8.1 Graphing $f(x) = ax^2$

Learning Target:

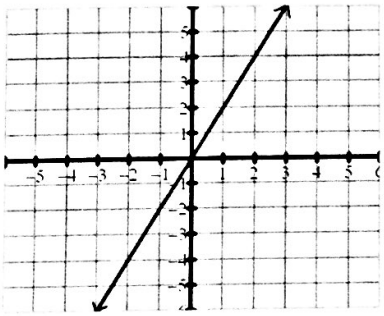
- What are some of the characteristics of the graph of a quadratic function of the form $f(x) = ax^2$?

Success Criteria:

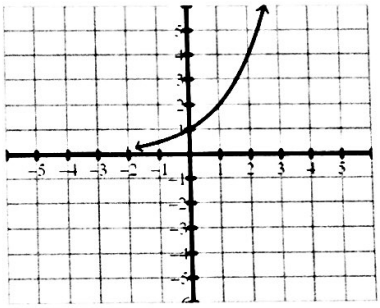
- I can graph and use quadratic functions of the form $f(x) = ax^2$
- I can identify characteristics of quadratic functions

In previous chapters, we saw what the graphs of the equations $y = 2x$ and $y = 2^x$ look like:

$y = 2x$ **(Linear)**



$y = 2^x$ **(Exponential)**



I can graph and use quadratic functions of the form $f(x) = ax^2$

Intro Problem #1: (Do as a class): What does the graph of a QUADRATIC equation such as $y = x^2$ look like?

For each given equation, make a table of ordered pair solutions (remember to follow the order of operations PEMDAS), then plot and connect the solution points to graph the equation.

Table and Graph of $y = x^2$

x	y
−2	4
−1	1
0	0
1	1
2	4

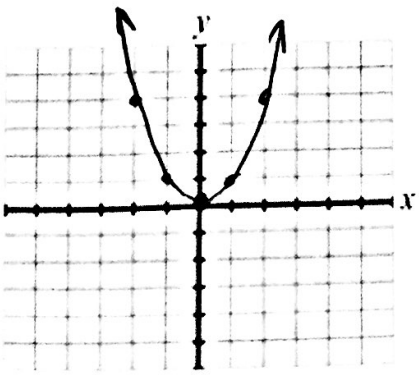
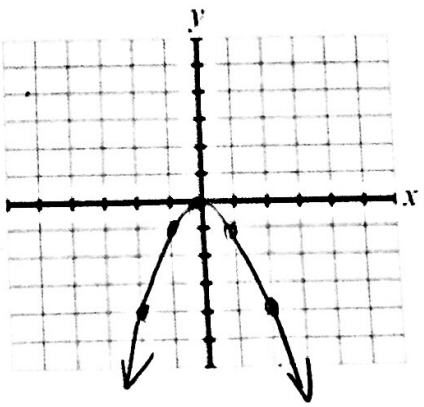


Table and Graph of $y = -x^2$

x	y
−2	−4
−1	−1
0	0
1	−1
2	−4



8.1 Graphing $f(x) = ax^2$

Observations: When the coefficient of x^2 is NEGATIVE the equation becomes $y = -x^2$, and the graph is reflected vertically over the x-axis. This happens is because you are taking all of the y-values for the equation $y = x^2$ (which were all positive) and multiplying them by a negative number. If there is a negative coefficient in front of the x^2 in the equation $y = ax^2$, the graph will always open down.

Intro Problem #2: (Do as a class): What effect does the coefficient a have o the equation $y = ax^2$, if $a > 1$?

Exploration-Grahing Quadratic Eqautions: $y = ax^2$

Using the TI-84 graphing calculator, graph each of the following quadratic functions. Please provide an accurate sketch for each graph (on the same graph paper) and label each graph. (HINT: You can use the table key on the calculator to provide points for your sketch.) Use different colors to graph each equation.

Also, adjust your WINDOW to the following:

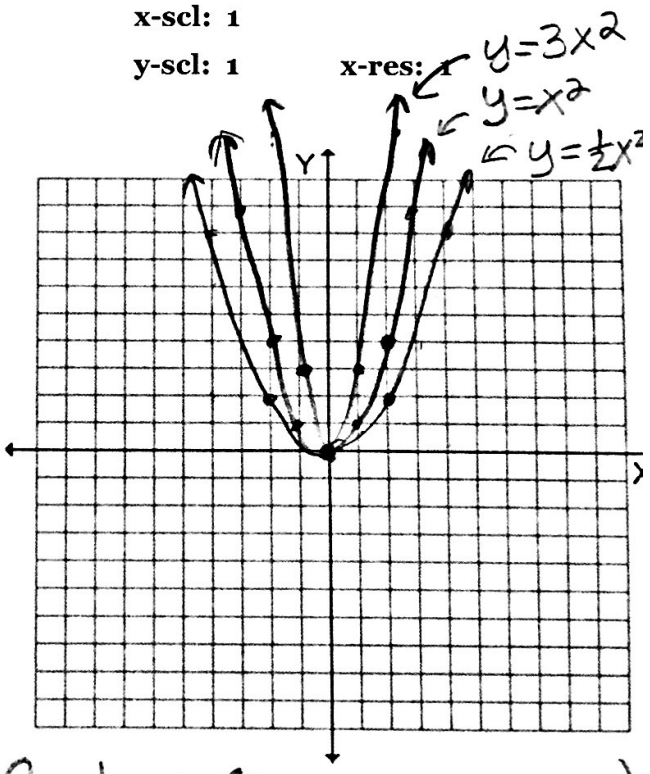
x-min: -10 **x-max: 10** **x-scl: 1**

y-min: 10 **y-max: 10** **y-scl: 1** **x-res: 1**

1. $y = x^2$ **a=** 1

2. $y = 3x^2$ **a=** 3

3. $y = \frac{1}{2}x^2$ **a=** $\frac{1}{2}$



1. What do you notice about the effect the leading coefficient, "a" has on the graph? as a gets larger the graph rises faster (is narrower)

2. Complete the statement based on the above graphs:

If "$|a|$" is greater than 1, then the graph is narrower.

If "$|a|$" is less than 1 and greater than 0, then the graph is Wider.

8.1 Graphing $f(x) = ax^2$

Observations: When the x^2 in the equation $y = x^2$ is multiplied by a number $a > 1$, the graph of the equation $y = ax^2$ will be narrower than the graph of $y = x^2$. This happens is because the previous ordered pair *y*-values for the equation $y = x^2$ are now larger than before, making the graph rise more quickly. The larger we make the value of *a*, the narrower the graph will be.

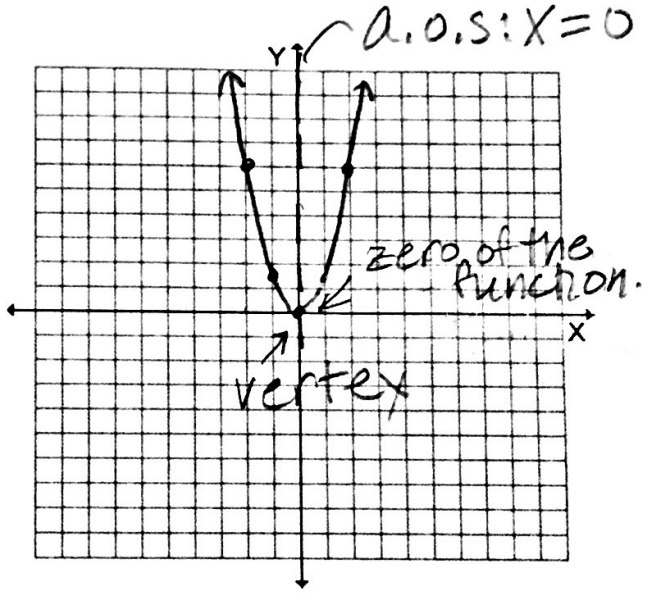
When a is a number BETWEEN 0 and 1, in other words $0 < a < 1$, the graph of the equation $y = ax^2$ will be wider than the graph of $y = x^2$. The smaller we make the value of a for $0 < a < 1$, the wider the graph will be.

Example 1: Graph the function: $y = \frac{3}{2}x^2$

Vertex (0,0)
a.o.s. $x = 0$
Zero at $x = 0$

(Label vertex, aos, zeros after the notes below!)

x	y
-2	6
-1	$\frac{3}{2}$
0	0
1	$\frac{3}{2}$
2	6



I can identify characteristics of quadratic functions

Now that we have some experience graphing quadratic functions, we can begin to identify specific characteristics of the graph.

- The graph of $y = ax^2$ is a U-shaped curve called a parabola.
- The "point" of the U (the highest point on the parabola if the graph opens down or lowest point if the graph opens up) is called the vertex.
- The line that divides the parabola into two symmetric pieces is the axis of symmetry. (aos)
- The zeros of the equation are the *x*-values for which $y = 0$ (which are the *x*-intercepts).

Identify the vertex, axis of symmetry, and zeros on the graph in Example 1.

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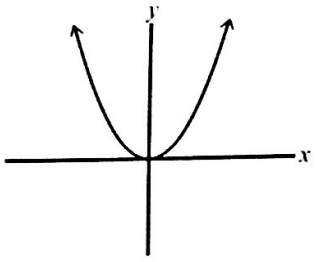
- Summary of additional characteristics from the explorations:



When a is POSITIVE, the parabola will open Up. U.

When a is NEGATIVE, the parabola will open down. ∩.

When $|a| > 1$, the parabola will be narrower than the parabola for $y = x^2$ (when $a = 1$).

When $0 < |a| < 1$, the parabola will be wider than the parabola for $y = x^2$ (when $a = 1$).

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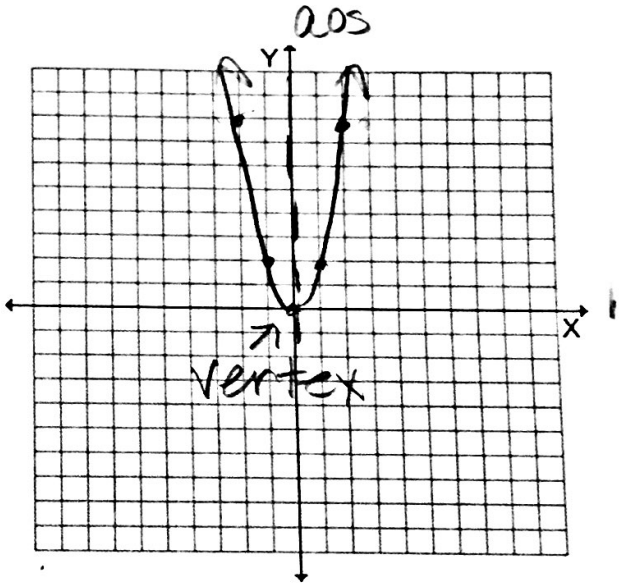
Example 2: Graph the function: $y = 2x^2$

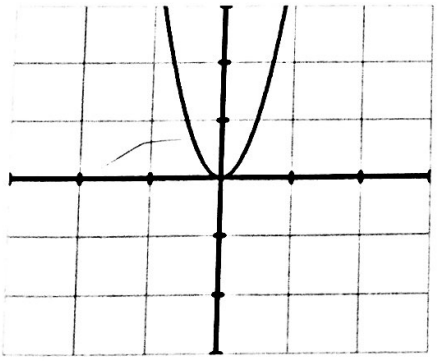
Identify the vertex, zeros and axis of symmetry. Tell whether the graph opens up or down.

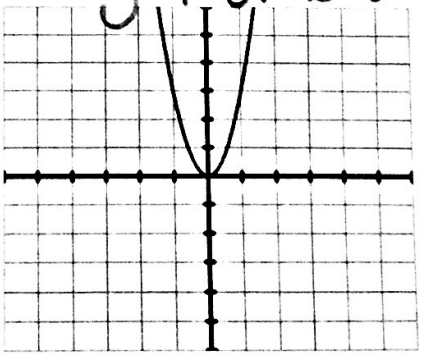
vertex (0,0)
zeros at x=0
a.o.s: X=0

x	y
-2	8
-1	2
0	0
1	2
2	8



Example 3: The graphs of the equations $y = 4x^2$ and $y = 3x^2$ are shown below. John says that the graph on the left must be the graph of $y = 4x^2$ since 4 is greater than 3 and we learned in the intro that a larger value of a gives a narrower parabola. Explain why John is incorrect. Each of the graphs has a different scale





Closure: What I learned today was …