Graphing Quadratics in Vertex Form

Quadratic functions can be written in different forms. One such form is called "*vertex form*" and the reason it is called *vertex form* is because you can easily find the vertex of the equation and the axis of symmetry equation.

VERTEX FORM: $y = a(x - h)^2 + k$

Now, what do all of these variables mean:

The "a"

If the "a" is negative, then the parabola opens _down_

If the "a" is positive, then parabola opens _up_

The "h"

The "h" is the _x-value_ of the vertex and therefore the axis of symmetry equation is x = _h_. *This gives us the vertical line of symmetry for the parabola.*

> * Notice that there is a negative in the model, so the "h" we use is always _opposite_ to what you see in the equation.

The "k"

The "k" is the _y-value_ of the vertex.

Characteristics

- Domain is always: _all real numbers_
- If "a" is positive, then the graph opens _up_ and the range is $y \geq$ _k_
- If "a" is negative, then the graph opens _down_ and the range is $y \leq$ _k_

Examples:

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

a = _1_

h = _1_

k = _2_

Therefore:

It opens _up_ and its vertex is

(_1_, _2_)

Axis of symmetry: _x = 1_

Domain is _all real numbers_

Range is _y ≥ 2_

$y = -3(x + 4)^2 - 5$

a = _-3_

h = _-4_

k = _-5_

Therefore:

It opens _down_ and its vertex is

(_-4_, _-5_)

Axis of symmetry: _x = -4_

Domain is _all real numbers_

Range is _y ≤ -5_

Try some on your own:

a. $y = -(x-3)^2 - 3$
   Opens: down
   Vertex: (3 , -3)
   Axis of symmetry: x = 3
   Domain: all real numbers
   Range: y ≤ -3

c. $y = -4(x-8)^2$
   Opens: down
   Vertex: (8 , 0)
   Axis of symmetry: x = 8
   Domain: all real numbers
   Range: y ≤ 0

b. $y = \frac{2}{3}(x+2)^2 + 10$
   Opens: up
   Vertex: (-2 , 10)
   Axis of symmetry: x = -2
   Domain: all real numbers
   Range: y ≥ 10

d. $y = 2x^2 - 5$
   Opens: up
   Vertex: (0 , -5)
   Axis of symmetry: x = 0
   Domain: all real numbers
   Range: y ≥ -5

To graph equations in *vertex form*, you will be asked to graph the vertex and two other points in order to graph the parabola.

<u>Steps to Graphing Vertex Form</u>

1. Find the vertex (h, k) and plot
2. Pick a value for x other than the x of the vertex and plug it in for x to find the corresponding y and plot. (HINT: You should pick zero or a value 1 or 2 above or below the x of the vertex)
3. Plot the symmetrical point to the point you found across the axis of symmetry.
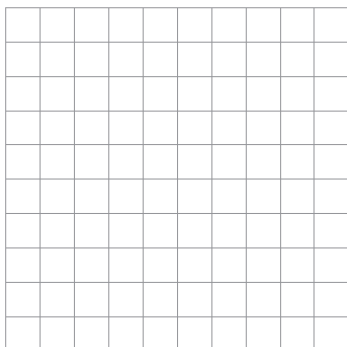4. Draw parabola.

<u>Examples:</u>

$y = (x-4)^2 - 3$

Opens: up
Vertex: (4 , -3)
Axis of symmetry: x = 4
Domain: all real numbers
Range: y ≥ -3

$y = -2(x+1)^2 + 5$

Opens: down
Vertex: (-1 , 5)
Axis of symmetry: x = -1
Domain: all real numbers
Range: y ≤ 5