Lesson and Enrichment
Objective: 4.02 Finding the axis of symmetry and vertex of a parabola

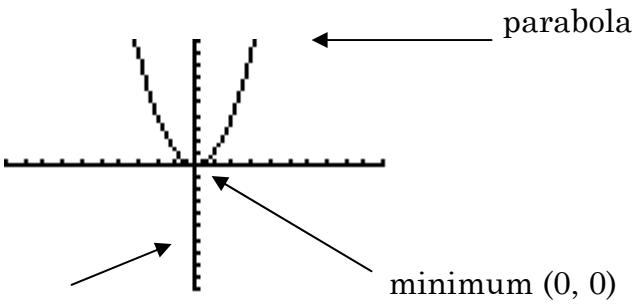
The line that divides a parabola into two matching halves is called the axis of symmetry.
The graph of $y = ax^2 + bx + c$ has an axis of symmetry at $x = \frac{-b}{2a}$

The highest (maximum) or lowest (minimum) point of a parabola is the vertex. Since the vertex is on the axis of symmetry, the x value of the coordinate can be used to find the equation of the axis of symmetry.

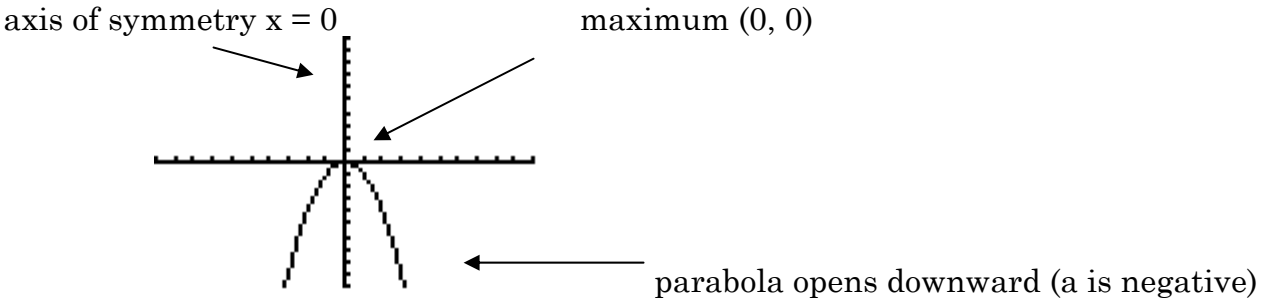
If $a > 0$ in $y = ax^2 + bx + c$: The parabola opens upward and there is a minimum.
If $a < 0$ in $y = ax^2 + bx + c$: The parabola opens downward and there is a maximum.

For example:

$y = x^2$



$y = -x^2$



Example:
Determine which way the parabola will open and tell whether there is a maximum or minimum. Then find the equation of the axis of symmetry and the vertex.

a. $y = x^2 + 4x + 3$

*The parabola opens upward.
*There is a minimum
*Axis of symmetry:
$x = \frac{-b}{2a}$ $x = \frac{-4}{2(1)}$ $x = -2$
*Vertex:
Substitute –2 for x in the given equation to find the y-coordinate of the vertex.
$y = (-2)^2 + 4(-2) + 3$
$y = -1$
(-2, -1) is the vertex.

b. $y = -\frac{1}{4}x^2 + 2x - 3$

*The parabola will open downward
*There is a maximum
*Axis of symmetry:
$x = \frac{-2}{2\left(-\frac{1}{4}\right)} = 4$
*Vertex:
$y = -\frac{1}{4}(4)^2 + 2(4) - 3$
$y = 1$
(4, 1) is the vertex

You try:

Determine which way the parabola will open and tell whether there is a maximum or minimum. Then find the equation of the axis of symmetry and the vertex.

1. $y = x^2 - 8x - 9$
2. $y = -x^2 + 4x - 4$

Answers:
1. Opens upward, minimum, x = 4 ,(4, -25)
2. Opens downward, maximum, x = 2, (2, 0)

Discovery: Make up four equations of a parabola and sketch each one. Use your graphing calculator to help you. In each example change the "a" value. You should use integers as well as fractions. Compare the graphs. How does the "a" change the appearance of the graph?

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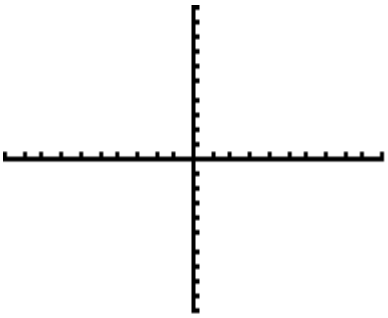
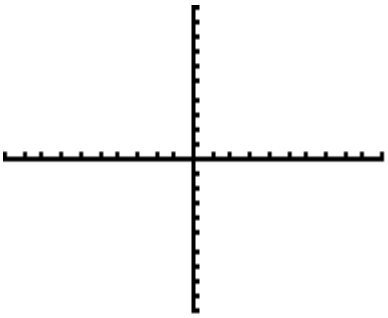
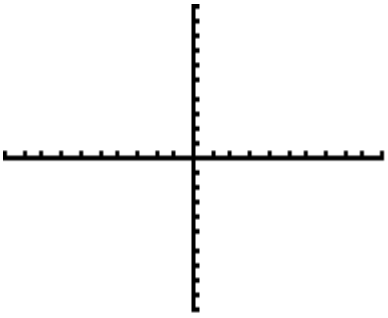


2._____



3._____



4._____