

Standard Form Of A Quadratic Function

- We have seen that Transformational Form has many advantages. It allows us to graph a function and identify key components from the equation itself, such as the vertex (h, k) , and the axis of symmetry $(x = h)$. There is another form known as the **Standard Form (SF)** of a function:

STANDARD FORM

$$y = a(x - h)^2 + k, \text{ where } a \neq 0$$

- Like Transformational Form, the vertex is (h, k) and the axis of symmetry is $x = h$. We can get the Standard Form of a function from its Transformational Form by solving for the variable y .
- Example 1:

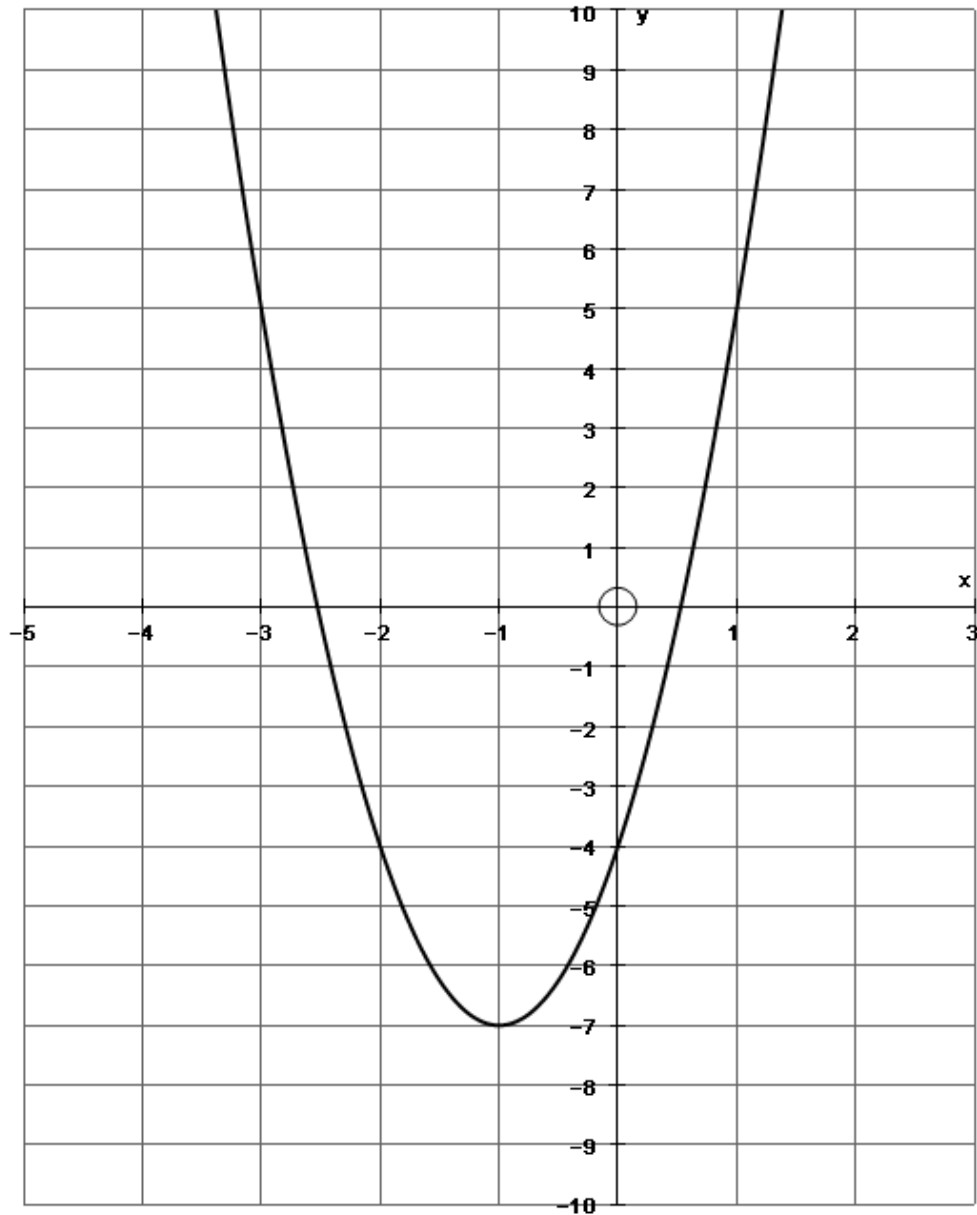
Identify the axis of symmetry and vertex of $\frac{1}{3}(y - 7) = (x + 5)^2$.

Solution:

The axis of symmetry is of the form $x = h$. Therefore, the axis of symmetry is $x = -5$.

Since the Standard Form of a function $y = a(x - h)^2 + k$ has the vertex located at (h, k) , then the function $\frac{1}{3}(y - 7) = (x + 5)^2$ has its vertex located at $(-5, 7)$.

- Example 2:
Use the graph of the function $y = 3(x + 1)^2 - 7$ to answer the following questions.



- (a.) Use the graph to identify the vertex.
The vertex is $(-1, -7)$.
- (b.) How could you get the vertex from the equation?
The x-value of the vertex is the same as the value of h in the equation and the y-value of the vertex is the same as the value of k in the equation.

- (c.) Use the graph to identify the axis of symmetry.
The axis of symmetry is $x = -1$.
- (d.) How could you get the axis of symmetry from the equation?
The x-value for the axis of symmetry is the same as the value of h in the equation.
- (e.) Use the graph to identify the y-intercept.
The y-intercept is $(0, -4)$.
- (f.) How could you get the y-intercept from the equation?
We could get the y-intercept from the equation by letting $x = 0$ and then solving for the value of y.
- (g.) Use the graph to identify the vertical stretch.
We can use the “slope” method. If we go over 1 horizontally along the x-axis, we would then go up 3 vertically until we intersected the graph. In our base $y = x^2$ graph, we would go over 1 horizontally and then go up 1 vertically until we intersected the graph. We have now tripled the vertical distance that we need to move, so our vertical stretch must be 3.
- (h.) How could you get the vertical stretch from the equation?
When using Standard Form, where our equation is of the form $y = a(x - h)^2 + k$, the vertical stretch is the absolute value of the variable a.

Summary

Standard Form: $y = a(x - h)^2 + k$, where $a \neq 0$

- $a > 0$ will produce a parabola that opens upward.
- $a < 0$ will produce a parabola that opens downward.
- The axis of symmetry is $x = h$.
- The vertex is (h, k) .
- The y-intercept is found by letting $x = 0$ and solving for y.
- The Range of the parabola is $\{y \mid y \geq k\}$ if $a > 0$, and $\{y \mid y \leq k\}$ if $a < 0$.
- The vertical stretch factor is $|a|$.