Properties of Quadratic Functions

Parabola: The term describing the U-shape of a quadratic function.

Quadratic Function: A function (relating an input, x, and output, y) that contains an x^2. Can be written in the form $y = ax^2 + bx + c$.

Vertex: The maximum or minimum point of a parabola.

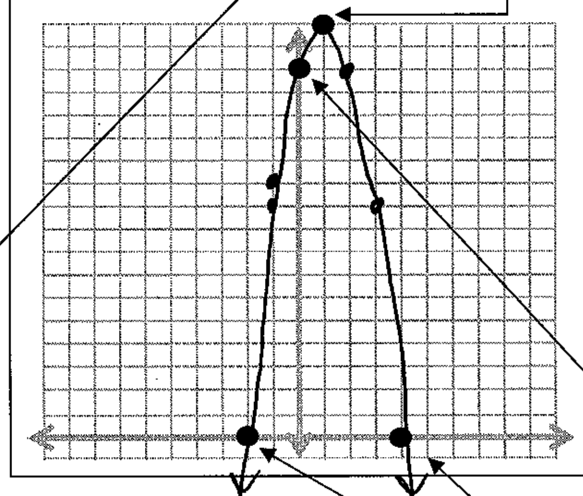
To find: Use the formula $x = \frac{-b}{2a}$ to find the x-coordinate. Plug this value back into the function to determine the y-coordinate.

Stretch or Compression: Whether the parabola is squashed or stretched vertically, as determined by the value of "a", compared to $y = 1x^2$

To find: Identify the value of a, ignoring the sign:

- If $|a| > 1$, the graph is stretched vertically .
- If $|a| < 1$, the graph is compressed vertically.

$f(x) = -2x^2 + 4x + 16$



Axis of Symmetry: The line around which the parabola is symmetric, written as x = #, because it is a vertical line.

To find: Use the formula $x = \frac{-b}{2a}$, same as the x-coordinate of the vertex.

Direction of Opening: Whether the parabola opens up or down, as determined by the value of "a"

To find: Identify the value of a:

- If "a" is positive, the parabola opens up.
- If "a" is negative, the parabola opens down.

$x = \frac{-4}{2(-2)}$

$x = \frac{-4}{-4} = 1$

x	y
-1	10
0	16
1	18
2	16
3	10

y-intercept: Where the graph crosses the y-axis, or the value of y when x is 0. Also the "c" value in $y = ax^2 + bx + c$.

To find: Plug 0 in for x and solve for y.

How to graph Quadratic Functions:

1. Identify the value of a, b, and c.
2. Calculate and x and y coordinates of the vertex.
3. Make a table of at least 5 input and output values, with the vertex in the middle
4. Plug in 2 x values less than the vertex and 2 values greater than the vertex. Plot points.

x-intercept: Where the graph crosses the x-axis, or the value of x when y is 0. These are also the solutions to the equation $0 = ax^2 + bx + c$.

To find: Plug 0 in for y and solve for x by factoring, taking square roots, or the quadratic formula.

Practice: Determine the direction of opening, y-intercepts, vertex, and x-intercepts for each function. Complete the table with the vertex and four other points. You will likely need to factor to find the x-intercepts. Show all work for finding the vertex and x-int!

1. $f(x) = x^2 + 2x - 8$

x	y
-3	-5
-2	-8
-1	-9
0	-8
1	-5

$x = \frac{-2}{2(1)} = -1$

$0 = x^2 + 2x - 8$

$0 = (x+4)(x-2)$

$x = -4 \quad x = 2$

Direction: Up

y-int: (0, -8)

Vertex: (-1, -9)

x-int: (-4,0)(2,0)

2. $f(x) = 4x^2 + 32x$

$x = \frac{-32}{2(4)} = \frac{-32}{8} = -4$

x	y
-6	-48
-5	-60
-4	-64
-3	-60
-2	-48

$0 = 4x^2 + 32x$

$0 = 4x(x+8)$

$x = 0 \quad x = -8$

Direction: Up

y-int: (0, 0)

Vertex: (-4, -64)

x-int: (0,0)(-8,0)

3. $f(x) = -2x^2 - x + 10$

$x = \frac{1}{2(-2)} = -.25$

x	y
-2	4
-1	9
$-\frac{1}{4}$	10.125
0	10
1	7

$0 = -2x^2 - x + 10$

$0 = -1(2x + x - 10)$

$0 = -1(2x+5)(x-2)$

$x = -\frac{5}{2} \quad x = 2$

Direction: Down

y-int: (0, 10)

Vertex: (-.25, 16.125)

x-int: $(-\frac{5}{2}, 0)(2, 0)$

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

$x = \frac{-2}{2(-5)} = .2$

x	y
-1	-4
0	3
.2	3.2
1	0
2	-13

$0 = -5x^2 + 2x + 3$

$0 = -1(5x^2 - 2x - 3)$

$0 = -1(5x+3)(x-1)$

$x = -\frac{3}{5} \quad x = 1$

Direction: Down

y-int: (0, 3)

Vertex: (.2, 3.3)

x-int: $(-\frac{3}{5}, 0)(1, 0)$