GreatHearts

Algebra 1

April 27 – May 1

Time Allotment: 40 minutes per day

Zoom Guided Instruction	Day/Time this Week
1st Period Ms. Steger	Monday & Wednesday, 10:00 – 10:50am
2nd Period Ms. Steger	Monday & Wednesday, 11:00 – 11:50am
3rd Period Ms. Brintnall	Monday & Wednesday, 1:00 – 1:50pm
4th Period Ms. Brintnall	Tuesday & Thursday, 10:00 – 10:50am

Student Name: ___________________________________

Teacher Name: ___________________________________

Teacher emails: Vanessa.steger@greatheartsnorthernoaks.org and melanie.brintnall@greatheartsnorthernoaks.org. Ms. Brintnall will be teaching Mrs. Chubb's Algebra 1 class for the remainder of the school. If you were in Mrs. Chubb's class, you should email Ms. Brintnall for help if needed!

Academic Honesty

I certify that I completed this assignment independently in accordance with the GHNO Academy Honor Code.

Student signature:

____

I certify that my student completed this assignment independently in accordance with the GHNO Academy Honor Code.

Parent signature:

____

Algebra 1
April 27 – May 1

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Name: ______________________

Packet Overview

Date	Objective(s)	Page Number
Monday, April 27	Graph quadratic equations given in standard and vertex form.	2 – 5
Tuesday, April 28	Identify key characteristics of a parabola (vertex, axis of symmetry, concave up/down) given only the vertex form of the equation.	6 – 8
Wednesday, April 29	Describe how changing *h* and *k* transforms the graph of a parabola.	9 – 12
Thursday, April 30	Review and Minor Assessment	12 -
Friday, May 1	Transform a standard form quadratic equation into vertex form.	

Dear Algebra 1 students,

We so enjoyed seeing many of you in Zoom guided instruction sessions last week! We loved reviewing all of the different ways we can solve quadratic equations with you, and many students asked excellent questions, such as "How do we solve with the quadratic formula if the discriminant is negative?", "How can we figure out whether the vertex is above, below, or on the x-axis?", and "How does the discriminant tell us how many x-intercepts there are?"

Earlier this semseter, we studied lines and learned that we can write the equation for a line in many different ways – standard form, slope-intercept form, and point-slope form. Even though we could right the same line in all three ways: $3x + 2y = 5$, $y = -\frac{3}{2}x - \frac{5}{2}$, and $y + 2 = -\frac{3}{2}(x - 3)$, we discovered that the graph of these equations would end up being the exact same line!

Do you remember when we first discovered the slope-intercept form of a line? We realized that, if we had a line in this form, we could immediately recognize important information about the equation without even graphing, namely its slope and y-intercept. This week, we will expand on our knowledge of the standard form for a quaratic equation and explore a new form of quadratic equations that will reveal important information about its parabola…without us even graphing!

Keep thinking like mathematicians – be on the lookout for patterns and think about *why* a process is mathematically true.

Email us anytime you'd like to share a question, observation, or discovery! We miss you!!!

With much love, Ms. Steger and Ms. Brintnall

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Algebra 1
April 27 – May 1

Name: ______________________

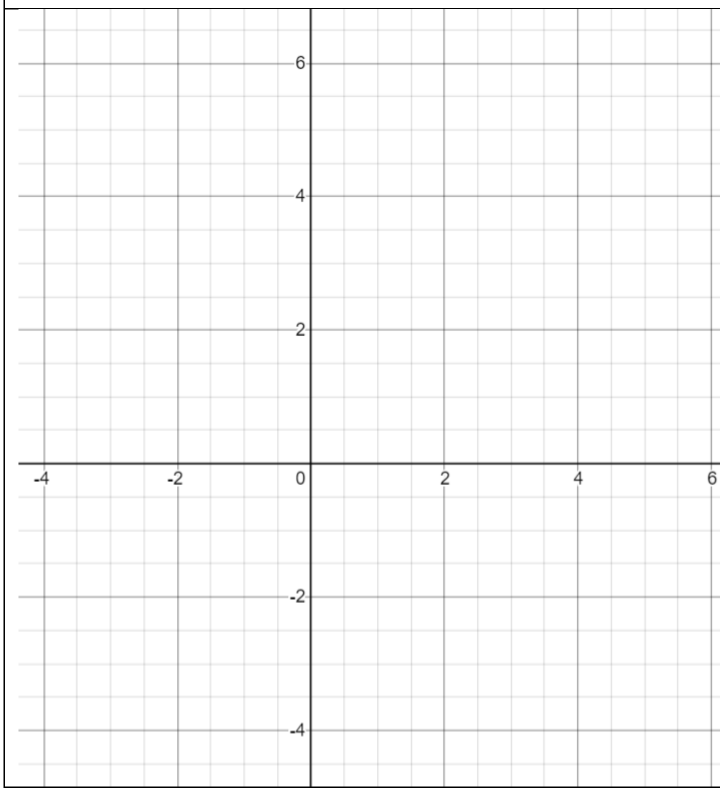
<u>Monday April 27</u>

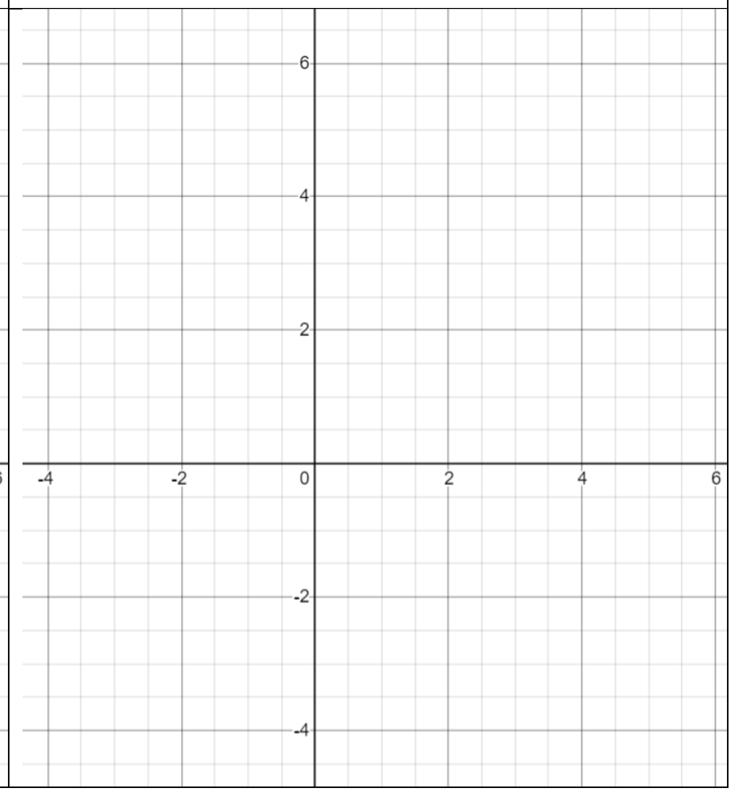
Lesson 1

Objective: Graph quadratic equations given in standard or vertex form.

Bell work: Graph the following equations. Remember to make a table of values to help you!

1) $5x + 2y = 8$	2) $y = -2.5x + 4$





3. Are these equations linear or quadratic? How do you know?
____
____

4. In what form of a line is equation #1 given? ______________________

5. In what form of a line is equation #1 given? ______________________

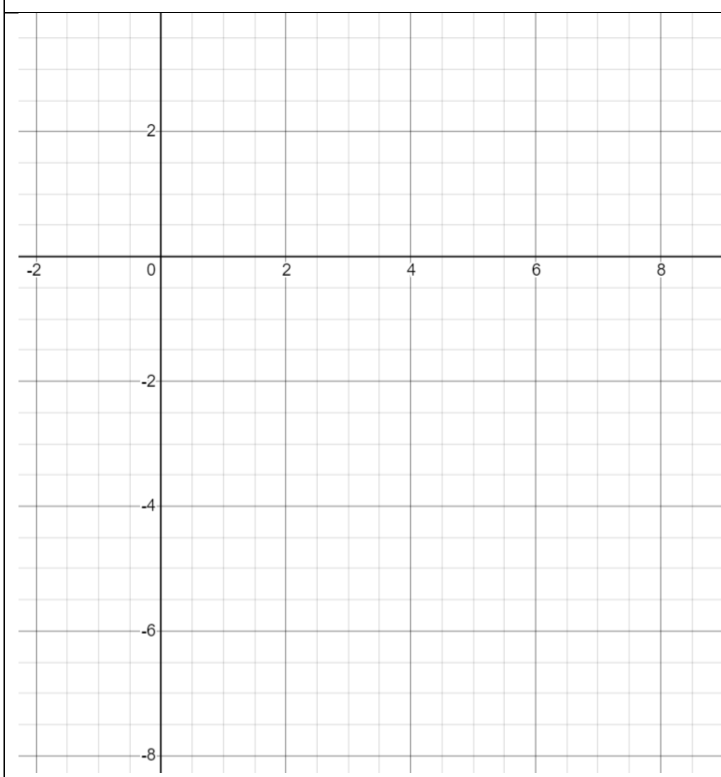
6. What do you notice about their graphs? ____

Name: ______________________

Make a table of values for each equation. In the space given, show your work plugging in points! Then, graph.

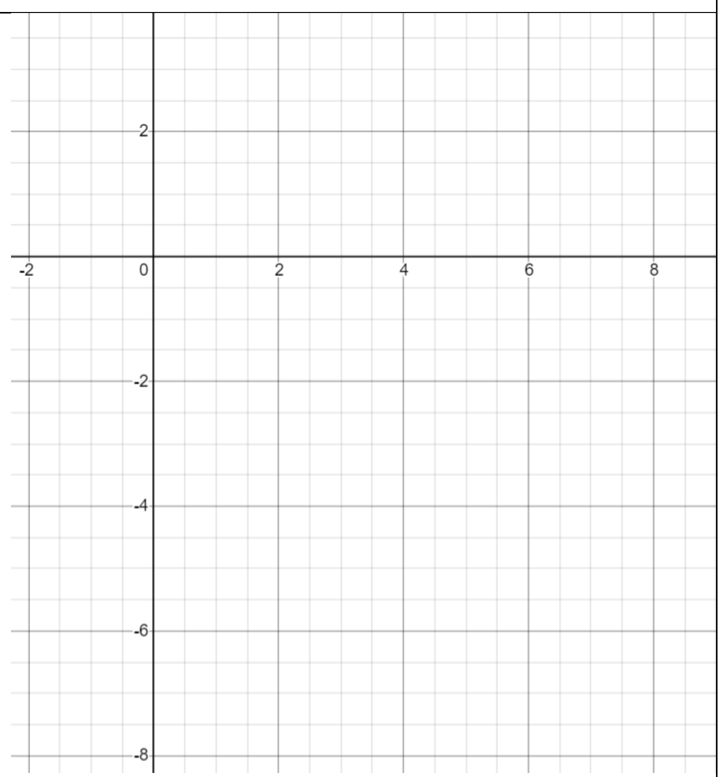
7) $y = x^2 - 8x + 9$

x	y



8) $y = (x - 4)^2 - 7$

x	y



Name: ______________________

9. Are the graphs on p.4 linear or quadratic? How do you know?

____

____

10. What do you notice about the two graphs? ____

11. Using the equation in #7, calculate the axis of symmetry and find the vertex. **Draw and label the axis of symmetry and circle and label the vertex on both graphs.** This is a problem like the ones we did last week – make sure to email or hop onto Zoom instruction if you are confused!

Axis of Symmetry Calculation:	Vertex Calculation:

As we reviewed in today's bell work, linear equations have multiple forms. We graphed what turned out to be the same equation in both standard and slope-intercept form. We could have also used point-slope form, or even put the equation in a form that did not fit any of the three forms we are familiar with!

Quadratic equations can also be written in standard form. We know the standard form for a quadratic equation: $y = ax^2 + bx + c$. The equation in #7 was given in standard form. The equation in #8 was given in what we call *vertex form*. We will know the general formula for vertex form eventually, but first, let's graph some more equations in vertex form to become comfortable using this form. As you graph, I want you to keep this question in the back of your mind: **"*Why* would we call this form *vertex* form? Why might *vertex form* be a helpful form of quadratic equations to know?"**

HINT: Before we practice graphing, think back to plugging in points for #8. What was the easiest value to plug in for *x*?

Hopefully, you found that plugging in "4" was very easy – it made the quantity squared become zero, and all we had to do was subtract 7! It was then easy to choose numbers on either side of 4, 3 and 5, so that the quantity squared would become 1. Next, it would have been helpful to choose 2 and 6, and so forth.

Using the hint about plugging in helpful points for #8 above, graph the following equations that are given in vertex form. SHOW YOUR WORK PLUGGING IN POINTS!

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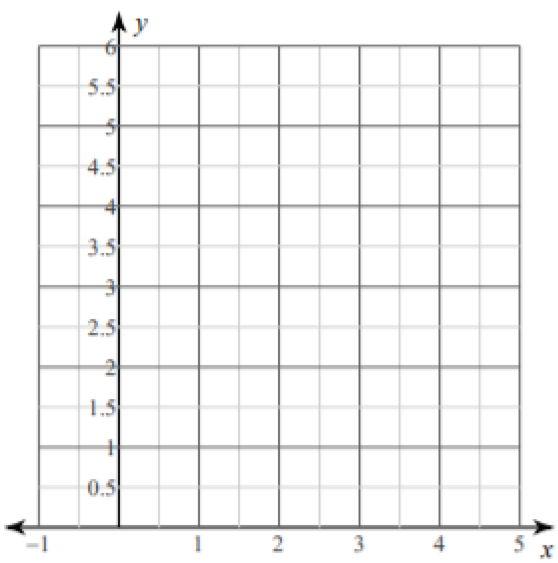
Algebra 1
April 27 – May 1

Name: ______________________

12) $y = (x-3)^2 + 1$

x	y

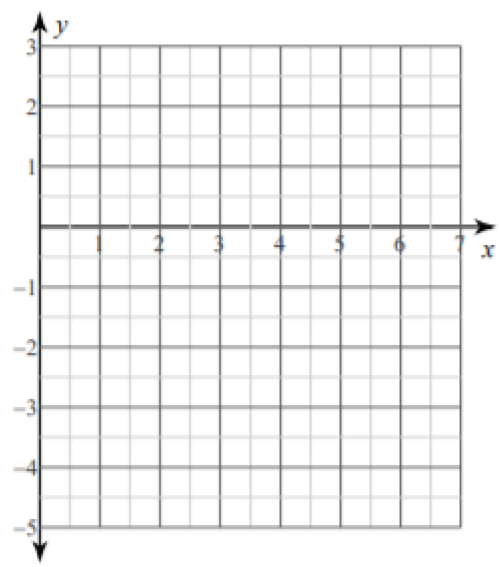
$y = (x-3)^2 + 1$



13) $y = \frac{1}{2}(x-4)^2 - 2$

x	y

$y = \frac{1}{2}(x-4)^2 - 2$



Draw and label both the axis of symmetry and vertex for each graph. Once you have done that, check your graphs with the answer key at the back of the packet. Now, you are finished with Monday's work for this week!

Algebra 1
April 27 – May 1

Name: ____________________

<u>Tuesday, April 28</u>

Lesson 2

Objective: Identify key characteristics of a parabola (vertex, axis of symmetry, concave up/down) given only the vertex form of the equation.

Bell work: Graph the following equations in vertex form. Show your work plugging in points!

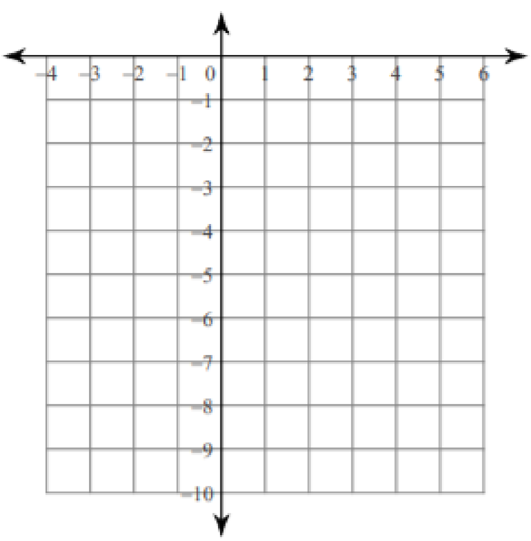
1) $y = -2(x-1)^2 - 1$

x	y

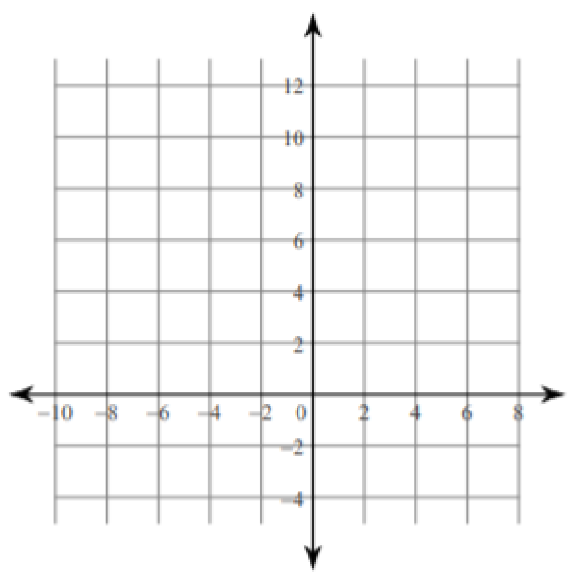
2) $y = 4(x+1)^2 - 4$

x	y

1) $y = -2(x-1)^2 - 1$



$y = 4(x+1)^2 - 4$



<u>Draw and label the axis of symmetry and vertex for each equation on your graphs.</u> Then, check your graphs with the answer key at the back of the packet.

Name: ______________________

Now, we are going to take a closer look at the last four quadratic equations in vertex form that you've graphed. We've written the equations down. *Look back at your graphs at the end of yesterday's lesson and from today's bell work* to fill in the vertex and axis of symmetry information for you in the table below:

Table A:

Equation:	$y = (x-3)^2 + 1$	$y = \frac{1}{2}(x-4)^2 - 2$	$y = -2(x-1)^2 - 1$	$y = 4(x+1)^2 - 4$
Vertex:				
Axis of symmetry:				

As mathematicians, we are always looking for patterns and relationships between values. Look at the table you've filled out above and write down two observations you notice. (HINT: How do the vertex and axis of symmetry relate to the vertex form equation?)

Observation #1:	Observation #2:
______________________________	______________________________
______________________________	______________________________
______________________________	______________________________

Based on your observations, can you identify the vertex and axis of symmetry of the following quadratic equations given in vertex form?

Table B:

Equation:	$y = -(x+2)^2 + 3$	$y = \frac{4}{3}(x-5)^2 - 1$	$y = -3\left(x + \frac{3}{2}\right)^2 - 6$
Vertex:			
Axis of symmetry:			

Once you've completed the table above, check your answers with the key for *Table B* at the end of the packet.

Yesterday, we asked you to keep the following questions in the back of your mind: **"*Why* would we call this form *vertex* form? Why might *vertex form* be a helpful form of quadratic equations to know?"**

Think about these questions for 1 – 2 minutes and respond below in at least 2 complete sentences:

____

____

____

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Algebra 1
April 27 – May 1

Name: ______________________

Now that we've worked with vertex form, it is time to formally *define* vertex form in mathematical notation.

The *vertex form* of a quadratic equation is given by

$$f(x) = a(x-h)^2 + k$$

in which *(h, k)* is the vertex and $x = h$ is the axis of symmetry.

There are two aspects of this equation we need to address:

1) We have the quantity $(x-h)$, which means that if we put in a positive value for h, such as 3, we will have subtraction in the parentheses $(x-3)$ and have a positive *x*-coordinate for our vertex, $(3, k)$. However, if we put a negative value in for h, such as -6, we will have addition in the parentheses $(x+6)$ and have a negative *x*-coordinate for our vertex, $(-6, k)$.

2) What is this a in front of the equation? It is the same a that we have when using standard form of a quadratic equation, $y = ax^2 + bx + c$. a tells us how wide or narrow the parabola is. It also tells us whether the parabola is concave up (when a is positive) or concave down (when a is negative).

Using your knowledge of vertex form, complete the following table.

Table C:

Equation:	$y = -3(x-4)^2 - 2$	$y = -\frac{1}{3}(x+8)^2 + 14$	$y = (x+11)^2 - 2.3$
a, h, and k	$a =$ _____ $h =$ _____ $k =$ _____	$a =$ _____ $h =$ _____ $k =$ _____	$a =$ _____ $h =$ _____ $k =$ _____
Vertex:			
Axis of symmetry:			
Concave UP or concave DOWN?			

Check your answers with the key for *Table C* at the end of this packet. Once you've completed that, you are finished with your work for Tuesday!

Algebra 1
April 27 – May 1

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Name: ______________________

Wednesday April 29

Lesson 3

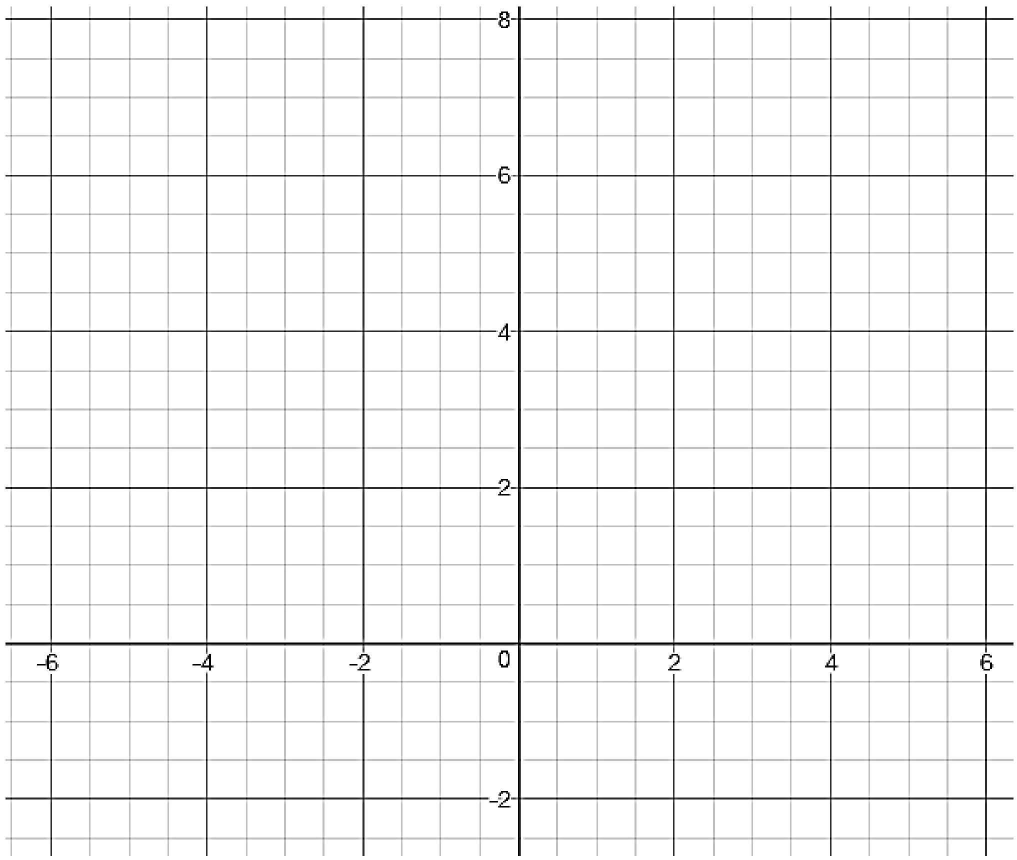
Objective: Describe how changing h and k transforms the graph of a parabola.

1. Make a table of values and graph all three functions on the coordinate plane below.

$f(x) = x^2$	
-2	
0	
2	

$f(x) = x^2 + 3$	
-2	
0	
2	

$f(x) = x^2 - 2$	
-2	
0	
2	



a) Describe what happens to the parent function when it is transformed to $f(x) = x^2 + k$, where k is a constant.

____

____

____

2. Make a table of values and graph all three functions on the coordinate plane below.

$f(x) = (x-1)^2$	
-2	
0	
2	

$a =$ ___; $h =$ ___; $k =$ ___

$f(x) = (x-1)^2 + 3$	
-2	
0	
2	

$a =$ ___; $h =$ ___; $k =$ ___

$f(x) = (x-1)^2 - 2$	
-2	
0	
2	

$a =$ ___; $h =$ ___; $k =$ ___

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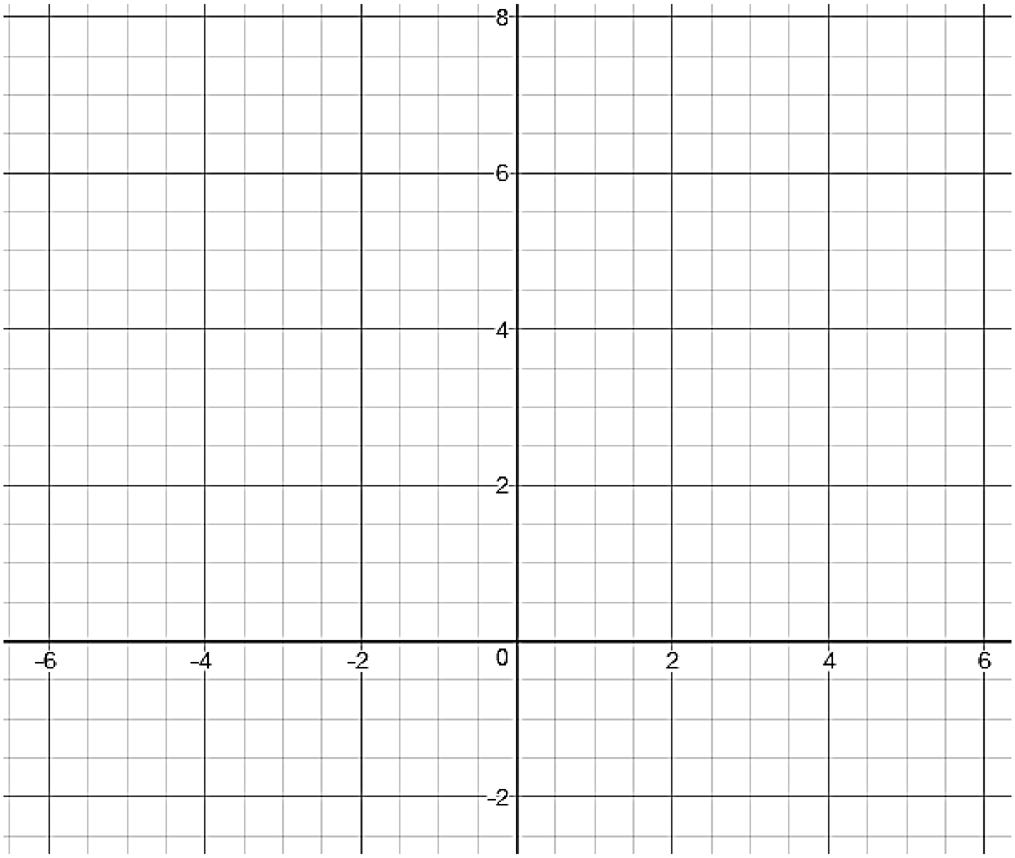
Name: ______________________



a) Which number impacts the height of a parabola, *a*, *h*, or *k*? ______

b) Describe what happens to the function when it is transformed to $f(x) = (x-1)^2 + k$, where *k* is a constant.

____

____

____

3. Make a table of values and graph all four functions *and the quadratic parent function* on the coordinate plane on the next page.

$f(x) = (x+1)^2$	
-2	
-1	
0	
1	
2	

$f(x) = (x-1)^2$	
-2	
-1	
0	
1	
2	

$f(x) = (x-3)^2$	
-1	
0	
1	
2	
3	

$f(x) = (x+3)^2$	
-3	
-2	
-1	
0	
1	

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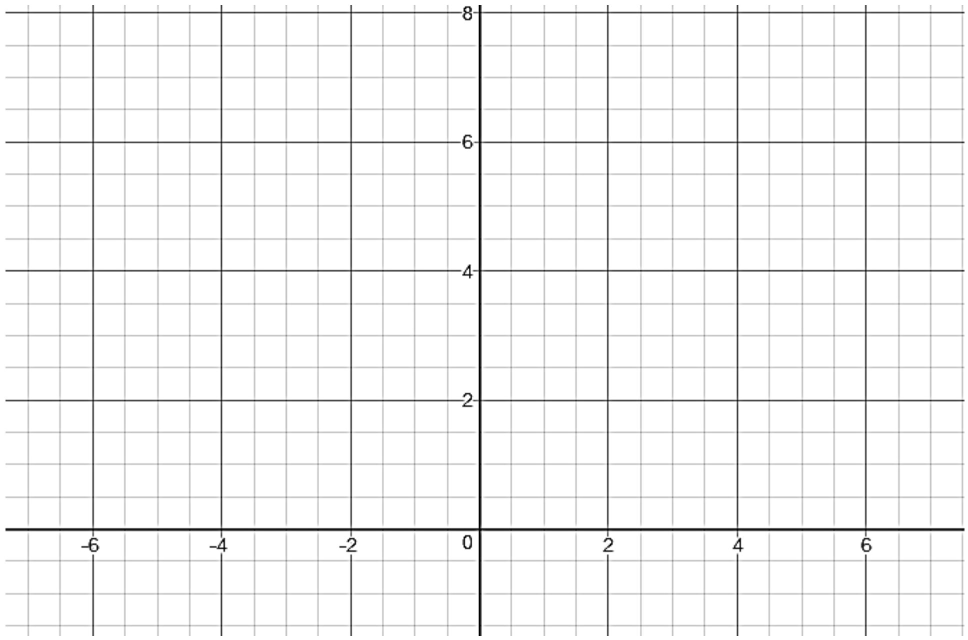
Name: ______________________



a) Describe what happens to the parent function when it is transformed to $(x) = (x - h)^2$. In your answer, mention what happens when h is positive AND when h is negative.

____

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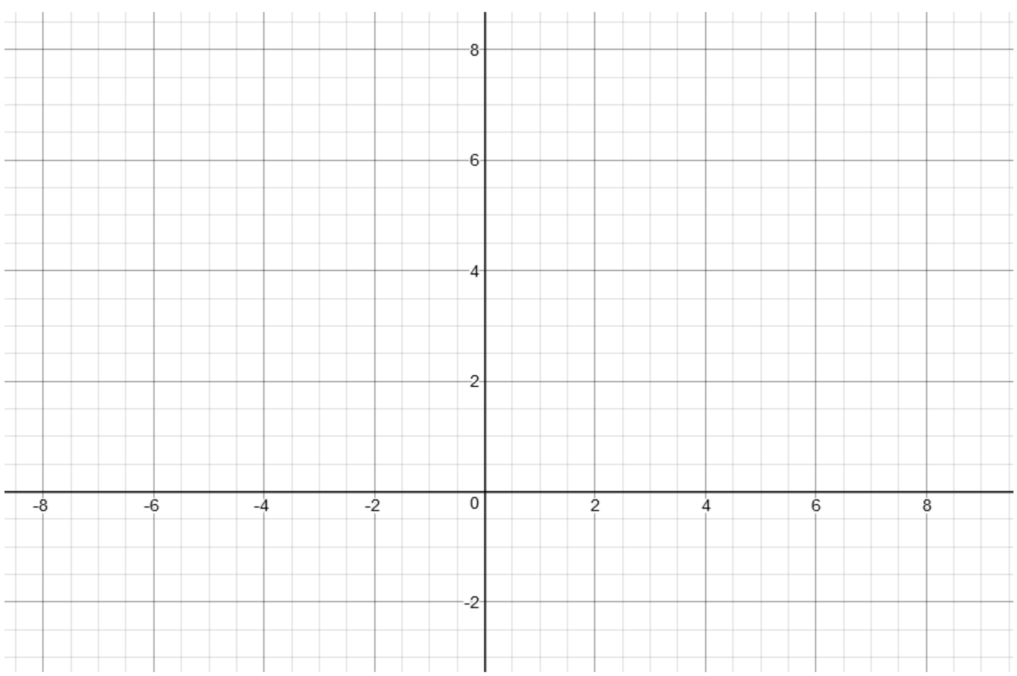
____

4. Graph 5 points for the parent function. Then, graph the following two functions WITHOUT a table of values using your knowledge of transformations. If you need help with this, check out this week's video on Google classroom!

$\boldsymbol{f(x) = (x-1)^2 + 2}$

$\boldsymbol{f(x) = (x+2)^2 - 3}$



Make sure you have three parabolas on this graph!

Algebra 1
April 27 – May 1

Name: ______________________

If you've worked for 40 minutes, you're finished! If you still have time, try this:
We've looked at what happens when we change h and k, but we haven't looked at what happens when we change a. Go to desmos.com and graph a variety of parabolas in vertex form with different a values, such as $y = (x-4)^2 + 1; y = 7(x-4)^2 + 1; y = -\frac{1}{3}(x-4)^2 + 1$

What happens when a changes? Was this what you expected to happen? Why or why not?

Thursday, April 29

Lesson 4: Review, minor assessment, and new lesson

Objective: Transform equations from standard form into vertex form.

Practice:

1. Write the formula for the vertex form of a quadratic equation:

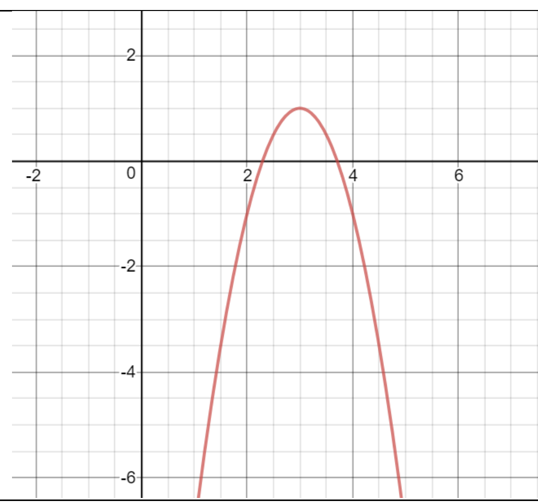
2. What is the vertex for the graph of the equation:

$$y = -5(x+2)^2 + 3$$

3. Write the vertex form equation for the parabola with a vertex at (4, -1) and a=1.

4. Which of the following equations matches the graph to the right?

a) $y = 2(x+3)^2 - 1$
b) $y = -2(x+3)^2 + 1$
c) $y = -2(x-3)^2 + 1$
d) d) $y = 2(x-3)^2 + 1$



5. If the equation $f(x) = 3(x-8)^2 + 3$ were changed to $f(x) = 3(x-5)^2 + 3$, which of the following would occur?

a) The parabola would shift three units left.
b) The parabola would shift three units right.
c) The parabola would shift three units up.
d) The parabola would shift three units down.

6. If the equation $f(x) = -\frac{1}{5}(x-1)^2 - 1$ were changed to $f(x) = -\frac{1}{5}(x-1)^2 + 5$, which of the following would occur?

a) The parabola would shift six units left.
b) The parabola would shift five units up.
c) The parabola would shift six units up.
d) The parabola would shift six units down.

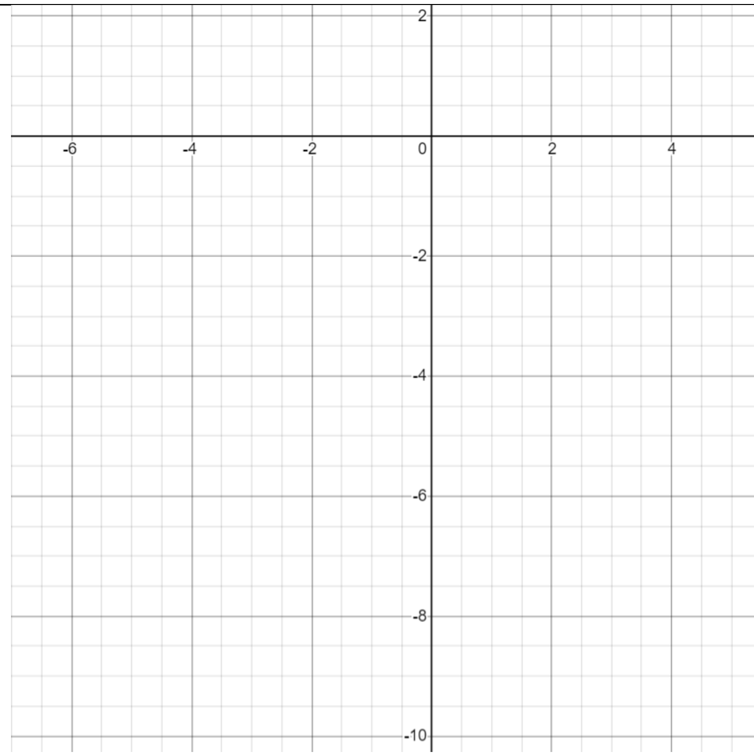
Name: ______________________

7. Graph the following equation:

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

Label the vertex with its ordered pair and the axis of symmetry with its equation.

SHOW WORK HERE:



Check your answers from the above practice with the key at the end of the packet. Reach out to Ms. Brintnall or Ms. Steger with any questions you still have! Then, you may proceed to the minor assessment below.

Minor Assessment (Quiz)

Please read these boxes carefully before starting on the minor assessment.

- ☐ I understand that I am NOT allowed to use this packet during my quiz.
- ☐ I understand that I am NOT allowed to use my own loose-leaf packet during my quiz.
- ☐ I understand that while Ms. Steger and Ms. Brintnall estimate that the quiz will take 10 minutes, it is okay to spend the time I need.
- ☐ I understand that I am NOT allowed to ask a parent, family member, or friend for help during my quiz.
- ☐ I understand that I am NOT allowed to use the internet or any other resource to help with my quiz.

Algebra 1
April 27 – May 1

Name: ______________________

Week 6 Minor Assessment

1. Write the formula for the vertex form of a quadratic equation:

2. What is the vertex for the graph of the equation: $y = 12(x-7)^2 - 2$

3. Write the vertex form equation for the parabola with a vertex at $(-3, 2)$ and $a = 4$.

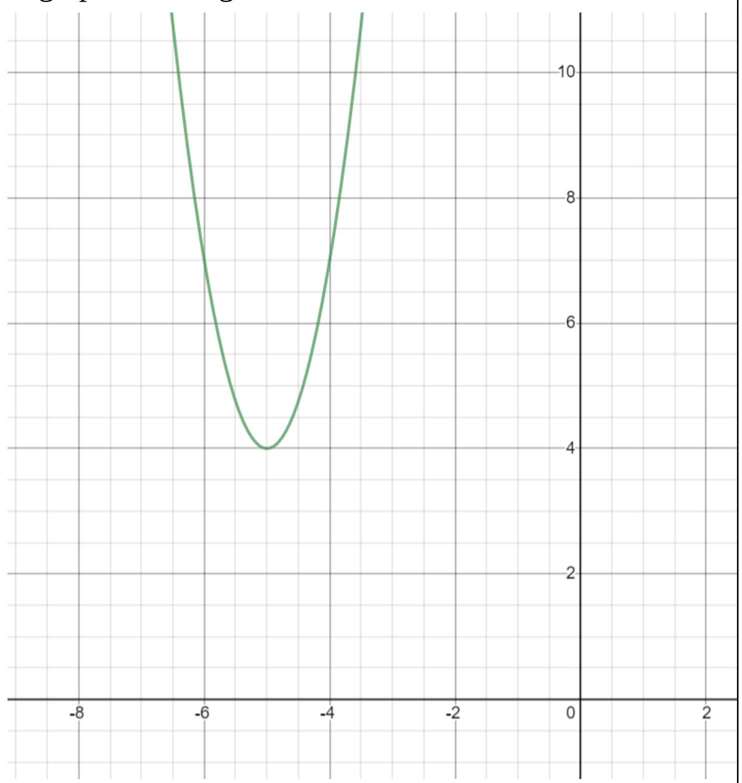
4. Which of the following equations matches the graph to the right?

a) $y = 3(x+5)^2 - 4$

b) $y = -3(x+5)^2 + 4$

c) $y = -3(x-5)^2 + 4$

d) d) $y = 3(x-5)^2 + 4$



5. If the equation $f(x) = -4(x-2)^2 - 2$ were changed to $f(x) = -4(x-2)^2 - 6$, which of the following would occur?

a) The parabola would shift four units left.

b) The parabola would shift four units right.

c) The parabola would shift four units up.

d) The parabola would shift four units down.

6. If the equation $f(x) = \frac{2}{3}(x+10)^2 - 1$ were changed to $f(x) = \frac{2}{3}(x+3)^2 - 1$, which of the following would occur?

a) The parabola would shift nine units right.

b) The parabola would shift seven units right.

c) The parabola would shift nine units left.

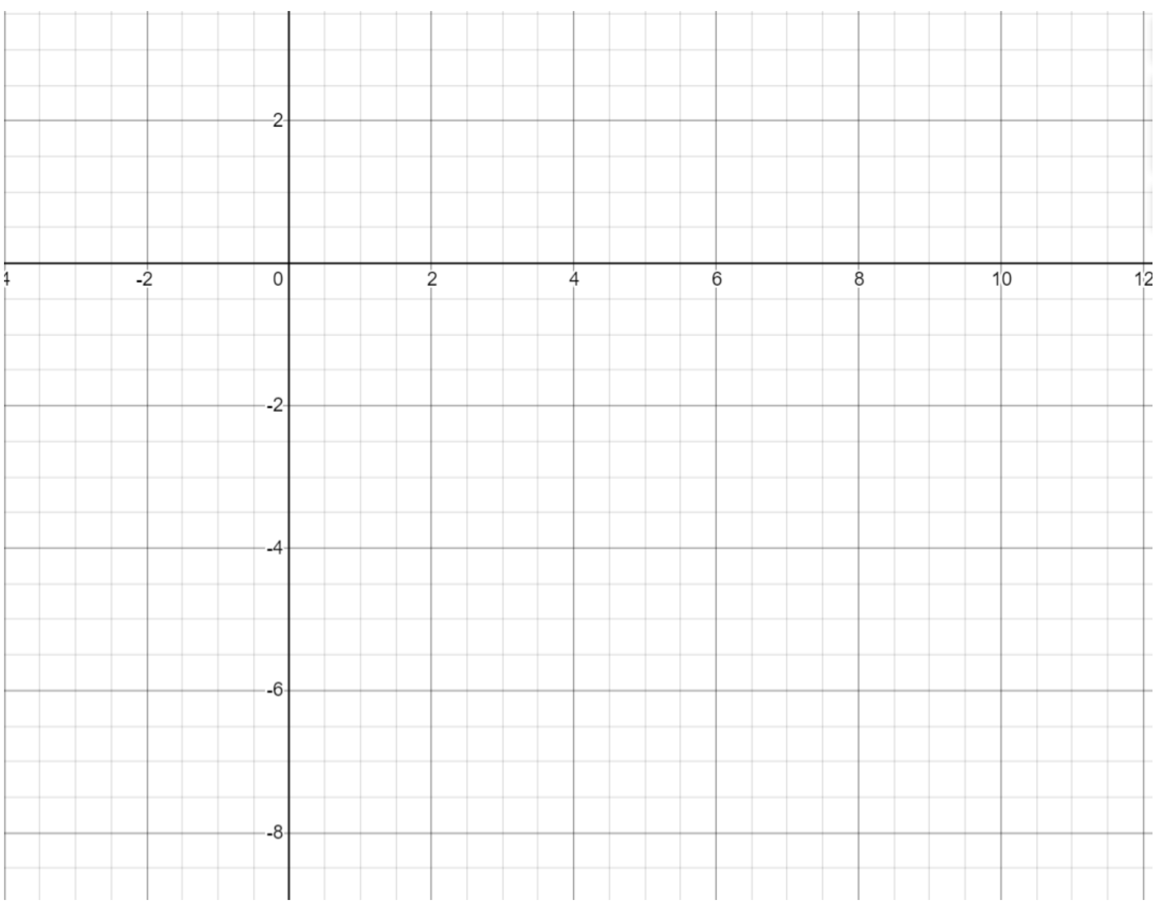
d) The parabola would shift seven units up.

Name: ______________________

7. Graph the following equation:
$y = -(x-4)^2 + 3$

Label the vertex with its ordered pair and the axis of symmetry with its equation.

SHOW WORK HERE:



You have finished Thursday’s Algebra I work! If submitting through Google classroom, scan or take pictures of pages 14 and 15 for the Minor Assessment submission.

Friday, May 1

Lesson 5

Objective: Transform quadratic equations from standard form into vertex form.

Good morning everyone! This week, we have been practicing using the vertex form of quadratic equations. Hopefully, you have recognized some benefits of vertex form – we can immediately determine the vertex and axis of symmetry just by looking at the equation! This is something we could not do immediately with standard form. Today, we will start learning how we can take a standard form equation and transform it into vertex form. This will take two days, so we will continue this concept next week as well.

Bell work:
Expand the following:

1. $(x-7)^2$	2. $(a+12)^2$	3. $(y-16)^2$

Look at your answers to the bell work. We have a special name for these – what is it?

They are all ______________ ________________ __________________!

Now, check your bell work with the answer key.

Lesson:
Notice that all vertex form parabolas have a *squared binomial*, which will always create a perfect square trinomial (PST) when multiplied out. **<u>Circle</u>** the ***squared binomial*** in each of the following vertex form equations:

$y=(x+4)^2-3$	$y=-\left(x+\frac{1}{2}\right)^2+8$	$y=4(x-5)^2+1$	$y=-\frac{2}{3}(x-6)^2-10$

Equations in standard form do not have a *squared binomial*. However, the fact that vertex form equations ALWAYS have this squared binomial means that we need to have a perfect square trinomial in order to write a quadratic equation in vertex form. Can you think of a process we have learned in the past in which we have built perfect square trinomials?!?!

Write your guess here: ____

Algebra 1
April 27 – May 1

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Name: ______________________

If you guessed "Completing the Square", you are correct! We will use the process of completing the square to create perfect square trinomials so that we can turn standard form equations into vertex form.

Read this example twice:

STEPS	EXPLANATION
$y = x^2 + 16 + 71$	This is an equation in standard form. I want it in vertex form, so it needs a PST. How do we build a PST?
$y = \underbrace{x^2 + 16x + \_\_\_\_}\ +71$	I'm going to move the 71 out of the way and focus on the x^2 and 16x. These are the building blocks of our PST.
Time to complete the square!	

	x	$+8$
x	x^2	$8x$
$+8$	$8x$	64

We want the number 64 to be in the blank! So, let's add 64 to both sides (we must follow the law of equality - whatever we do to one side, we must do to the other).

$$\underline{64} + y = x^2 + 16x + \underline{64} + 71$$

$$64 + y = (x+8)^2 + 71$$

Let's factor the PST!

$$64 + y = (x+8)^2 + 71$$
$$-64 \qquad\qquad\qquad -64$$
$$\boxed{y = (x+8)^2 + 7}$$

Now, we have to ensure y is all by itself on one side, so subtract 64 from both sides.

Hooray! It's now in vertex form!

Now, copy down the steps above to transform $y = x^2 + 16x + 71$ into vertex form. The act of copying the process will help strengthen your understanding!

Practice: Transform the following equations from standard form into vertex form using the process above.

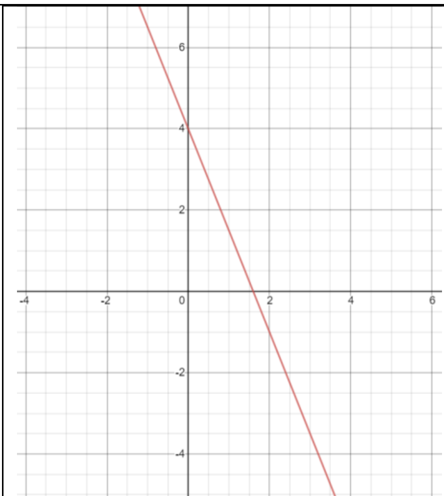
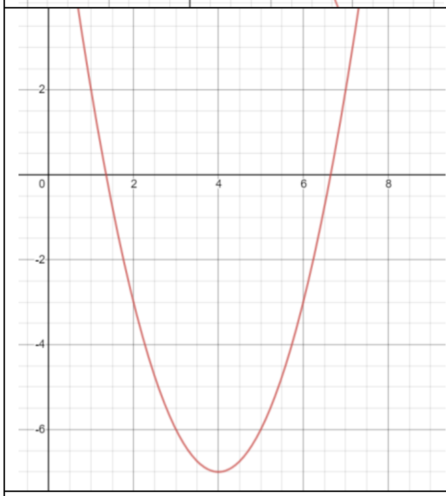
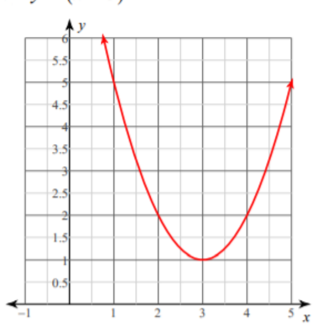
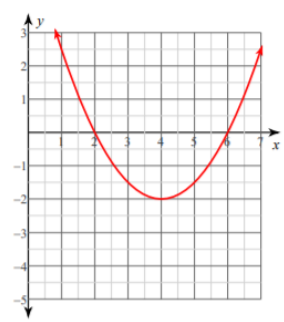
1. $y = x^2 - 2x - 5$	2. $y = x^2 + 4x$	3. $f(x) = x^2 + 18x + 85$

Check your work with the answer key at the end of the packet. You are now done with Week 6 for Algebra I!

Algebra 1
April 27 – May 1

Name: ______________________

<u>Answer Key for the Daily Work</u>

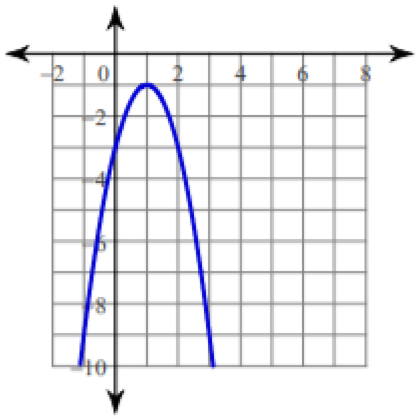
Lesson 1 (Monday)			1-2. Graph to right – same for both. 3. Both are linear because *x* is to the first power and forms a straight line when graphed. 4. standard form 5. slope-intercept form 6. They're the same line!
			7-8. Graph to right – same for both. 9. The graphs are quadratic because *x* is to the second power and they form parabolas when graphed. 10. They're the same! 11. Axis of symmetry: $x = 4$; Vertex: $(4, -7)$
		12-13. #12 Axis of symmetry: $x = 3$ Vertex: $(3, 1)$ #13 Axis of Symmetry: $x = 4$ Vertex: $(4, -2)$	$y = (x-3)^2 + 1$  $y = \frac{1}{2}(x-4)^2 - 2$ 

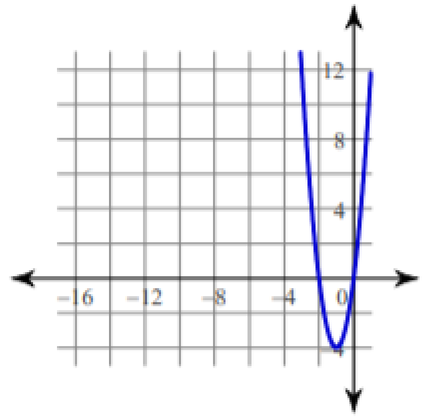
Lesson 2 (Tuesday)

1-2.

#1
Axis of Symmetry: $x = 1$
Vertex: $(1, -1)$

#2
Axis of Symmetry: $x = -1$
Vertex: $(-1, -4)$





Observations: Answers may vary.

Table B:

Equation:	$y = -(x+2)^2 + 3$	$y = \frac{4}{3}(x-5)^2 - 1$	$y = -3\left(x + \frac{3}{2}\right)^2 - 6$
Vertex:	(-2, 3)	(5, -1)	$\left(-\frac{3}{2}, -6\right)$
Axis of symmetry:	$x = -2$	$x = 5$	$x = -2$

Table C:

Equation:	$y = -3(x-4)^2 - 2$	$y = -\frac{1}{3}(x+8)^2 + 14$	$y = (x+11)^2 - 2.3$
a, h, and k	a = -3 h = 4 k = -2	$a = -\frac{1}{3}$ h = 5 k = 14	a = 1 h = -11 k = -2.3
Vertex:	$(4, -2)$	$(-8, 14)$	$(-11, -2.3)$
Axis of symmetry:	$x = 4$	$x = -8$	$x = -11$
Concave UP or concave DOWN?	Concave down	Concave down	Concave up

Lesson 3 (Wed.)

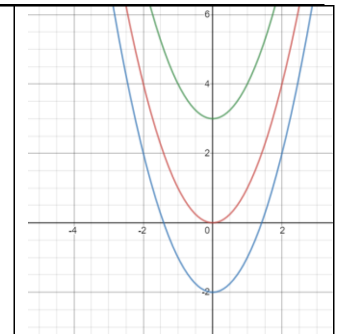
1.

$f(x) = x^2$	
-2	4
0	0
2	4

$f(x) = x^2 + 3$	
-2	7
0	3
2	7

$f(x) = x^2 - 2$	
-2	2
0	-2
2	2

a) The parabola shifts up k units when k is positive and down k units when k is negative.



2.

$f(x) = (x-1)^2$	
-2	9
0	1
2	1

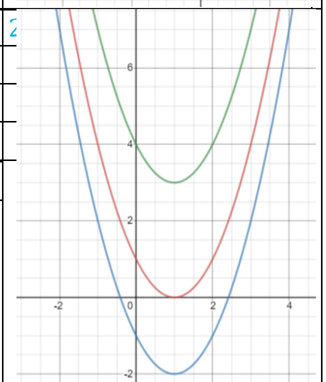
a = *1*; h =*1*; k = *0*

$f(x) = (x-1)^2 + 3$	
-2	1
0	2
2	2

a =*1*; h = *1*; k = *3*

$f(x) = (x-1)^2 - 2$	
-2	7
0	-1
2	-1

a = *1*; h =*1*; k = *-1*



a) k
b) k shifts the parabola up or down k units

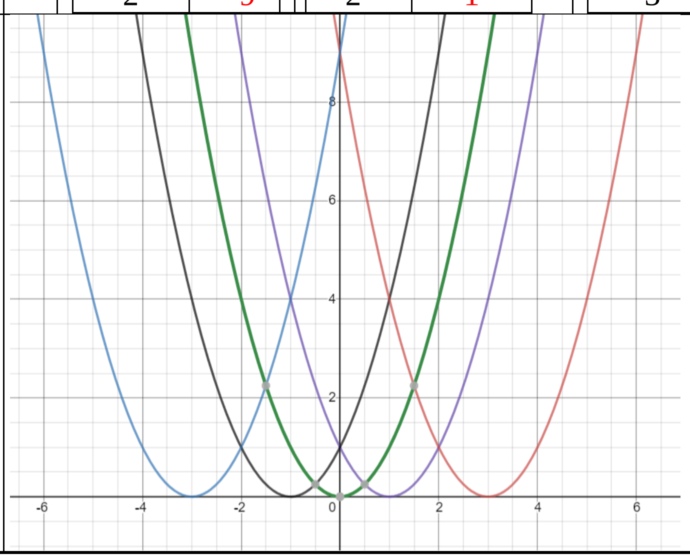
3.

$f(x) = (x+1)^2$	
-2	1
-1	0
0	1
1	4
2	9

$f(x) = (x-1)^2$	
-2	9
-1	4
0	1
1	0
2	1

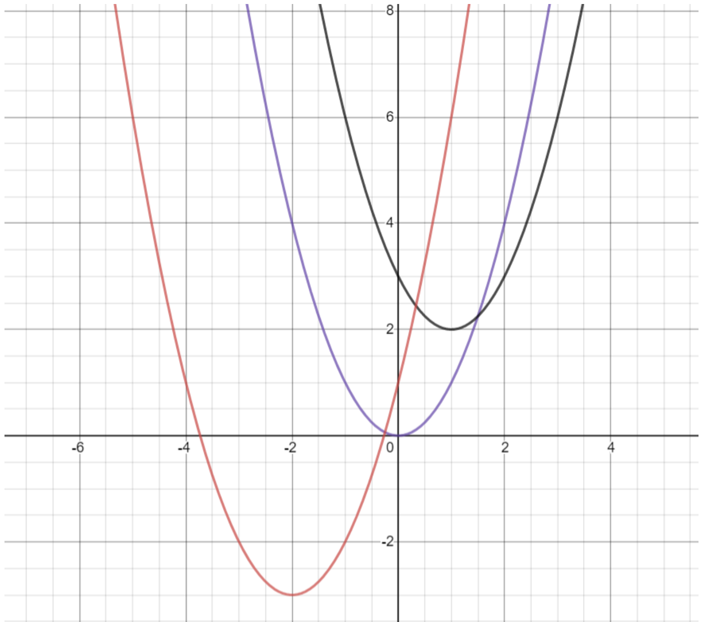
$f(x) = (x-3)^2$	
-1	16
0	9
1	4
2	1
3	0

$f(x) = (x+3)^2$	
-3	0
-2	1
-1	4
0	9
1	16



a) When h is negative (and therefore the quantity squared involves addition), the parabola shifts h units to the right. When h is positive (and therefore the quantity squared involves subtraction), the parabola shifts h units to the left. Essentially, h inside the quantity indicates a horizontal shift of the parabola.

4.



$\boldsymbol{f(x) = (x-1)^2}$

$\boldsymbol{f(x) = (x+2)^2}$

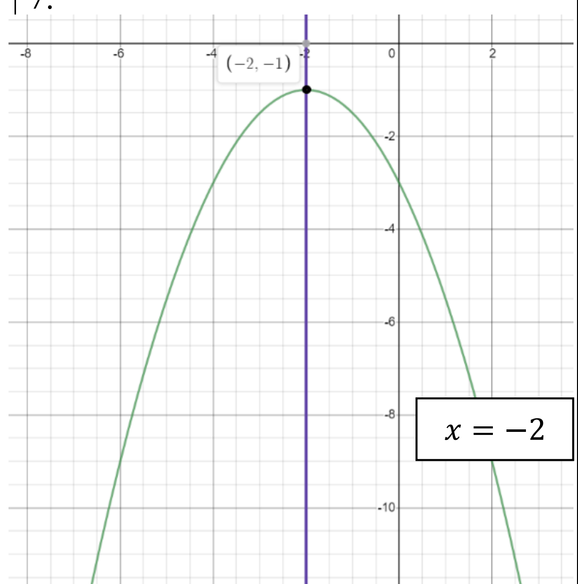
$y = x^2$

Lesson 4 (Thursday)

Practice:

1. $f(x) = a(x-h)^2 + k$
2. (-2, 3)
3. $y = (x-4)^2 - 1$
4. c
5. a
6. c

7.



$x = -2$

Algebra 1
April 27 – May 1

Name: ______________________

Lesson 5 (Friday)	Bell work: 1. $x^2 - 14x + 49$ 2. $a^2 + 24a + 144$ 3. $y^2 - 32y + 256$ All are perfect square trinomials!	1. 1. $y = x^2 - 2x - 5$ $y = x^2 - 2x + \_\_\_ - 5$ $\begin{array}{c\|c\|c} & x & -1 \\ \hline x & x^2 & -x \\ \hline -1 & -x & 1 \end{array}$ $\underline{1} + y = x^2 - 2x + \underline{1} - 5$ $1 + y = (x-1)^2 - 5$ $-1 \qquad\qquad -1$ $\boxed{y = (x-1)^2 - 6}$
	2. 2. $y = x^2 + 4x$ $y = x^2 + 4x + \_\_\_$ $\begin{array}{c\|c\|c} & x & +2 \\ \hline x & x^2 & 2x \\ \hline +2 & 2x & 4 \end{array}$ $\underline{4} + y = x^2 + 4x + \underline{4}$ $4 + y = (x+2)^2$ $-4 \qquad\qquad -4$ $\boxed{y = (x+2)^2 - 4}$	3. 3. $f(x) = x^2 + 18x + 85$ $f(x) = x^2 + 18x + \_\_\_ + 85$ $\begin{array}{c\|c\|c} & x & +9 \\ \hline x & x^2 & 9x \\ \hline +9 & 9x & 81 \end{array}$ $\underline{81} + f(x) = x^2 + 18x + \underline{81} + 85$ $81 + f(x) = (x+9)^2 + 85$ $-81 \qquad\qquad -81$ $\boxed{f(x) = (x+9)^2 - 4}$