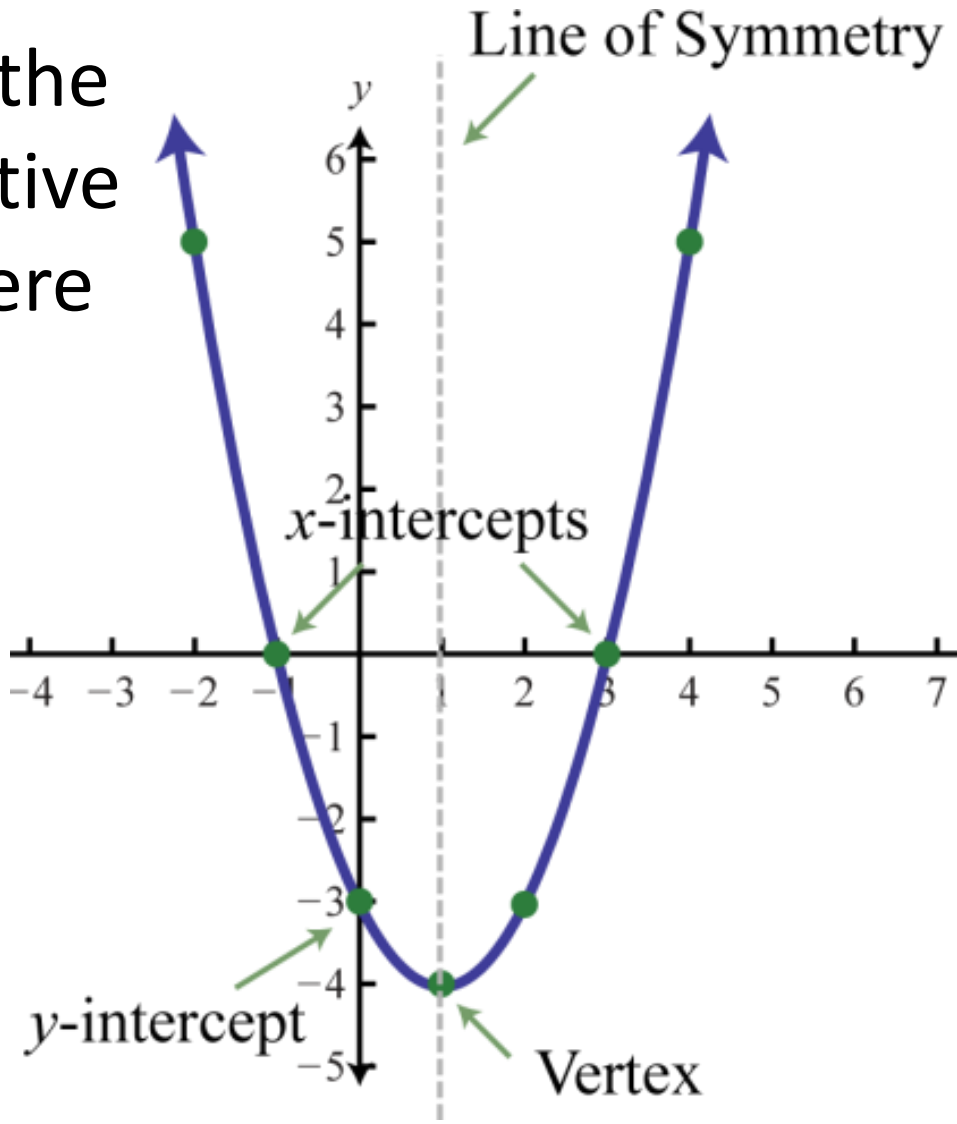
Vertex Form of a Quadratic

The **vertex** of a parabola is the absolute max/min, the relative max/min and the point where the graph changes increasing/decreasing

A line of symmetry can be drawn through the vertex.



Vertex Form of a Quadratic Function

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

a indicates a reflection across the *x*-axis and/or a vertical stretch or compression.

h indicates a horizontal translation.

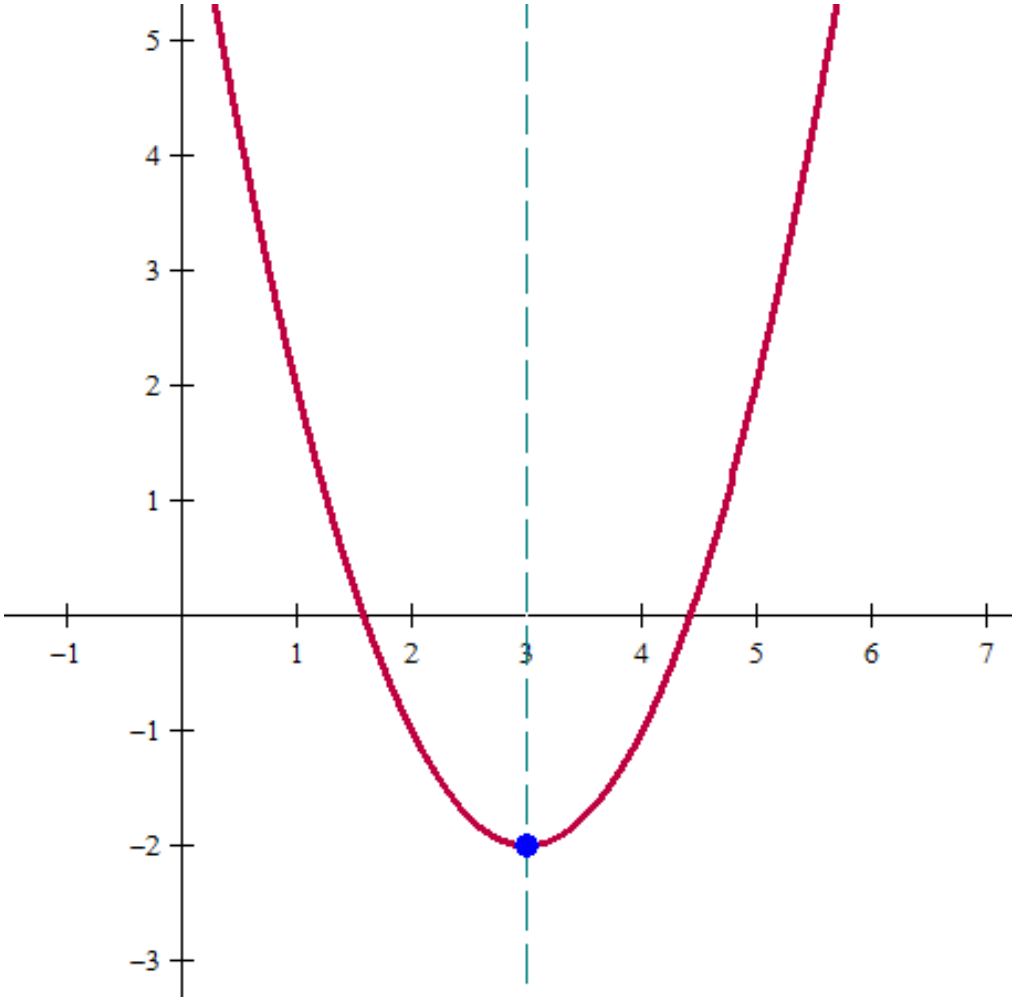
k indicates a vertical translation.

The vertex of the parabola is at the point (h, k).

The axis of symmetry is the line x = h.

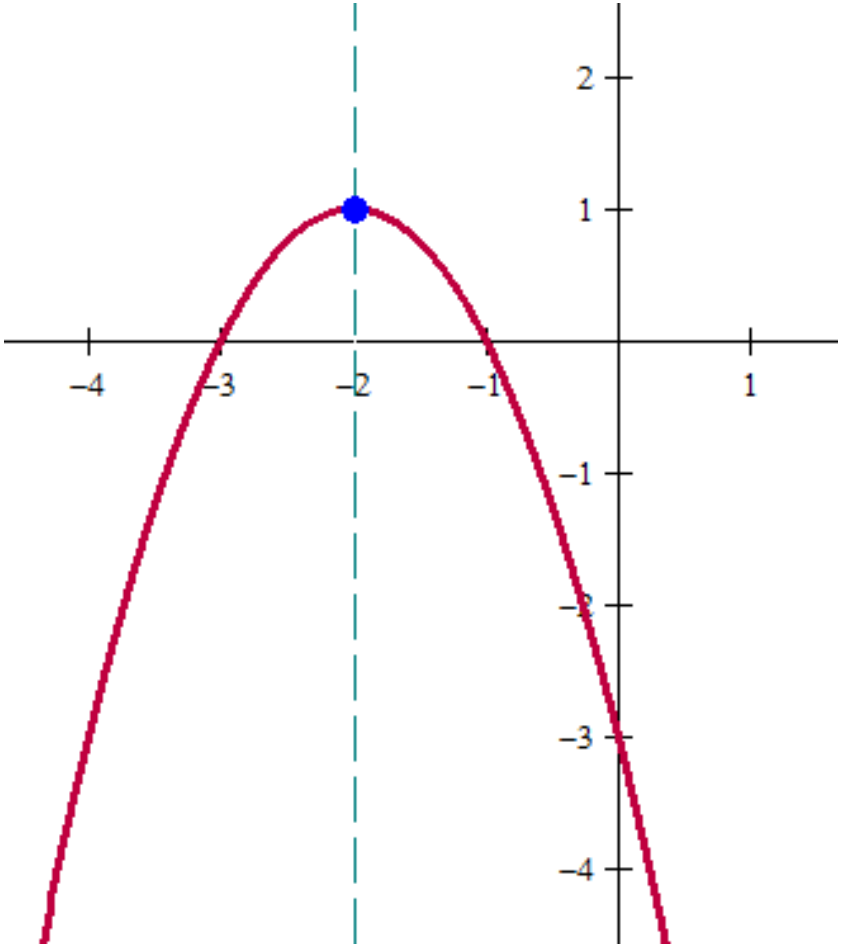
If “a” is positive…

- The graph opens upward
- The vertex is the absolute and relative minimum



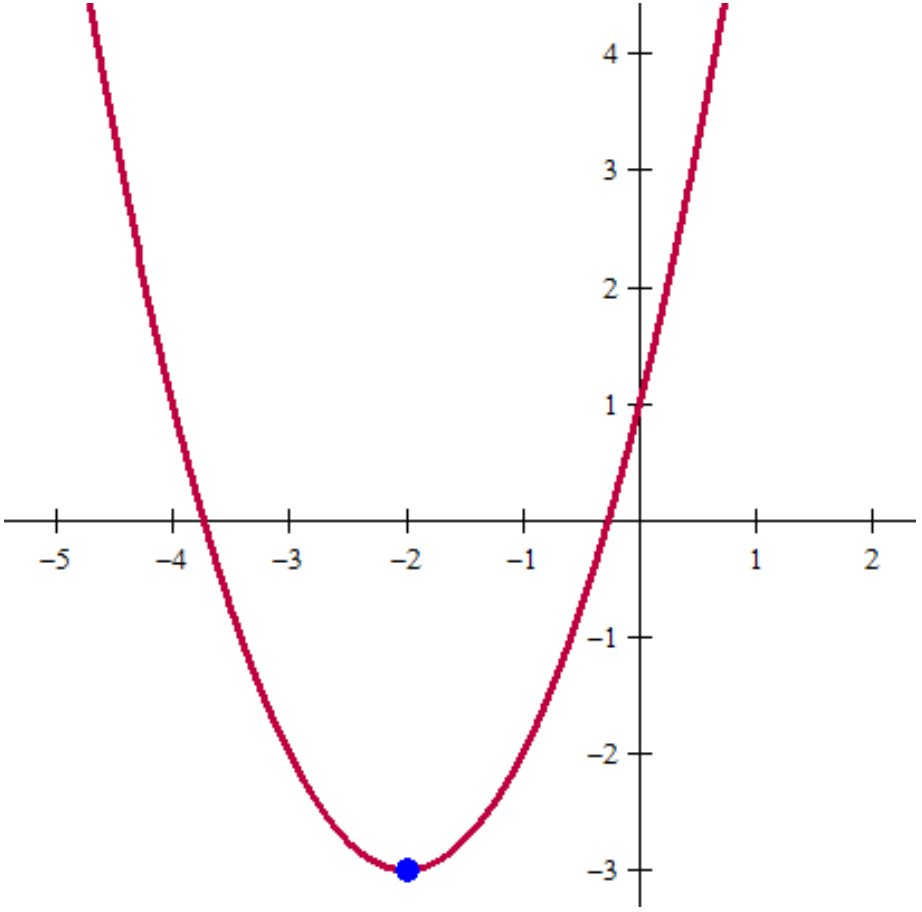
If “a” is negative…

- The graph opens downward
- The vertex is the absolute and relative maximum



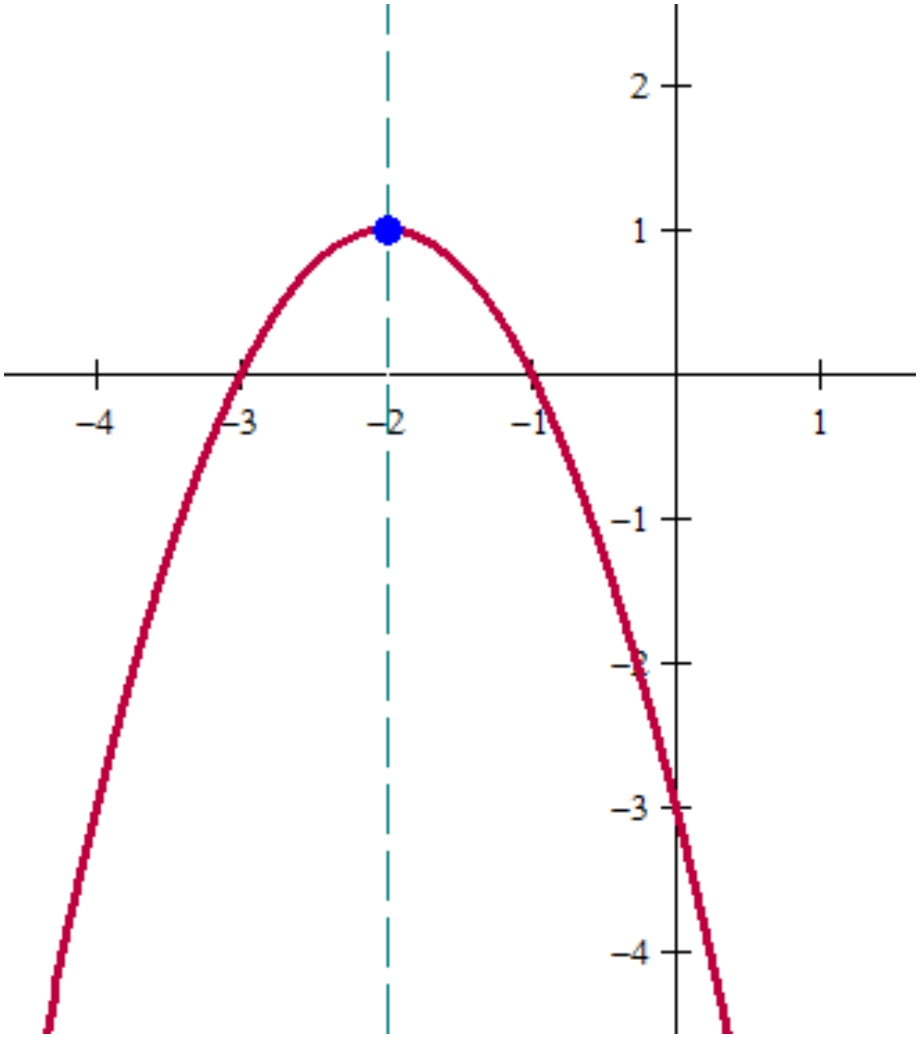
Graph the equation $y = (x + 2)^2 - 3$

The vertex is (-2, -3)

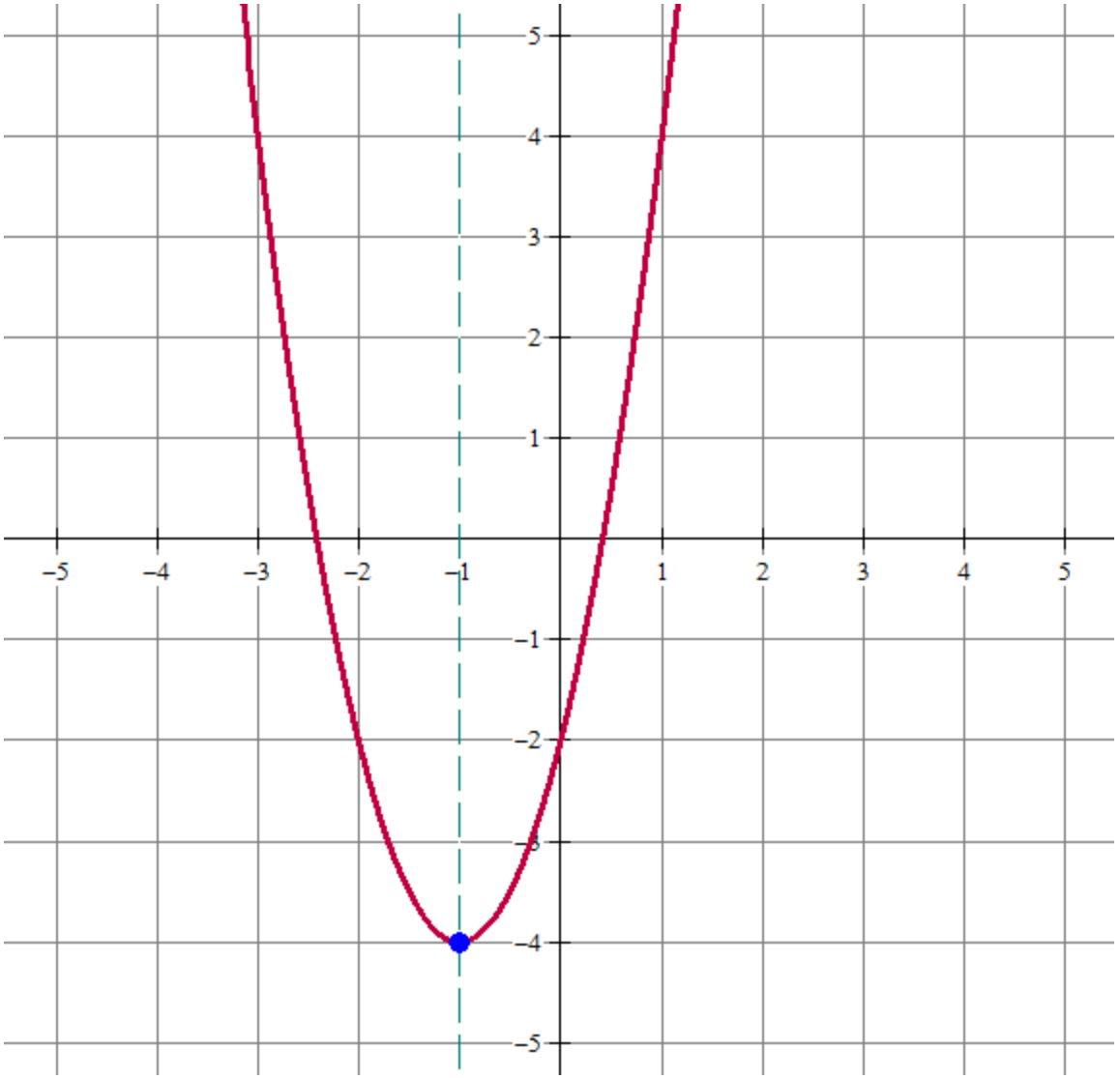


Write the equation of the parabola in vertex form.

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



Graph the equation $y = 2(x + 1)^2 - 4$



Example) Write the vertex form of the equation given the following points:

Vertex: (-3, 5) Other points: (-1, 13), (0, 23)

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

$$f(x) = a(x+3)^2+5$$ Sub. the vertex into h and k

$$13 = a(-1+3)^2+5$$ Sub. the x and y values from one point in for x and y

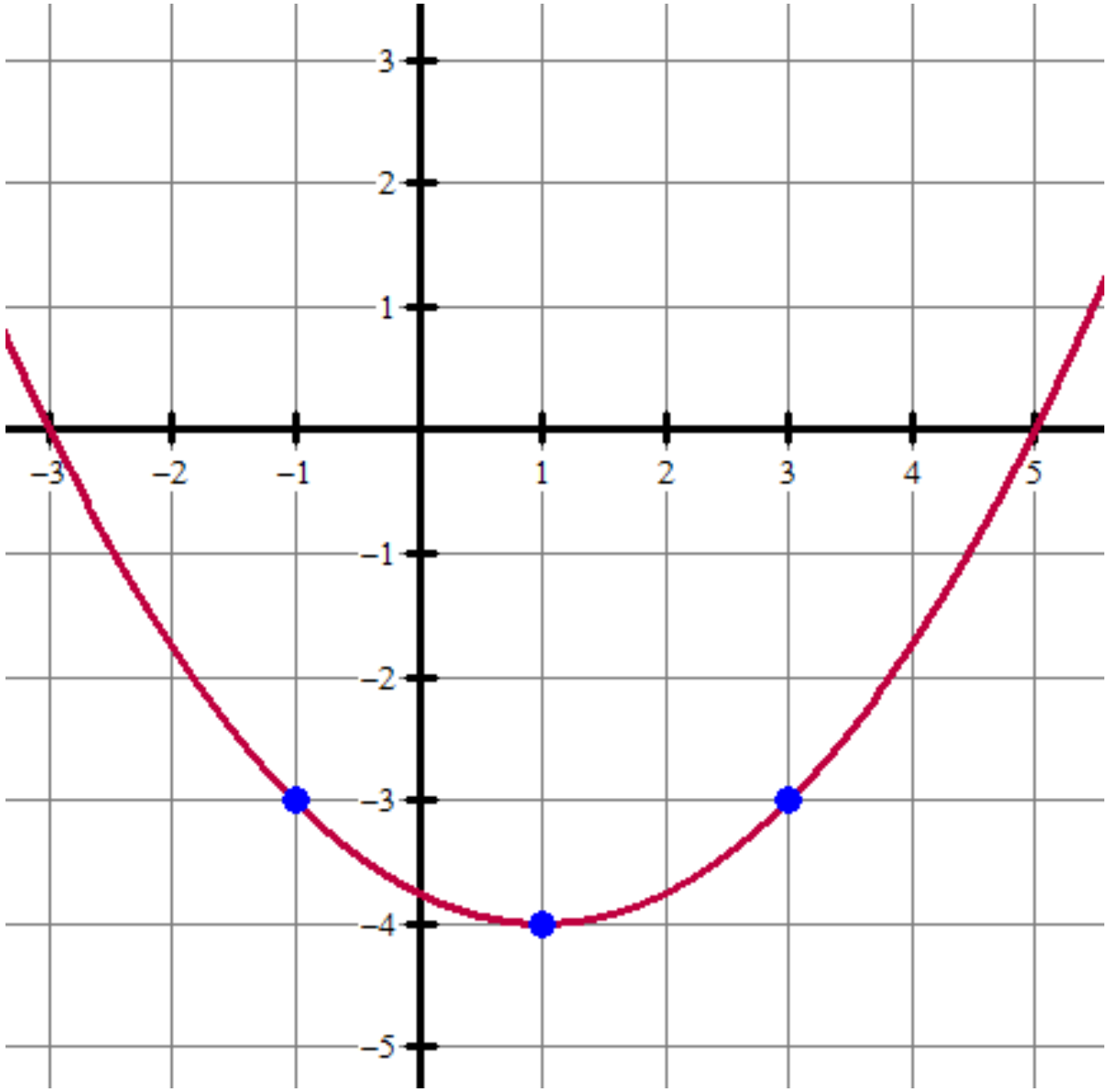
$$13 = 4a + 5$$ Solve for a: $(-1+3)^2 = 4$

$$8 = 4a$$ Solve for a: subtract 5

$$2 = a$$ Solve for a: divide by 4

$$f(x) = 2(x+3)^2+5$$ Sub a, h, and k for final answer

Write the equation of the parabola in vertex form.



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

$$f(x) = a(x-1)^2-4$$ Sub. the vertex into h and k

$$-3 = a(3-1)^2 - 4$$ Sub. the x and y values from one point in for x and y

$$-3 = 4a - 4$$ Solve for a: $(3 – 1)^2 = 4$

$$1 = 4a$$ Solve for a: add 4

$$\frac{1}{4} = a$$ Solve for a: divide by 4

$$f(x) = \frac{1}{4}(x-1)^2-4$$ Sub a, h, and k for final answer

Example) Write the vertex form of the equation given the following table.

x	f(x)
-2	-3
1	1
4	-3

The point (1, 1) is the vertex. Because f(-2) = f(4), the axis of symmetry has to be in the middle of them.

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

$$f(x) = a(x-1)^2+1$$ Sub. the vertex into h and k

$$-3 = a(4-1)^2+1$$ Sub. the x and y values from one point in for x and y

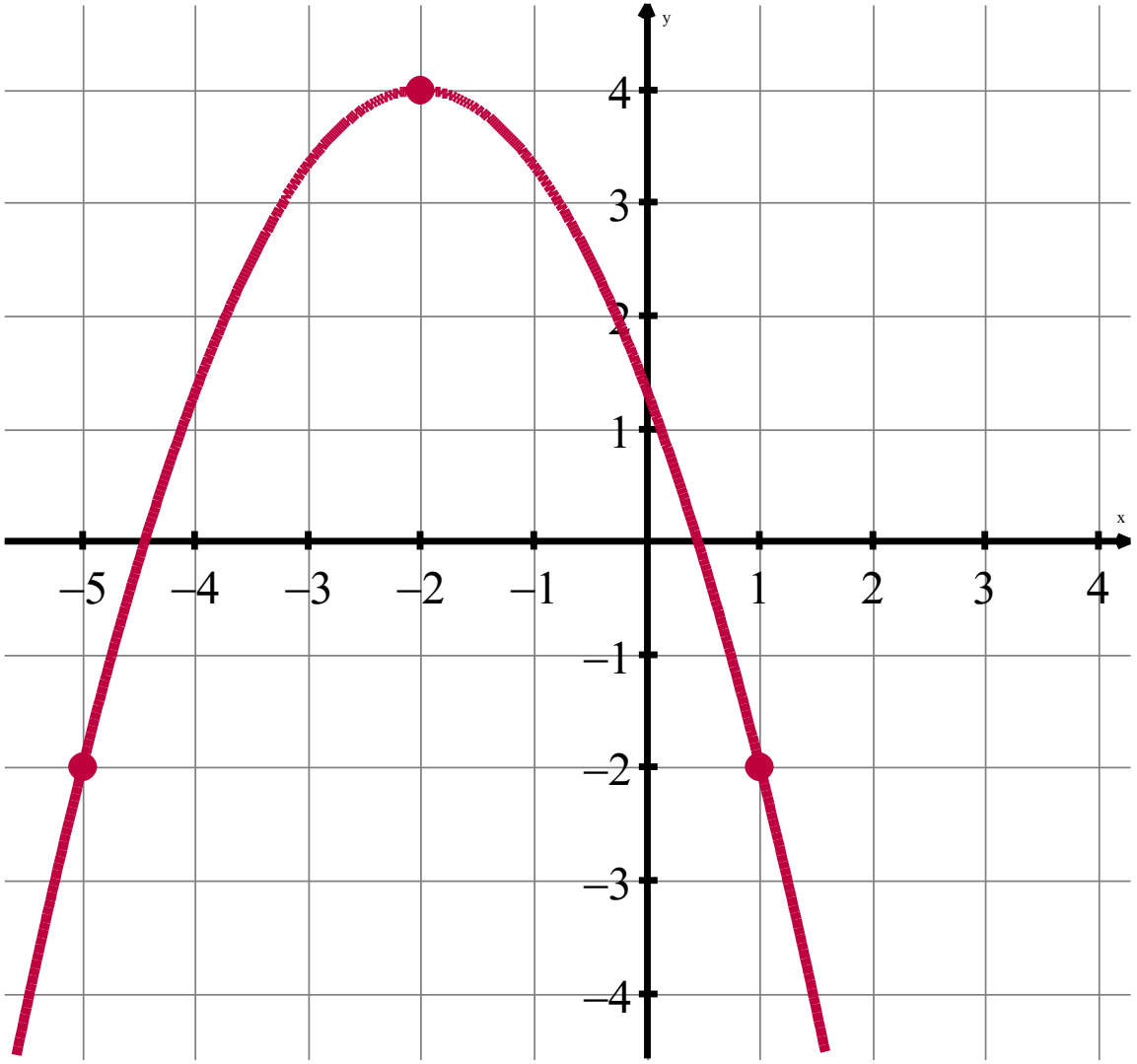
$$-3 = 9a+1$$ Solve for a: $(4-1)^2 = 9$

$$-4 = 9a$$ Solve for a: subtract 1

$$\frac{-4}{9} = a$$ Solve for a: divide by 9

$$f(x) = \frac{-4}{9}(x-1)^2+1$$ Sub a, h, and k for final answer

Write the equation of the parabola in vertex form.



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

$$f(x) = a(x+2)^2+4$$ Sub. the vertex into h and k

$$-2 = a(1+2)^2+4$$ Sub. the x and y values from one point in for x and y

$$-2 = 9a+4$$ Solve for a: $(1+2)^2 = 9$

$$-6 = 9a$$ Solve for a: subtract 4

$$\frac{-2}{3} = a$$ Solve for a: divide by 9

$$f(x) = \frac{-2}{3}(x+2)^2+4$$ Sub a, h, and k for final answer