Vanessa Youmans

Graphing Quadratics

Objectives:

Upon Completion of this lesson the student will be able to:

- Recognize a, b, and c in quadratic equations
- Understand the role of a
- Understand the role of –a

Materials and Tools Needed:

- TI-83 graphing calculator
- Graph paper
- Straight edge

Target Audience:

- Grades 9 and 10

NCTM Standards:

Algebra
Understand patterns, relations and functions
Represent and analyze mathematical situations and structures using algebraic symbols

NYS Standards:

Information Systems
Mathematics
Technology

Key Terms:

Quadratic
Axis of symmetry
Coefficient
Vertex

Vanessa Youmans

Name _____
Date _____

Graphing Quadratic Equations

The standard form of a quadratic equation is $y = ax^2 + bx + c$, where $a \neq 0$. a, b, and c are real numbers called coefficients.

In the quadratic equation $y = 2x^2 + 4x - 5$ a=2, b=4, and c= -5.

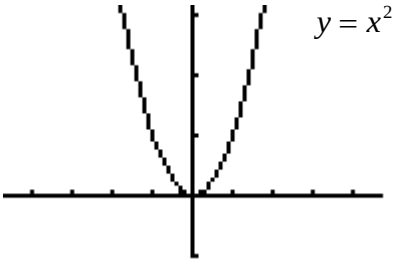
Try to find a, b, and c in the following quadratic equations.

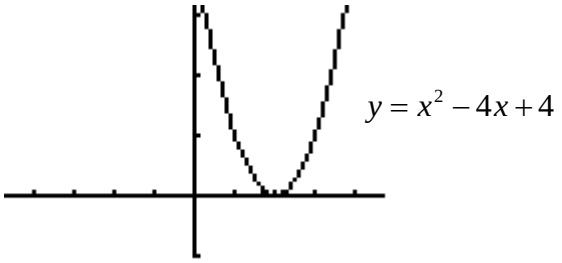
1. $y = 3x^2 + 9x - 2$ a= _____ b=_____ c=_____

2. $y = 7x^2 - 7$ a= _____ b=_____ c=_____

3. $y = -x^2 + 2x + 1$ a= _____ b=_____ c=_____

We know that the graphs of quadratics equations are parabolas.





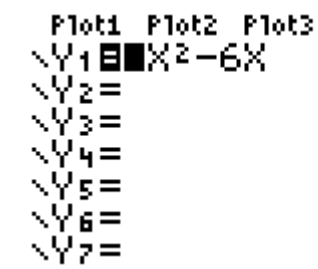
In order to graph quadratic equations we need to know the axis of symmetry.

The quadratic equation $y = ax^2 + bx + c$ has axis of symmetry $x = -\frac{b}{2a}$.

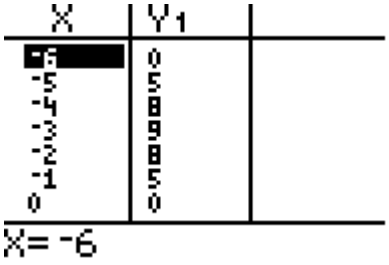
The quadratic equation $y = -x^2 - 6x$ has b= -6, a = -1. So the axis of symmetry for this parabola is $x = \frac{-(-6)}{2(-1)} = \frac{6}{-2} = -3$.

Vanessa Youmans

Using your graphing calculator, enter this function into Y_1. Then go to table set up and start your table at the **axis of symmetry value – 3.**

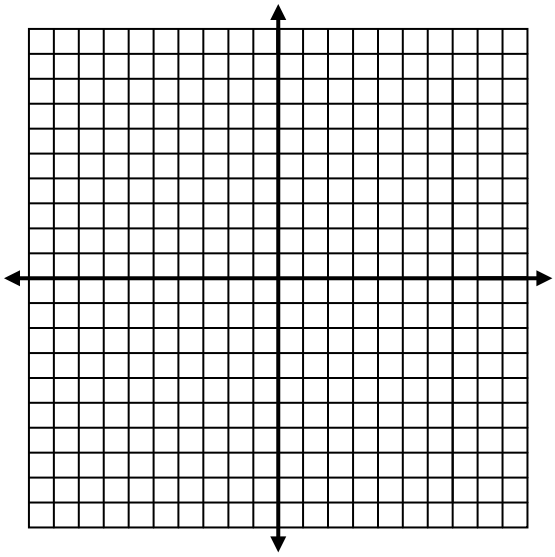


Copy the table onto your graph paper.



You know you have a good table when you can see the symmetry in the y-values.

Graph these points on the graph paper.

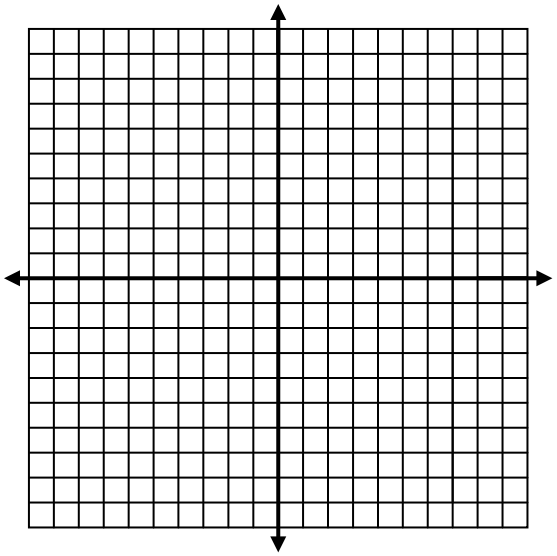


Vanessa Youmans

Try the following examples:

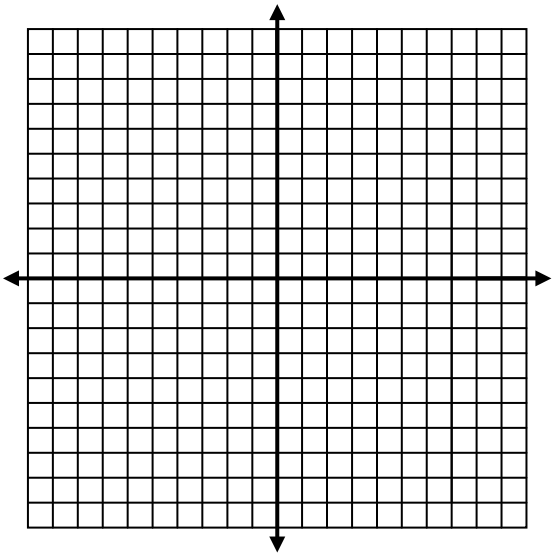
1. $f(x) = x^2 - 6x + 8$

x	y



2. $f(x) = 2x^2 + x - 3$

x	y



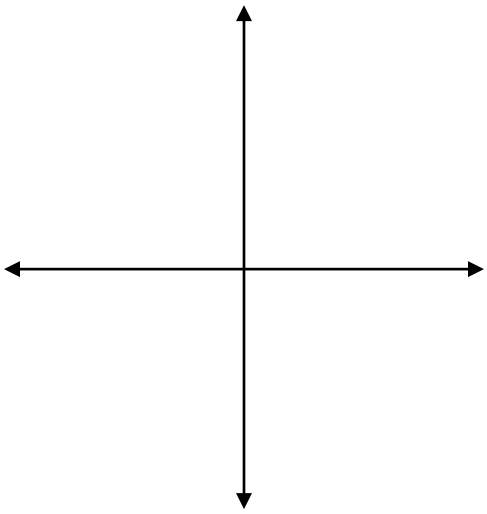
Vanessa Youmans

Lets examine the role of a in the quadratic equation $y = ax^2 + bx + c$.

Using your graphing calculator, graph the following functions.

```
 Plot1 Plot2 Plot3
\Y1■2X²
\Y2■(1/2)X²
\Y3=
\Y4=
\Y5=
\Y6=
\Y7=
```

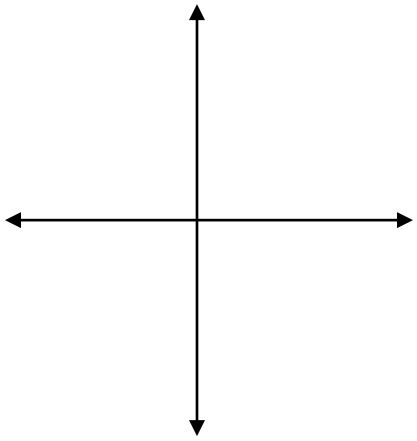
Sketch the graphs of these functions here.



What is the vertex of these graphs?

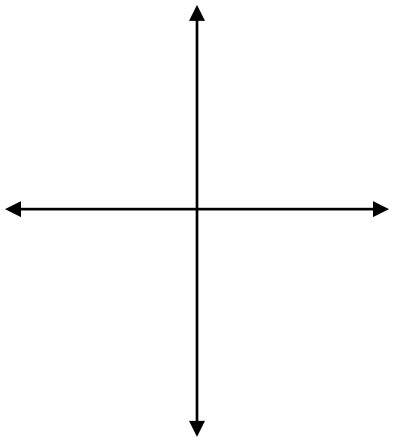
Using your graphing calculator, graph the following functions.

```
 Plot1 Plot2 Plot3
\Y1■2X²
\Y2■10X²
\Y3=
\Y4=
\Y5=
\Y6=
\Y7=
```



Using your graphing calculator, graph the following functions.

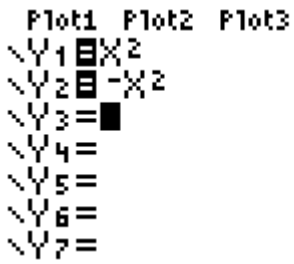
```
 Plot1 Plot2 Plot3
\Y1■(1/10)X²
\Y2■10X²
\Y3=
\Y4=
\Y5=
\Y6=
\Y7=
```

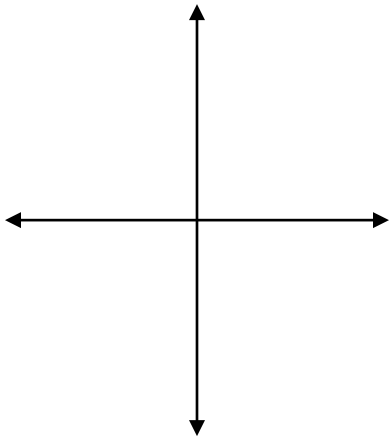


Vanessa Youmans

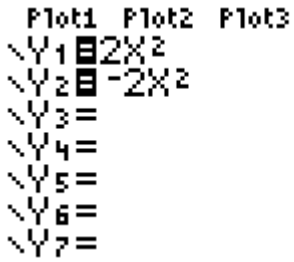
What seems to happen to the graph when a gets larger?

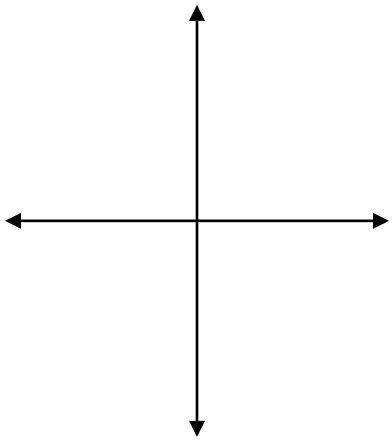
Using your graphing calculator, graph the following functions.





Using your graphing calculator, graph the following functions.





Describe the shape of the graph when $a > 0$.

Describe the shape of the graph when $a < 0$.

Vanessa Youmans

Closure

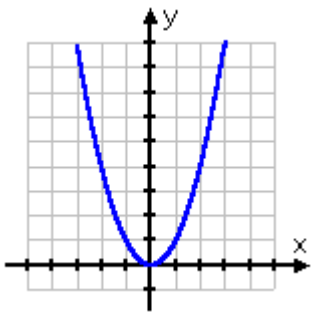
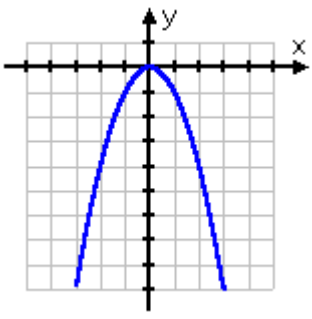
The general form of a quadratic is "$y = ax^2 + bx + c$". For graphing, the leading coefficient "a" indicates how "fat" or "skinny" the parabola will be. For $|a| > 1$ (such as $a = 3$ or $a = -4$), the parabola will be "skinny", because it grows more quickly (three times as fast or four times as fast, respectively, in the case of our sample values of a). For $|a| < 1$ (such as $a = {}^1/_3$ or $a = {}^{-1}/_4$), the parabola will be "fat", because it grows more slowly (one-third as fast or one-fourth as fast, respectively, in the examples). Also, if a is negative, then the parabola is upside-down. You can see these trends when you look at how the curve moves as "a" changes:

See if you can predict the shape of the following graphs. Choose from the following list of identifiers. Up/down skinny/fat

$f(x) = 2x^2 + 3x + 2$ $\qquad$ $y = -\frac{1}{2}x^2 + 3$

$y = \frac{1}{4}x^2 - \frac{1}{2}x + 2$ $\qquad$ $f(x) = 3x^2 + 2x - 1$

Use your graphing calculator to verify your predictions.

positive quadratic $y = x^2$	**negative** quadratic $y = -x^2$
	
	

Vanessa Youmans

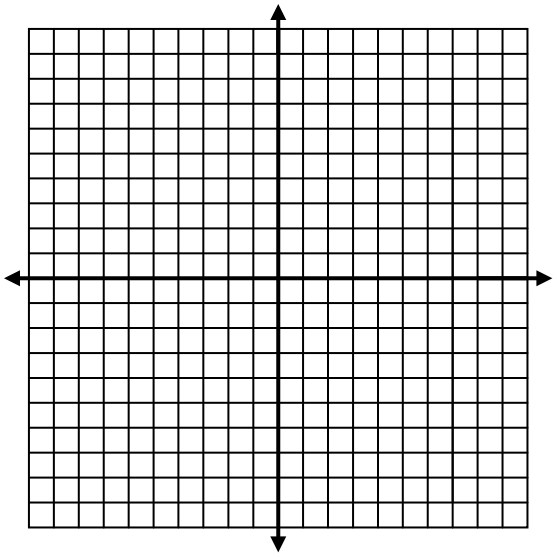
Name _____
Date _____

Assesment:

1. What happens to the graph of the equation $y = ax^2 + bx + c$ when a gets larger?

2. What is the difference between the graphs of $y = 2x^2$ and $y = -2x^2$?

3. Graph the equation $y = -x^2 - 4x - 5$.



4. Some parabolas have maximum points and some have minimum points. Look at the two pictures on the last page and make a conclusion about which graph has a max, and which has a min. $(a > 0 \text{ or } a < 0)$ Explain.

Vanessa Youmans

Assessment Rubric

4 POINTS: For the free response questions, the student gives clear and concise answers that are mathematically correct. The graphing question has axes labeled appropriately, the graph is labeled, and a good table of values was found using the axis of symmetry. Question #4 is answered correctly with explanation.

3 POINTS: One of the free response questions is answered inappropriately but the graphing questions is correct as above, and question #4 is correct as above. **or** The free response questions are correct, but the student did not label the graph appropriately and question #4 is correct as above. **or** The free response questions are correct, the graphing question is correct, but question #4 is incorrect because the student could not make a conjecture.

2 POINTS: The free response questions are answered appropriately but the graphing question contains severe conceptual errors and question #4 is correct as above.

1 POINT: The free response questions are answered inappropriately and the graphing question contains severe conceptual errors. Question #4 may or may not be answered appropriately. An effort was made but the student clearly does not understand the exercise.

0 POINTS: No effort was made by the student to answer the questions.