $\frac{-b}{2a}$ $\frac{-4}{2(1)}$ $\frac{-4}{2} = -2$ (-2,-1)

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

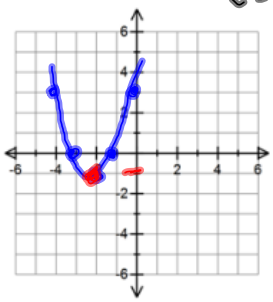
Axis of Symmetry: $x = -2$

Direction of Opening: up ↑

Is the vertex a maximum or minimum?

Maximum or minimum value: -1 is y coord of vertex

y-intercept: $x = 0$ (0, 3)



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

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

Range: ↑ $[-1, \infty)$ y value of vertex

Vertical Stretch:

- a changes how wide the graph is.
  - If $|a|>1$, the graph is **thinner** than the graph of $y=x^2$.
  - If $|a|<1$, the graph is **wider** than the graph of $y=x^2$.

How a changes the pattern:
The normal pattern is find the vertex, then move over 1 up 1. To find the next two points go back to the vertex and move over 2 up 4.
When a is not 1 you multiply the y-value(the "up" number) by "a" to get the up value.
Example: $y = 3x^2$ Instead of over 1 up 1 it would be over 1 up 3 (one times 3) and instead of over 2 up 4 it would be over 2 up 12 (four times 3)

b) $f(x)=\frac{1}{2}(x-1)^2-4$ Form of the equation: vertex $a=\frac{1}{2}$ $h=1$ $k=-4$

Vertex: (h,k) $(1,-4)$

Axis of Symmetry: $x=1$

Direction of Opening: up (a is positive)

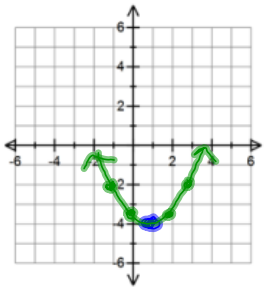
Is the vertex a maximum or minimum?

Maximum or minimum value: -4 (y-coord)

y-intercept: $(0,-3.5)$

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

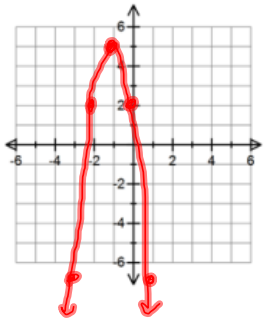
Range: $[-4,\infty)$



Vertex	x	y
	-1	-2
	0	-3.5
	1	-4
	2	-3.5
	3	-2

c) $f(x) = -3x^2 - 6x + 2$ Form of the equation: Standard $a = -3$ $b = -6$ $c = 2$

Vertex: $\frac{-b}{2a}$ $\frac{6}{2(-3)} = \frac{6}{-6} = -1$ $(-1, 5)$



Axis of Symmetry: $x = -1$

Direction of Opening: down

Is the vertex a maximum or minimum? a is neg

Maximum or minimum value: 5

y-intercept: $x = 0$ $(0, 2)$

x	y
-3	-7
-2	2
-1	5
0	2
1	-7

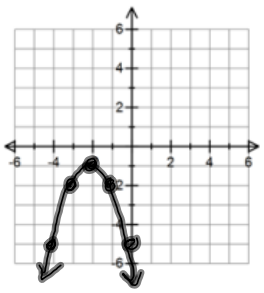
Vertex

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

Range: $(-\infty, 5]$

d) $f(x) = -(x+2)^2 - 1$ Form of the equation: vertex $a = -1$ $h = -2$ $k = -1$

Vertex: (h, k) $(-2, -1)$



Axis of Symmetry: $x = -2$

Direction of Opening: down

Is the vertex a maximum or minimum?

Maximum or minimum value: -1

y-intercept: $x = 0$ $(0, -5)$

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

Vertex

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

Range: $(-\infty, -1]$

e) $f(x)=2(x-4)^2-3$ Form of the equation: Vertex $a=2$ $h=4$ $k=-3$

Vertex: (h,k) $(4,-3)$

Axis of Symmetry: $x=h$ $x=4$

Direction of Opening: ↑

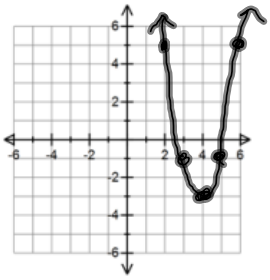
Is the vertex a maximum or minimum?

Maximum or minimum value: y coord -3

y-intercept: $2(0-4)^2-3 \Rightarrow (0,29)$

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

Range: $[-3,\infty)$ ↑



Vertex	x	y
	2	5
	3	-1
	4	-3
	5	-1
	6	5

f) $f(x)=-\frac{1}{2}x^2-x+2$ Form of the equation: Standard $a=-\frac{1}{2}=-.5$ $b=-1$ $c=2$

Vertex: $\frac{-b}{2a}$ $\frac{1}{2(-\frac{1}{2})}=-1$ $(-1,2.5)$

Axis of Symmetry: $x=-1$

Direction of Opening: down ↓

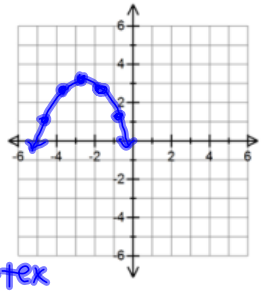
Is the vertex a maximum or minimum?

Maximum or minimum value: y coord of vertex 2.5

y-intercept: $x=0$ $(0,2)$

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

Range: $(-\infty,2.5]$ ↓



Vertex	x	y
	-3	.5
	-2	2
	-1	2.5
	0	2
	1	.5