

# Algebra 1

## Lesson 10.2

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

### Warm-Up

Evaluate each of the following for  $x = 2$ .

(a)  $y = 3x + 5$

$$y = 3(2) + 5 = 11$$

$$y = 11$$

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

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

$$y = 4 - 6 + 5 = 3$$

(b)  $y = \frac{12}{2x}$

$$y = \frac{12}{2(2)} = \frac{12}{4} = 3$$

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

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

$$y = -8 + 10 - 1 = 1$$

### Quadratic Functions

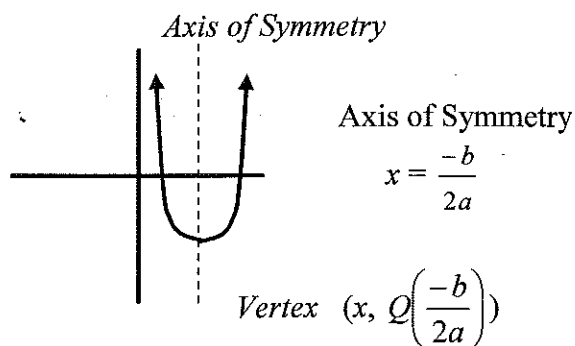
A second degree polynomial function is called **quadratic**

$$Q(x) = ax^2 + bx + c$$

The graph of a quadratic function is a **parabola**.

If  $a > 0$ , the parabola is concave up

If  $a < 0$ , the parabola is concave down



### Example 1. Finding the Axis of Symmetry and Vertex

Consider the function  $y = 3x^2 + 12x - 8$

$$a = 3 \quad b = 12 \quad c = -8$$

(a) Use the formula  $x = -\frac{b}{2a}$  to find the axis of symmetry

$$x = -\frac{12}{2(3)} = -\frac{12}{6} = -2$$

$$x = -2$$

(b) Find the vertex of the function and write it as an ordered pair.

$$(-2, -20)$$

$$y = 3(-2)^2 + 12(-2) - 8$$
$$y = 12 - 24 - 8 = -20$$

### Example 2. Finding the Axis of Symmetry and Vertex

Consider the function  $y = x^2 - 2x - 3$

$$a = 1 \quad b = -2 \quad c = -3$$

(a) Use the formula  $x = -\frac{b}{2a}$  to find the axis of symmetry

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

$$x = 1$$

(b) Find the vertex of the function and write it as an ordered pair.

$$(1, -4)$$

$$y = (1)^2 - 2(1) - 3$$
$$y = 1 - 2 - 3 = -4$$

**Example 3. Graphing  $y = ax^2 + bx + c$**

Consider the function  $y = 2x^2 - 8x + 7$

$a = 2$   
 $b = -8$   
 $c = 7$

$(0, c)$  will be on every parabola

(a) Determine whether the parabola will open up or open down.

OPENS UP B/c  $a > 0$

(b) Find and sketch the axis of symmetry.

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

(c) Find and plot the vertex. Is the vertex a minimum or a maximum?

$(2, -1)$   
 $y = 2(2)^2 - 8(2) + 7$   
 $y = 8 - 16 + 7 = -1$

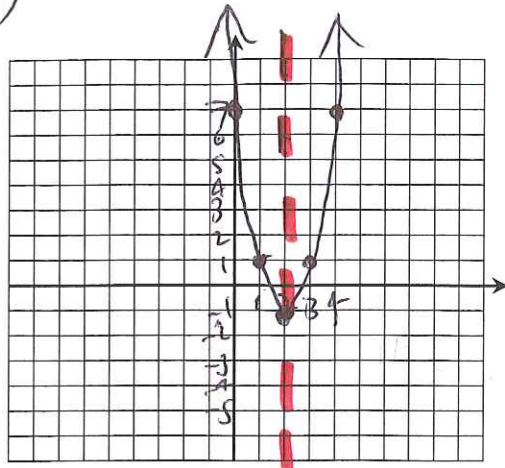
MINIMUM

(d) Make a table of values to plot additional points.

x	0	1	2	3	4
y	7	1	-1	1	7

$y = 2(1)^2 - 8(1) + 7$   
 $y = 2 - 8 + 7 = 1$

(e) Draw a smooth curve to connect all points.



**Example 4. Graphing  $y = ax^2 + bx + c$**

Consider the function  $y = -3x^2 + 12x - 1$

$a = -3$   
 $b = 12$   
 $c = -1$

$(0, -1)$

(a) Determine whether the parabola will open up or open down.

OPENS DOWN B/c  $a < 0$

(b) Find and sketch the axis of symmetry.

$x = \frac{-(12)}{2(-3)} = \frac{-12}{-6} = 2$   $x = 2$

(c) Find and plot the vertex. Is the vertex a minimum or a maximum?

$(2, 11)$   
 $y = -3(2)^2 + 12(2) - 1$   
 $y = -12 + 24 - 1 = 11$

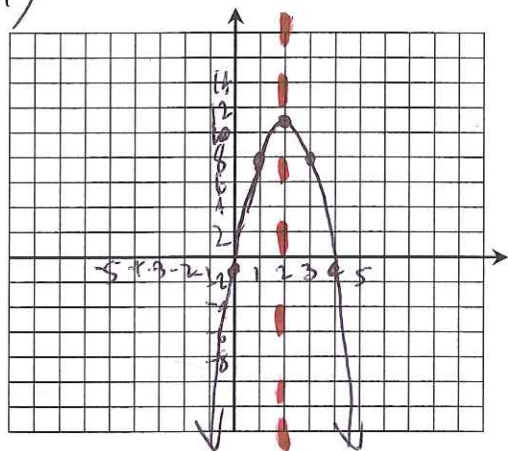
(d) Make a table of values to plot additional points.

x	0	1	2	3	4
y	-1	8	11	8	-1

MAXIMUM

(e) Draw a smooth curve to connect all points.

$y = -3(1)^2 + 12(1) - 1$   
 $y = -3 + 12 - 1 = 8$



**Assignment**

New: Pgs. 638 - 639 #4-20 (evens)

**Review:**

Solve.

1.  $x^2 - 6x - 16 = 0$

2.  $3(2x - 4) = 12$

3.  $x^2 = 6x$

4.  $4 - 2x < -6$