Name________________________________

Algebra 2

Lesson 5-2

Properties of Parabolas

We learned last section that the standard form for a quadratic equation is: $\boldsymbol{y = ax^2 + bx + c}$. From this form we can learn several things about the look of the parabola formed by this equation.

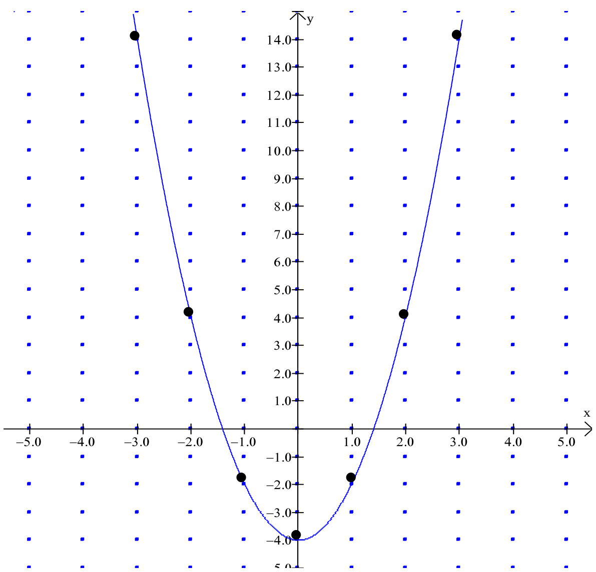
1. When b=0, the function is: $y = ax^2 + c$. When graphed, the parabola will be symmetric around the y-axis. Therefore, the **axis of symmetry is:** $\boldsymbol{x = 0}$, and the **vertex of the graph is the y-intercept, (0,c).**
2. If a>0 the parabola will open upward. a<0, open downward.
3. The larger **a,** the narrower the parabola. The smaller **a,** the wider the parabola.

To graph a quadratic equation in the form $\boldsymbol{y = ax^2 + c}$**:**

1. the vertex is at (0,c)
2. The sign of **"a"** tells us it opens up **(+)** or down **(-).**
3. Pick at least 3 points on one side of the vertex, solve for y and then find the **corresponding** points using symmetry to graph the other side.

Example: Graph the function $y = 2x^2 - 4$

1. vertex: (0,-4)
2. The **+ coefficient** for **a** tells us that the parabola opens upward



3. Chose integers that are close to the vertex; based on symmetry the corresponding **x-values** will as below, note the y-values will be equal

x	-3	-2	-1	0	1	2	3
y	14	4	-2	-4	-2	4	14

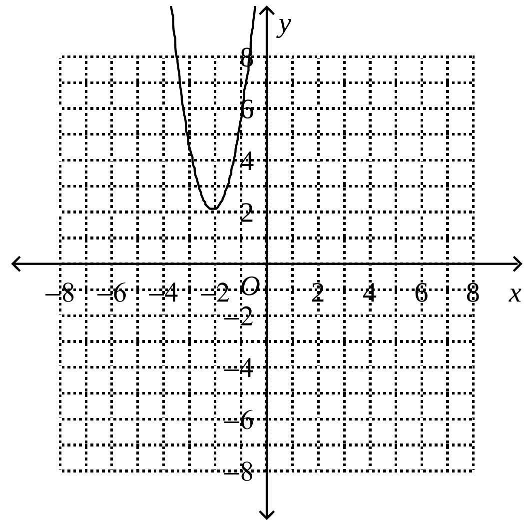
Well, what if the **equation is in standard form:** $\boldsymbol{y = ax^2 + bx + c}$?

1. The sign of the coefficient of **a** still tells us whether the parabola opens up **(+)** or down **(-).**
2. Axis of symmetry is now found from the coefficients of the equation, hence the axis is the line: $\boldsymbol{x = \frac{-b}{2a}}$
3. The vertex of the parabola is at the point: $\boldsymbol{x = \frac{-b}{2a},\ y = f\left(\frac{-b}{2a}\right)}$.
4. Now, the parabola may be translated along the x-axis. Therefore the **y-intercept** is at **(0,c)**.

Example: Graph the function: $y = 3x^2 + 12x + 14$.

1. a=3, so graph opens upward
2. Axis of symmetry: $x = \frac{-12}{2(3)} = -2$
3. Vertex is at: : $\boldsymbol{x = \frac{-12}{2(3)} = -2}$, $\boldsymbol{y = f\left(\frac{-12}{2(3)}\right) = f(-2) = 2}$
   Solve for y at x=2: $y = 3(-2)^2 + 12(-2) + 14 = 12 - 24 + 14 = 2\ or\ (-2,2)$.
4.

x	-5	-4	-3	-2	-1	0	1
y				2	5	14	29



Calculator Minimums and Maximum:

1. Hit **Y=** type in the quadratic equation. **Remember:** must be in the "y=" form.

2. **GRAPH** if the parabola is off the view screen: **WINDOW** adjust the minimum and maximum values for x and y. **GRAPH** and view the parabola.

3. **2nd TRACE** choose **3 minimum** if the parabola is opening up or choose **4 maximum** if the parabola is opening down. Question: **left bound?** Arrow over so that asterisk is flashing on the left side of the min or max **ENTER right bound?** Arrow over so that the asterisk is flashing on the right side of the min or max. **ENTER Guess? ENTER** the x and y values will be given at the bottom of the view screen.

1. Given the equation: $y = 8x^2 + 12x + 16$

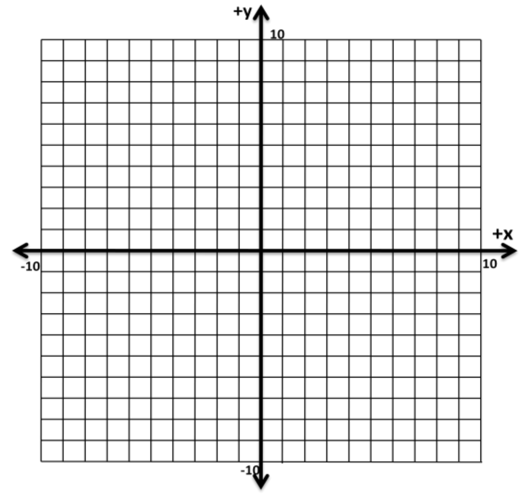
Does the parabola open up or down?

What is the axis of symmetry?

What are the coordinates for the vertex?

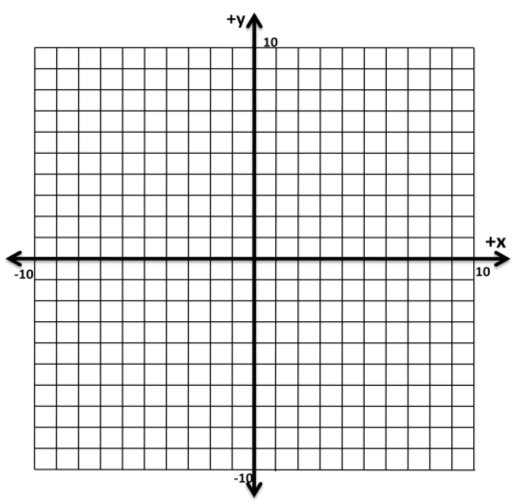
3. Graph the function $y = 3x^2 - 4x + 4$

Give the min/max value



2. Graph the function: $\mathbf{y = -2x^2 + 2x + 3}$

Give the min/max value



4. Find the function of $ax^2 + c$

Which contains the given points: (0,2), (3,2).