## Algebra 2

Lesson 5-2: Properties of Parabolas
Mrs. Snow, Instructor
PARABOLA STANDARD FORM:
$y=a x^{2}+b x+c$

1. When $\mathrm{b}=0$, the function is: $y=a x^{2}+c$. When graphed, the parabola will be symmetric around the $y$-axis. Therefore, the axis of symmetry is: $\boldsymbol{x}=\mathbf{0}$, and the vertex of the graph is the $\boldsymbol{y}$-intercept, $(0, \mathrm{c})$.
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.
4. Setting $x=0 \rightarrow y=c \quad \therefore \quad c$ is the $y$-intercept!

To graph a quadratic equation in the form $y=a x^{2}+c$ :

1. The vertex is at $(0, c)$. Note that this is also the $y$-intercept.
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.
Graph the function $y=2 x^{2}-4$

Well, what if the equation is in standard form: $\boldsymbol{y}=\boldsymbol{a} \boldsymbol{x}^{2}+\boldsymbol{b x}+\boldsymbol{c}$ ?

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: $\boldsymbol{x}=\frac{-\boldsymbol{b}}{2 \boldsymbol{a}}$
3. The vertex of the parabola is at the point: $\boldsymbol{x}=\frac{-\boldsymbol{b}}{2 \boldsymbol{a}}, \boldsymbol{y}=\boldsymbol{f}\left(\frac{-\boldsymbol{b}}{2 \boldsymbol{a}}\right)$; basically when $\boldsymbol{x}=\frac{-\boldsymbol{b}}{2 a}$, what is $y$ ?
4. Now, the parabola will be translated along the $x$-axis; however, the $y$-intercept is at $(0, c)$.

Example: Graph the function: $y=3 x^{2}+6 x-4$

$$
\text { 1. } a=\quad b=\quad c=
$$

2. $a$ is + or - so opens $\qquad$
3. $y=$ intercept $=c=$ $\qquad$ plot point
4. Axis of symmetry: $x=\frac{-b}{2 a}=\frac{-6}{2(3)}=-\mathbf{1}=\boldsymbol{x}$ graph axis of symmetry.
5. Vertex: $x=-1: y=f\left(\frac{-6}{2(3)}\right)=f(-1)=-7$ When $x=-1$, solve for $y$

$$
y=3(-1)^{2}+6(-1)-4=3-6-4=-7
$$

$$
\therefore(-1,-7), \text { vertex. }
$$

6. Select $x$-values adjacent to the axis of symmetry and find the corresponding $y=$ value

| $x$ | -4 | -3 | -2 | -1 | 0 | 1 | 2 |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| $y$ |  |  |  | -7 |  |  |  |

. Domain:
Range:
7. Complete table with corresponding points reflected across the axis of symmetry.

## Calculator Minimums and Maximum:

1. Hit $\mathbf{Y}=$ 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. $\mathbf{2}^{\text {nd }}$ TRACE choose $\mathbf{3}$-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.

Given the equation: $y=-x^{2}+2 x+3$

1. $a=\quad b=\quad c=$
2. $a$ is + or - so opens $\qquad$
3. $y=$ intercept $=c=$ $\qquad$ plot point
4. Calculate and graph Axis of symmetry: $x=\frac{-b}{2 a}$
5. Calculate vertex
6. Make a table of values including $y$-intercept and vertex Choose 3 points on one side of the vertex.

7. State the minimum/maximum value.
8. Domain:

Range:
7. Compete the table of values and graph.

## Application:

The number of bacteria in a refrigerated food is given by $n(t)=20 t^{2}-20 t+120$, for $-2 \leq t \leq 14$ and where $t$ is the temperature of the food in Celsius. At what temperature will the number of bacteria be a minimum?

Nike Shoes estimates that its monthly profit P in hundreds of dollars can be modeled by the formula $P=-2 x^{2}+4 x+6$, where x is the number of shoes produced per month in thousands
How many shoes should be produced per month to earn the maximum profit?
What is the maximum monthly profit?

A company's weekly revenue in dollars is given by $R(x)=2000 x-2 x^{2}$, where $x$ is the number of items produced during a week. What amount of items will produce the maximum revenue?

