

# TODAYS NOTES

Desmos

**Unit 8: Quadratic Functions****Learning Goal 8.1 – Transformations & Characteristics of Quadratic Functions****After completion of this unit, you will be able to...**

- Identify transformations from an function or graph
- Create a function to describe given transformations
- Describe characteristics of a quadratic function on a graph (vertex, axis of symmetry, intercepts, zeros, intervals of increase/decrease, extrema, positive/negative areas, and end behavior)

**Timeline for Unit 8**

Monday	Tuesday	Wednesday	Thursday	Friday
<b>20</b> <i>No School</i>	<b>21</b> Day 1 – Transformations of Quadratic Functions	<b>22</b> Day 2 – Characteristics of Quadratic Functions	<b>23</b> Day 3 – Characteristics of Quadratic Functions	<b>24</b> Day 4 – <b>8.1 Learning Assessment</b>
<b>27</b> Day 5 – Graphing in Vertex Form Graphing in Standard Form	<b>28</b> Day 6 – Graphing in Factored Form Practice	<b>29</b> Day 7 – Writing Equations of Parabolas	<b>30</b> Day 8 – Comparing Different Forms of Quadratics	<b>31</b> Day 9 – <b>8.2 Learning Assessment</b>
<b>3</b> Day 10 – Average Rate of Change	<b>4</b> Day 11 – Applications of the Vertex	<b>5</b> Day 12 – Comparing Different Quadratic Functions	<b>6</b> Day 13 – Comparing Different Quadratic Functions	<b>7</b> Day 14 – <b>8.3 Learning Assessment</b>

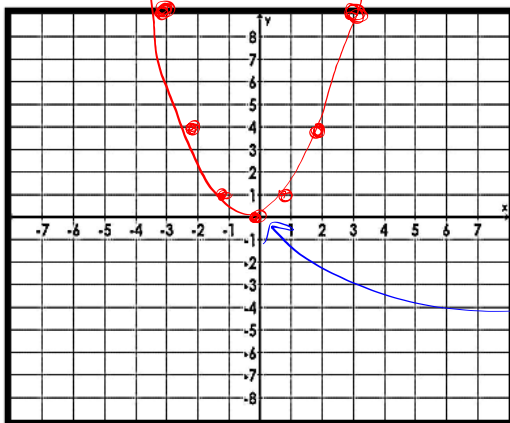
**Tutoring Times**

	Monday	Tuesday	Wednesday	Thursday	Friday
AM	Mrs. Jackson 7:45 – 8:15 Room 1210	Mr. Phillips 7:45 – 8:15 Room 1206	Mrs. Jackson & Mr. Webb 7:45 – 8:15 Room 1210 Room 1205	Mr. Watson & Mr. Phillips 7:45 – 8:15 Room 1208 Room 1206	Mr. Watson 7:45 – 8:15 Room 1208
PM	NONE	Mrs. Petersen 3:30 – 4:30 Room 1210	NONE	NONE	NONE

### Day 1: Quadratic Transformations (H & K values)

The **parent function** of a function is the simplest form of a function. The parent function for a quadratic function is  $y = x^2$  or  $f(x) = x^2$ . Graph the parent function below.

x	$x^2$
-3	9
-2	4
-1	1
0	0
1	1
2	4
3	9



As you can see, the graph of a quadratic function is very different than the graph of a linear function.

The U-shaped graph of a quadratic function is called a

parabola.

The highest or lowest point on a parabola is called the

vertex.

One other characteristic of a quadratic equation is that one of the terms is always  $x^2$ .

There are several different forms a quadratic function can be written in, but the one we are going to work with for today is called **vertex form**. In the following explorations below, you are going to learn the effect of a, h, and k values have on the parent graph.

#### Vertex Form

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

Variable	Summary of the Effects of the Transformations			
<b>a</b>	Reflect over x-axis	Up: +	Stretch or shrink	Stretch: bigger than
		Down: -		Shrink: b/w 0 and 1
<b>h</b>	left or right	Left: positive		
		Right: negative		
<b>k</b>	up or down	Up: +		
		Down: -		

Vertex:  $(h, k)$

[students.desmos.com](https://students.desmos.com)

CODE: 2GR6FZ

Algebra I

Unit 8: Quadratic Functions

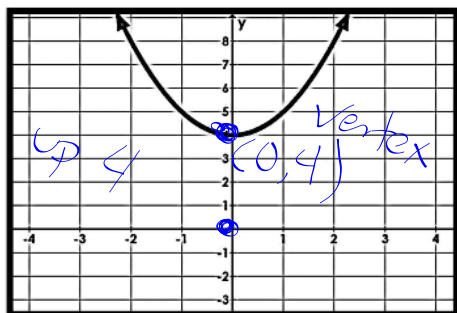
Notes

**Slide 1 ~ The K Value ~  $y = x^2 + k$** 

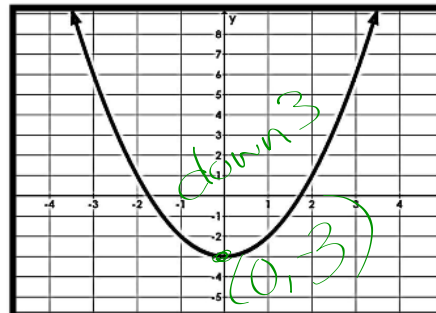
- a. What does the k value do to the blue graph? moves it up and down
- b. What does a positive k value do to the blue graph? moves it up
- c. What does a negative k value do to the blue graph? moves it down
- d. Which coordinate of the vertex changes when there is a k value present? y value
- e. Name the transformations that would occur for the following equations (you may use the regular Desmos calculator for help). Then name the vertex.

Equation	Transformations	Vertex
1. $y = x^2 + 5$	up 5	$(0, 5)$
2. $y = x^2 - 3$	down 3	$(0, -3)$
3. $y = x^2 + 7$	up 7	$(0, 7)$
4. $y = x^2 - 4$	down 4	$(0, -4)$

- f. Describe the transformations and name the vertex. Create an equation for the graphs listed below.



$$y = x^2 + 4$$



$$y = x^2 - 3$$

- g. Given the transformations listed below, create an equation that would represent the transformations.

1. Shifted up 8 units

$$y = x^2 + 8$$

2. Shifted up 20 units

$$y = x^2 + 20$$

3. Shifted down 5 units

$$y = x^2 - 5$$

Algebra I

Unit 8: Quadratic Functions

Notes

**Slide 2 ~ The H Value ~  $y = (x - h)^2$** 

- a. What does the h value do to the blue graph? moves left or right
- b. What does a positive h value do to the blue graph? moves to the right
- c. What does a negative h value do to the blue graph? left
- d. Which coordinate of the vertex changes when there is an h value present? x-value

**Slide 3 ~ The Tricky Part about the H Value**

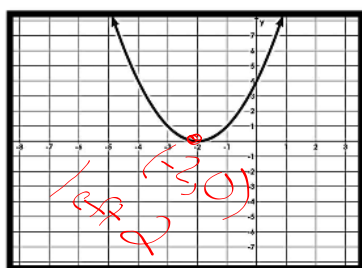
- e. Compare the blue graph to the black graph. How did the blue graph move? moved left
- f. What should be the h-value for the blue graph? negative
- g. However, when you look at the equation for the blue graph, what do you notice?  
the equation is positive  $y = (x+4)^2$
- h. Compare the green graph to the black graph. How did the green move? moved right
- i. What should be the h-value for the green graph? positive
- j. However, when you look at the equation for the green graph, what do you notice?  
the equation is negative  $y = (x-2)^2$

HMMM.....Now read Slide 4!

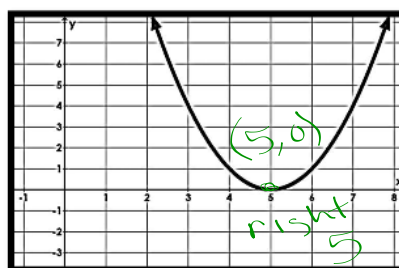
k. Name the transformations that would occur for the following equations (you may use the regular Desmos calculator for help). Then name the vertex.

Equation	Transformations	Vertex
1. $y = (x - 4)^2$	right 4	$(4, 0)$
2. $y = (x + 6)^2$	left 6	$(-6, 0)$
3. $y = (x - 7)^2$	right 7	$(7, 0)$
4. $y = (x + 3)^2$	left 3	$(-3, 0)$

l. Describe the transformations and name the vertex. Create an equation for the graphs listed below.



$$y = (x+2)^2$$



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

m. Given the transformations listed below, create an equation that would represent the transformations.

1. Shifted right 8 units

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

2. Shifted left 20 units

$$y = (x+20)^2$$

3. Shifted left 5 units

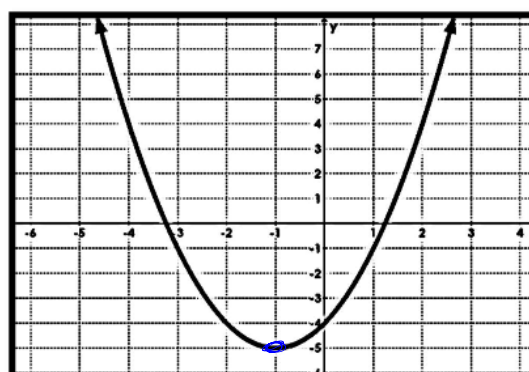
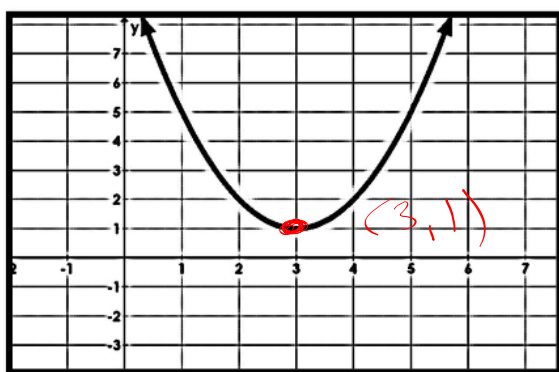
$$y = (x+5)^2$$

## Putting It All Together with H and K

**Practice:** Identify the transformations and vertex from the equations below.

Equation	Transformations	Vertex
1. $y = (x - 2)^2 + 4$	right 2 up 4	$(2, 4)$
2. $y = (x + 3)^2 - 2$	left 3 down 2	$(-3, -2)$
3. $y = (x - 9)^2 - 5$	right 9 down 5	$(9, -5)$
4. $y = (x + 5)^2 + 6$	left 5 up 6	$(-5, 6)$

**Practice:** Describe the transformations and name the vertex. Create an equation for the graphs listed below.



Transformations:	right 3 up 1	Transformations:	left 1 down 5
Vertex:	$(3, 1)$	Vertex:	$(-1, -5)$
Equation:	$y = (x - 3)^2 + 1$	Equation:	$y = (x + 1)^2 - 5$

**Practice:** Given the transformations listed below, create an equation that would represent the transformations.

1. Shifted <sup>k</sup>up 4 units and <sup>h</sup>left 3 units

$$y = (x + 3)^2 + 4$$

2. Shifted right 5 units and down 2 units

3. Shifted left 8 units and down 1 unit

4. Shifted up 5 units and right 9 units



Algebra I

Unit 8: Quadratic Functions

Notes

**Slide 5 ~ The A Value, part 1 ~  $y = ax^2$** 

- a. What does the a value do to the blue graph? Stretch or shrink
- b. When a is greater than 1, what does it do to the blue graph? stretch (skinny)
- c. When a is between 0 and 1, what does it do to the blue graph? shrink (wide)
- d. If there is only an a value, what will the vertex always be? (0,0)

**Slide 6 ~ The A Value, part 2 ~  $y = ax^2$** 

- a. What does the a value do to the blue graph? reflected over x-axis
- b. When a is less than 1, what does it do to the blue graph? reflected over x-axis

**Practice:** Describe the transformations from the given function to the transformed function.

a.  $f(x) = x^2 \rightarrow f(x) = 4x^2$

Stretch 4

b.  $y = x^2 \rightarrow y = \frac{1}{4}x^2$

shrink  $\frac{1}{4}$ 

c.  $f(x) \rightarrow 6f(x)$

stretch 6

d.  $f(x) = x^2 \rightarrow f(x) = -x^2$

Reflect

f.  $y = x^2 \rightarrow y = -\frac{1}{2}x^2$

reflect, shrink  $\frac{1}{2}$ 

g.  $f(x) \rightarrow -4f(x)$

reflect, stretch by 4

**Putting It All Together with A, H, and K****Practice:** Given the equations below, name the vertex and describe the transformations: (h,k)

Equation	Transformations	Vertex
1. $y = -(x-4)^2 + 7$ <i>a h k</i>	reflect, right 4, up 7	(4, 7)
2. $y = -2(x+2)^2 + 5$ <i>a h k</i>	reflect, stretch by 2, left 2, up 5	(-2, 5)
3. $y = \frac{1}{2}(x-3)^2 - 8$	shrink $\frac{1}{2}$ , right 3, down 8	(3, -8)

**Practice:** Create an equation to represent the following transformations:

- a. Shifted down 4 units, right 1 unit, and reflected across the x-axis
- b. Shifted up 6 units, reflected across the x-axis, and stretch by a factor of 3
- c. Shifted up 2 units, left 4 units, reflected across the x-axis, and shrunk by a factor of  $\frac{1}{4}$ .

# Class Practice

Algebra 1

Unit 8: Quadratic Functions

Practice

Day 1 – Quadratic Transformations (h &amp; k)

Name: \_\_\_\_\_

Practice Assignment

Date: \_\_\_\_\_ Block: \_\_\_\_\_

1. Match each equation with its graph, vertex, and description of its transformations by placing the appropriate letter on each line:

Equations:      A.  $y = (x + 3)^2 - 2$       B.  $y = (x - 3)^2 - 2$       C.  $y = (x - 3)^2 + 2$       D.  $y = (x + 3)^2 + 2$

Vertex:                      \_\_\_\_\_                      \_\_\_\_\_                      \_\_\_\_\_                      \_\_\_\_\_

Transformations:        \_\_\_\_\_                      \_\_\_\_\_                      \_\_\_\_\_                      \_\_\_\_\_

Graphs:                      \_\_\_\_\_                      \_\_\_\_\_                      \_\_\_\_\_                      \_\_\_\_\_

Answer Bank:

A. (-3, 2)

B. Left 3, down 2

C. (3, -2)

D. Right 3, down 2

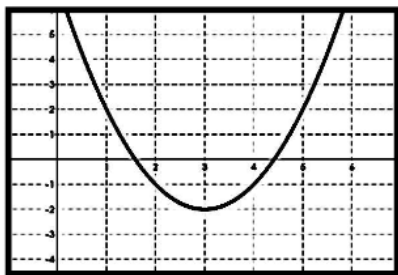
E. (3, 2)

F. Right 3, up 2

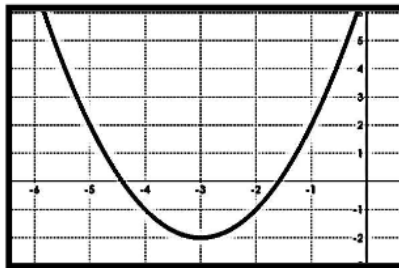
G. (-3, -2)

H. Left 3, up 2

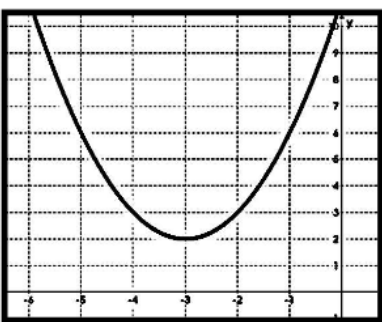
I. Graph 1



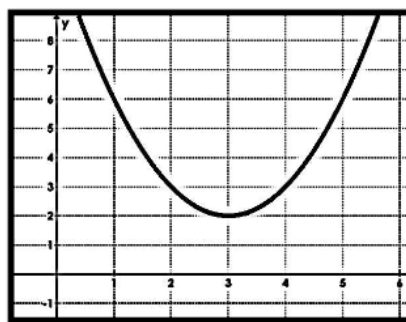
J. Graph 2



K. Graph 3



L. Graph 4



Algebra 1

Unit 8: Quadratic Functions

Practice

**2. Given each equation, name the vertex and describe the transformations.**

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

b.  $y = (x + 1)^2 - 6$

c.  $y = x^2 - 7$

d.  $y = (x + 2)^2$

**3. Create an equation that represents each transformation.**

a. Shifted down 6 units and left 4 units

b. Shifted right 8 units and up 5 units

c. Shifted left 1 units

d. Shifted down 10 units

**4. Name the vertex from the given transformations.**

a. Shifted left 3 units and down 4 units

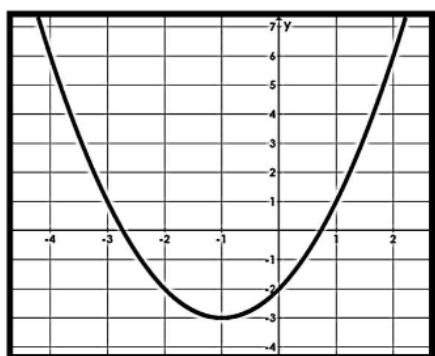
b. Shifted up 9 units and right 2 units

c. Shifted up 7 units

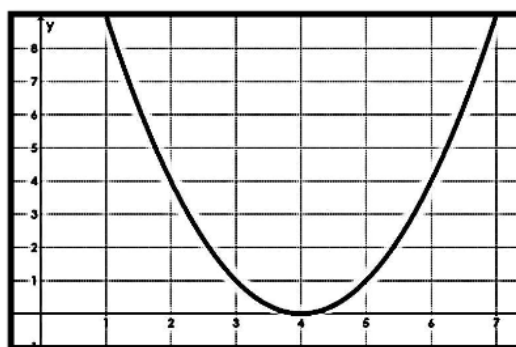
d. Shifted right 4 units

**5. Create an equation that represents each graph. Name the vertex.**

a.



b.



# Class Practice

Algebra 1

Unit 8: Quadratic Functions

Practice

Day 2 – Quadratic Transformations (all)

Name: \_\_\_\_\_

Practice Assignment

Date: \_\_\_\_\_ Block: \_\_\_\_\_

Describe the transformations of the parent graph for each equation. Then name vertex.

1.  $f(x) = x^2 + 5$

2.  $f(x) = -(x+9)^2 - 2$

3.  $f(x) = \frac{1}{2}(x-10)^2$

Vertex: \_\_\_\_\_

Vertex: \_\_\_\_\_

Vertex: \_\_\_\_\_

4.  $f(x) = -5x^2 + 2$

5.  $f(x) = \frac{2}{3}(x-8)^2$

6.  $f(x) = (x+1)^2 + 4$

Vertex: \_\_\_\_\_

Vertex: \_\_\_\_\_

Vertex: \_\_\_\_\_

Write the quadratic equation in vertex form that has been...

\_\_\_\_\_ 7. shifted to the right 4 and up 3

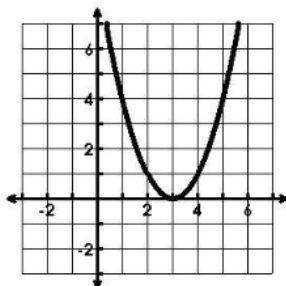
\_\_\_\_\_ 8. reflected over the x-axis and shifted left 11

\_\_\_\_\_ 9. moved down 4 and shrunk by  $\frac{1}{4}$ 

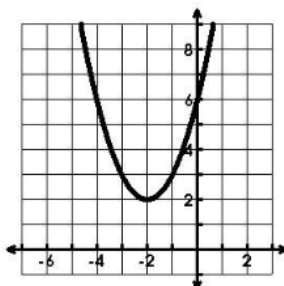
\_\_\_\_\_ 10. reflected over the x-axis, shifted left 9 and down 8.

Describe the transformations and write an equation for each quadratic function. Assume all functions have no stretches or shrinks.

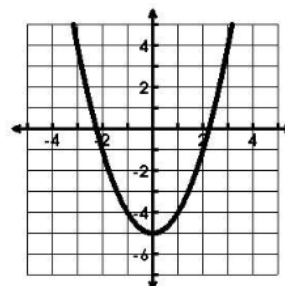
11.



12.



13.



14. Describe and correct the errors in analyzing the equation of  $f(x) = -6(x - 1)^2 + 4$ .



The graph is shifted up four units and shifted left one unit, followed by a stretch by a factor of 6, followed by a reflection over the x-axis. The vertex is  $(1, 4)$ .



The graph is shifted up 1 unit and shifted right 4 units, followed by a stretch by a factor of 6, followed by a reflection over the x-axis of the graph of the parent quadratic function. The vertex is  $(-1, 4)$ .

15-20. Match each function to its graph.

15.  $g(x) = 2(x - 1)^2 - 2$

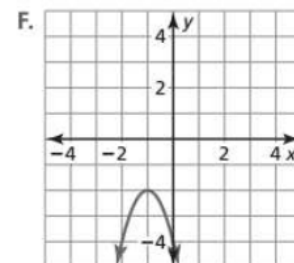
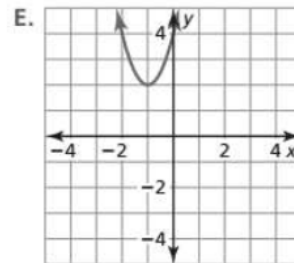
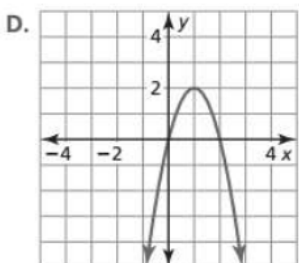
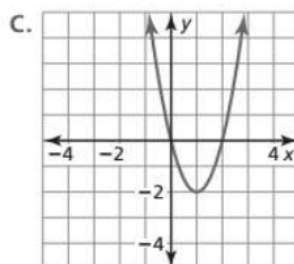
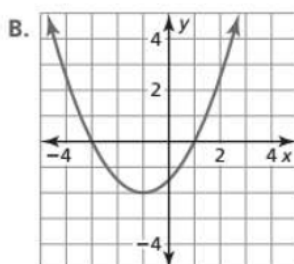
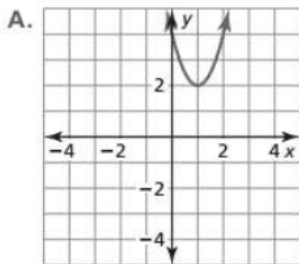
16.  $g(x) = \frac{1}{2}(x + 1)^2 - 2$

17.  $g(x) = -2(x - 1)^2 + 2$

18.  $g(x) = 2(x + 1)^2 + 2$

19.  $g(x) = -2(x + 1)^2 - 2$

20.  $g(x) = 2(x - 1)^2 + 2$



Algebra 1

Unit 8: Quadratic Functions

Practice

**Directions: Describe each transformation and name the vertex.**

Graph	Vertex	Describe the transformation(s)
$y = x^2 + 4$		
$y = x^2 - 1$		
$y = 2x^2$		
$y = -x^2 + 6$		
$y = \frac{1}{4}(x - 3)^2$		
$y = -3(x + 2)^2$		
$y = (x - 1)^2 + 3$		
$y = 2(x + 6)^2$		
$y = (x - 3)^2 - 5$		
$y = -\frac{1}{2}(x + 4)^2 + 5$		



Attachments

---

Syllabus - Math I A.doc