QUADRATIC EQUATIONS IN VERTEX FORM

Any quadratic equation can be expressed in the form $\mathbf{y = a(x-h)^2+k}$. This is called the vertex form of a quadratic equation. The graph of a quadratic equation forms a parabola. The width, direction, and vertex of the parabola can all be found from this equation.

The value of a

The value of **a** tells us if the parabola opens upward or downward. If a is positive the parabola opens upward. If **a** is negative the parabola opens downward. The value of **a** also indicates the width of a parabola. When we talk about how wide or narrow a parabola is, we are comparing the parabola to the parent quadratic function of $\mathbf{y = x^2}$, which has a standard width of $\mathbf{a=1}$. The smaller the absolute value of **a**, the wider the parabola will be. Use your calculator to graph the parent function, $y = x^2$. Then, graph the following four quadratic equations on your calculator and compare their widths to the standard width of the parent graph.

1. $y = 2x^2$ Twice as wide or twice as narrow? _____
2. $y = 1/3x^2$ 3 times wider or 3 times narrower? _____
3. $y = -5x^2$ 5 times wider or 5 times narrower? _____
4. $y = 1/4x^2$ 4 times wider or 4 times narrower? _____

The value of h and k

The values of **h** and **k** in the vertex form of a quadratic equation tell us the vertex of the parabola. The value of **h** tells us the x-value of the vertex. The value of **k** tells us the y-value of the vertex. Graph the following four equations on your calculator and find the vertex of each parabola.

1. $y = 2(x - 4)^2 + 3$ vertex_____

2. $y = -1/2(x + 2)^2 + 1$ vertex_____

3. $y = -3(x - 1)^2 - 2$ vertex_____

4. $y = -1/4(x + 3)^2 - 5$ vertex_____

Checking for Understanding

We have now looked at how to determine the direction, width, and vertex of a parabola by looking at the vertex form of its quadratic equation. So, without using your calculator, give some information about each of the following equations compared to the parent function.

1. $y = 2(x - 3)^2 - 8$ Wider or narrower?_____

   Upward or downward?_____ Vertex_____

2. $y = -1/3(x + 1)^2 - 1$ Wider or narrower?_____

   Upward or downward?_____ Vertex_____

3. $y = -4(x - 2)^2 + 5$ Wider or narrower?_____

   Upward or downward?_____ Vertex_____