

Understanding Quadratic Functions Algebraically

need to understand how to find the different parts of the parabola if we did not have the graph to refer to. Again we will need to identify if the parabola is **concave up** or **concave down**, if the parabola will have a **minimum** or a **maximum** point, the **axis of symmetry**, the **roots** and the **vertex**.

All quadratic equations can be written in the form:

$$y = ax^2 + bx + c$$

We can use this general form to identify the coefficients **a**, **b**, and **c**. Given the two quadratic functions below find the values for **a**, **b**, and **c**.

$$y = x^2 + 6x - 7$$

$$a = 1$$

$$b = 6$$

$$c = -7$$

$$y = -4x^2 + 8x + 12$$

$$a = -4$$

$$b = 8$$

$$c = 12$$

To help us locate the axis of symmetry, we can use the formula:

$$x = \frac{-b}{2a}$$

Find the Axis of Symmetry for the two quadratics above.

$$y = x^2 + 6x - 7$$

$$x = \frac{-6}{2(1)}$$

$$x = -3$$

$$y = -4x^2 + 8x + 12$$

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

$$x = 1$$

We should also note that the **Axis of Symmetry passes through the Vertex**. So to find the coordinate of the vertex we simply plug in the value for the axis of symmetry for x and solve for y .

$$y = x^2 + 6x - 7$$

$$y = (-3)^2 + 6(-3) - 7$$

$$y = 9 - 18 - 7$$

$$y = -16$$

$$(-3, -16)$$

$$y = -4x^2 + 8x + 12$$

$$y = -4(1)^2 + 8(1) + 12$$

$$y = -4 + 8 + 12$$

$$y = 16$$

$$(1, 16)$$

Let's Try One from Top to Bottom

1. For the function $y = x^2 + 8x - 20$ and *without* the use of a graph, determine the following:

Concavity

Up

or

Down

Minimum

or

Maximum

Axis of Symmetry

$$x = \frac{-b}{2a}$$

$$x = \frac{-8}{2(1)}$$

$$x = -4$$

Vertex

$$y = (-4)^2 + 8(-4) - 20$$

$$y = 16 - 32 - 20$$

$$y = -36$$

$$(-4, -36)$$

Roots

$$0 = x^2 + 8x - 20$$

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

$$x - 2 = 0$$

$$x = 2$$

$$x + 10 = 0$$

$$x = -10$$

1, 20

2, 10

4, 5

Nonetheless, you **absolutely** should use the graphing calculator to check your above values. If the question does not specify, then you may use any method. Especially for multiple choice, use the method you like best.

1. What is the axis of symmetry of $y = x^2 - 2x + 1$?

(a) $x = -2$

(b) $x = -1$

(c) $x = 0$

(d) $x = 1$

2. Which of the following is the vertex (turning point) of $y = -x^2 + 8x - 5$?

(a) $(7, 2)$

(b) $(4, 11)$

(c) $(0, -5)$

(d) $(-5, 0)$

3. The greater solution of the equation $x^2 + 7x + 10 = 0$ is

$$(x + 2)(x + 5) = 0$$
$$x = -2 \quad x = -5$$

(a) -2

(b) 2

(c) -5

(d) 5