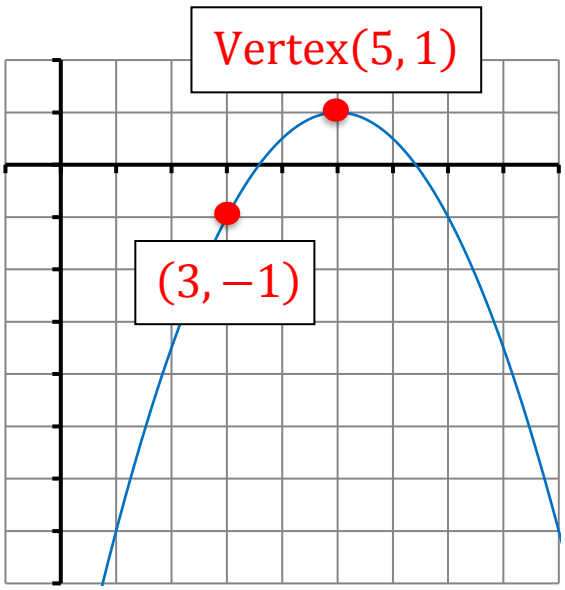
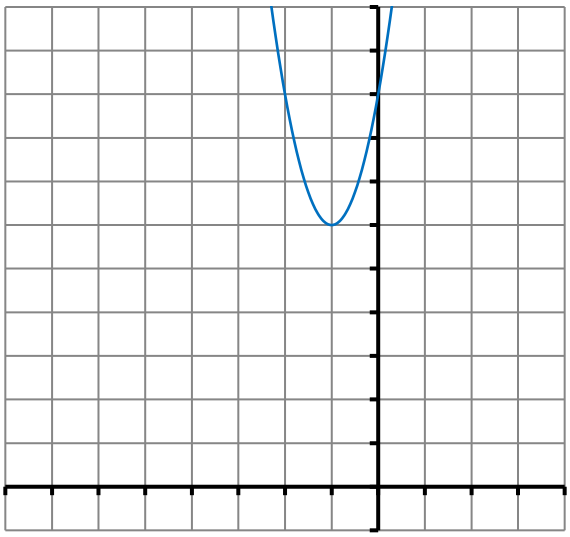
To find the expression that represents a quadratic function based on the graph of a parabola, we need to follow the same procedure that was used to find a quadratic function algebraically. That is, plug the vertex into the standard form of a quadratic function, then use any other point that the parabola passes through to determine the leading coefficient a. So using the graph of a parabola, we need to identify the vertex of the graph first, and then identify any other point the parabola passes through.

<u>Example 1:</u> Find the standard form $f(x) = a(x-h)^2 + k$ of the quadratic function that represents each of the following parabolas.

a.



b.



Vertex: $(5, 1)$

$f(x) = a(x-5)^2 + 1$

I will use the point $(3, -1)$
to find the value of a.

$-1 = a(3-5)^2 + 1$

$-2 = a(4)$

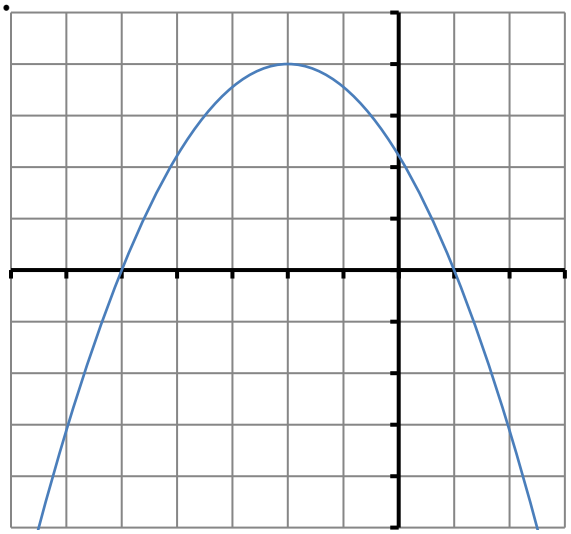
$-\frac{1}{2} = a$

$\boldsymbol{f(x) = -\frac{1}{2}(x-5)^2 + 1}$

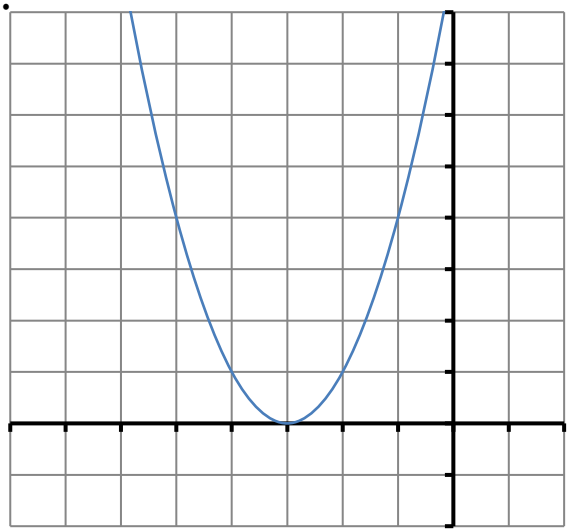
When determining the value of the leading coefficient a, be sure that it is consistent with the orientation of the parabola (opening up or opening down). A parabola that opens up (its vertex lies at the bottom of the parabola) should have a positive leading coefficient ($a > 0$). A parabola that opens down (its vertex lies at the top of the parabola) should have a negative leading coefficient ($a < 0$).

<u>Example 2:</u> Find the standard form $f(x) = a(x-h)^2 + k$ of the quadratic function that represents each of the following parabolas.

a.



b.



$$f(x) = a\big(x - (-3)\big)^2 + 0$$

$$f(x) = a(x+3)^2$$

I will use the point $(-2,1)$ to find the value of a.

$$1 = a(-2+3)^2$$

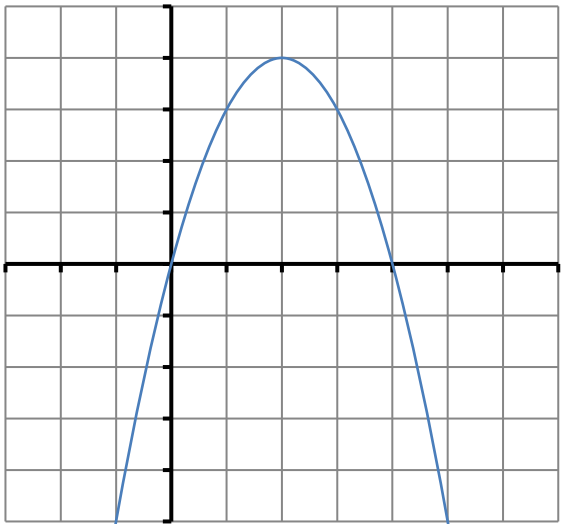
$$1 = a(1)$$

$$1 = a$$

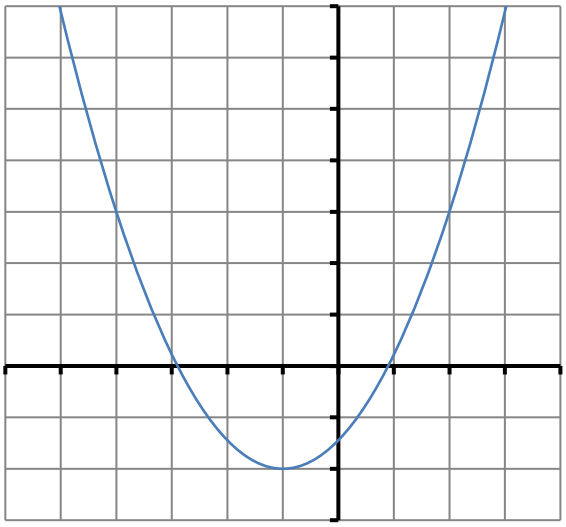
$$\boldsymbol{f(x) = (x+3)^2}$$

<u>Example 3:</u> Find the standard form $f(x) = a(x-h)^2 + k$ of the quadratic function that represents each of the following parabolas.

a.



b.



$f(x) = a(x-2)^2 + 4$

I will use the point (1,3)
to find the value of a.

$3 = a(1-2)^2 + 4$

$-1 = a(1)$

$-1 = a$

$\boldsymbol{f(x) = -(x-2)^2 + 4}$

Answers to Examples:

1a. $f(x) = -\frac{1}{2}(x-5)^2 + 1$; *1b.* $f(x) = 3(x+1)^2 + 6$;

2a. $f(x) = -\frac{4}{9}(x+2)^2 + 4$; *2b.* $f(x) = (x+3)^2$;

3a. $f(x) = -(x-2)^2 + 4$; *3b.* $f(x) = \frac{5}{9}(x+1)^2 - 2$;