## Quadratic Functions – Characteristics

1. The axis of symmetry of a parabola does not always contain which point?

A. Maximum or Minimum
B. Vertex
C. Midpoint of the x-intercepts
**D. *y*-intercept**

2. What is the value of the function $f(x) = x^2 - 5x + 2$ evaluated at $x = 2$?

A. 16
B. 6
C. 2
**D. -4**

# DAY 5 AGENDA 2/28/18

1. Warm-up: Kahoot Review on Transformations

https://play.kahoot.it/#/?quizId=8b9f8aa9-9436-4c90-b5c7-aaefc35b5429

2. Warm-up: Kahoot Review on Characteristics

3. https://play.kahoot.it/#/lobby?quizId=b8786039-88b0-4f27-baf1-f0776e4058d7

4. Quiz

5. Graphing Vertex Form

# AFTER QUIZ

- Turn in HW on Day 3 – Characteristics (#1-9)
- Pick up Day 5 HW
- You are going to work on the factoring problems on the back side – Review a - i. This should be a review from Unit 3A.

# DAY 5: GRAPHING IN VERTEX FORM

Unit 3B: Quadratic Functions

# VERTEX FORM

**Vertex Form of a Quadratic Function:**

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

**a** determines how the graph opens

positive **a**, graph opens 

negative **a**, graph opens 

&

(h , k) is our vertex.

**NOTE:** Our vertex is at (h, k), **NOT** (-h, k).

# IDENTIFYING THE VERTEX

Find the vertex of the following:

1) $y = (x - 18)^2 + 9$ Vertex = (18, 9)

2) $y = 4(x + 6)^2 - 7$ Vertex = (-6, -7)

3) $y = (x - 2)^2 - 2$ Vertex = (2, -2)

Find the vertex for each of the following quadratics and determine whether the graph opens up or down:

a) $y = (x - 1)^2 - 2$ Vertex = (1, -2) Graph Opens  because a is p

b) $y = -3(x + 4)^2 + 1$ Vertex = (-4, 1) Graph Opens  because a is n

c) $y = 2x^2 + 3$ Vertex = (0, 3) Graph Opens  because a is p

d) $y = -(x - 3)^2$ Vertex = (3, 0) Graph Opens  because a is n

# GRAPHING IN VERTEX FORM

1) Find the vertex (h, k).

2) Use your vertex as the center for your table and determine two x values to the left and right of your h value and substitute those x values back into the equation to determine the y values.

   - Using practice problem number 3, let's practice filling in our table.

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

V = 2, -2

| x | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| y | 2 | -1 | -2 | -1 | 2 |

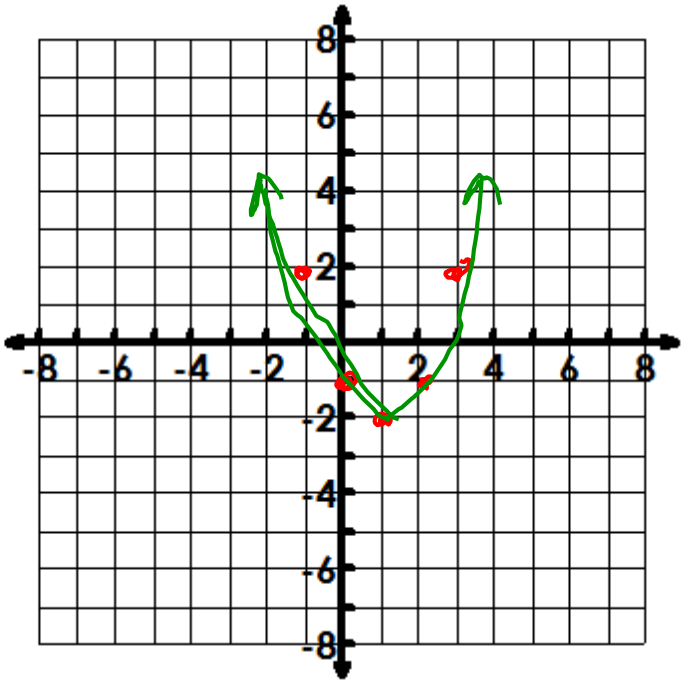
3) Plot your points and connect them from left to right!

# EXAMPLE 1

**Example 1:** Graph $y = (x-1)^2 - 2$.

Vertex = (1, -2)

| x | -1 | 0 | 1 | 2 | 3 |
|---|---|---|---|---|---|
| y | 2 | -1 | -2 | -1 | 2 |

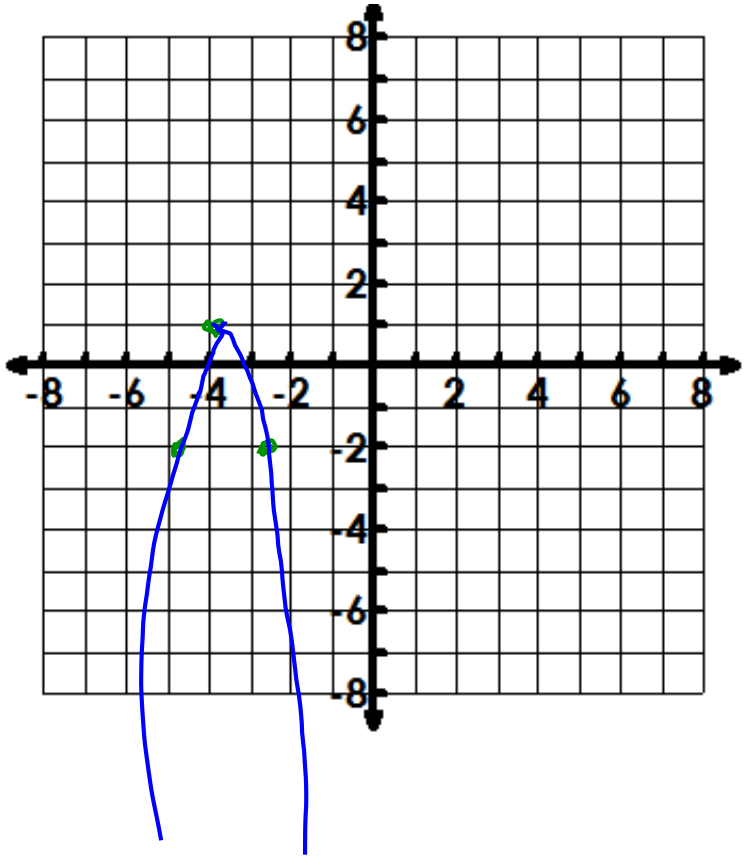


# EXAMPLE 2

**Example 2:** Graph: $y = -3(x + 4)^2 + 1$.

Vertex = (−4, 1)

| x | −6 | −5 | −4 | −3 | −2 |
|---|---|---|---|---|---|
| y | −11 | −2 | 1 | −2 | −11 |

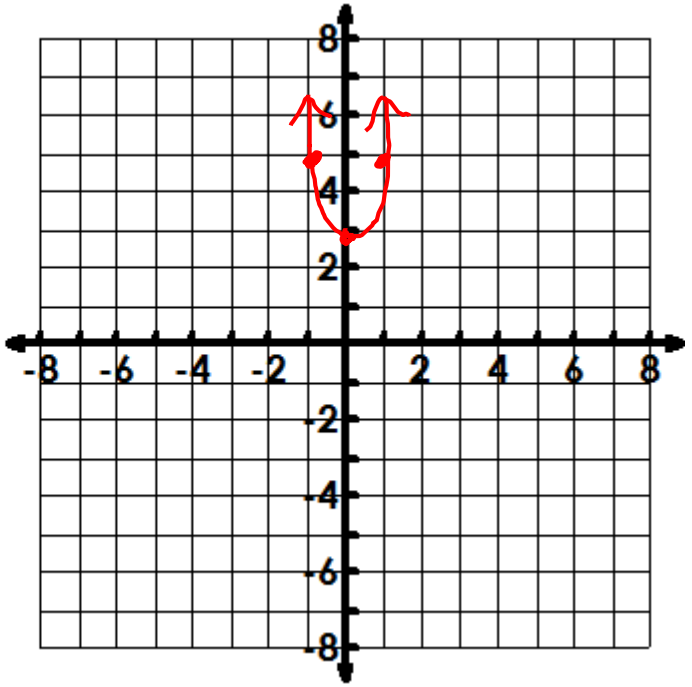


# EXAMPLE 3

**Example 3:** Graph $y = 2x^2 + 3$.

Vertex = (0, 3)

| x | -2 | -1 | 0 | 1 | 2 |
|---|---|---|---|---|---|
| y | 11 | 5 | 3 | 5 | 11 |

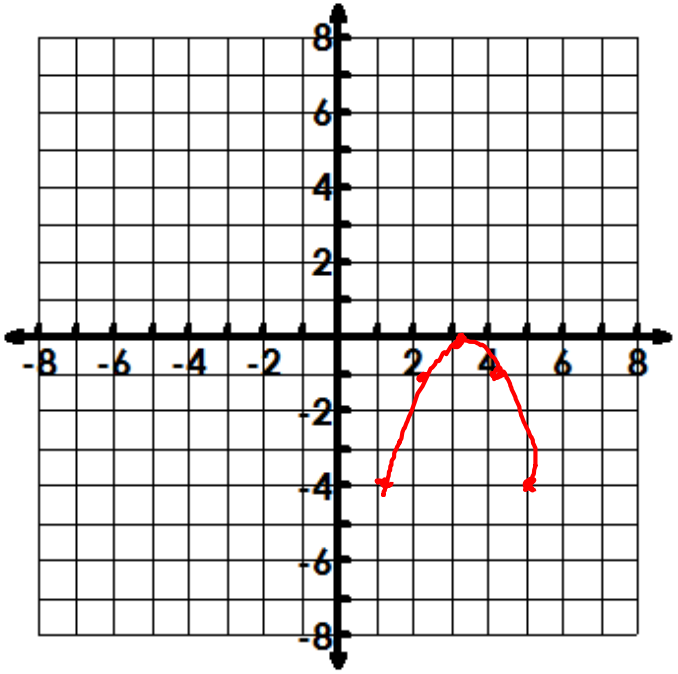


# EXAMPLE 4

**Example 4:** Graph: $y = -(x - 3)^2$.

Vertex = (3, 0)

| x | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| y | -4 | -1 | 0 | -1 | -4 |



# Graphing Quadratic Functions

## Vertex Form

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

The AXIS OF SYMMETRY is $x = h$. This is the "inverse of the inside."

The VERTEX is on the axis of symmetry line at $(h, k)$. The is what you get if you "inverse the inside and keep the constant." Look for this vertex in your table. The a-value determines whether your graph "goes up" on both sides or "goes down" on both sides of your vertex.

The vertex is a MINIMUM if the a-value is positive because it goes up on both sides, looks like a "U," and has a low point. The vertex is a MAXIMUM if the a-value is negative because it goes down on both sides, looks like an "∩," and has a high point.

A good PARABOLA has at least five points. Make a table of values with your vertex in the middle and plot them to make a good graph.

Your parabola looks just like the parent function but might include some transformations. If the a-value is negative, your graph has been REFLECTED over the x-axis. If the a-value (ignoring the negative) is less than one, your graph has been SHRUNK or COMPRESSED vertically. If the a-value (ignoring the negative) is bigger than one, your graph has been STRETCHED vertically. The location of the vertex determines where the graph has been SHIFTED or TRANSLATED.

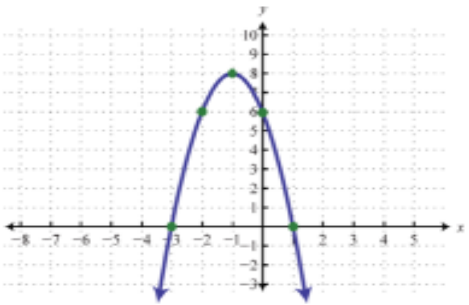
Example:

$y = -2(x + 1)^2 + 8$

$a = -2 \quad h = -1 \quad k = 8$

Vertex: $(-1,8)$

| $X$ | $Y$ |
|---|---|
| $-3$ | 0 |
| $-2$ | 6 |
| $-1$ | 8 |
| 0 | 6 |
| 1 | 0 |



This graph is a parabola that has been reflected over the x-axis, stretched vertically, and translated left 1 unit and up 8 units.

# Practice

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

A = 1 H = -3 K = -5

Vertex? (-3, -5)

Transformations?

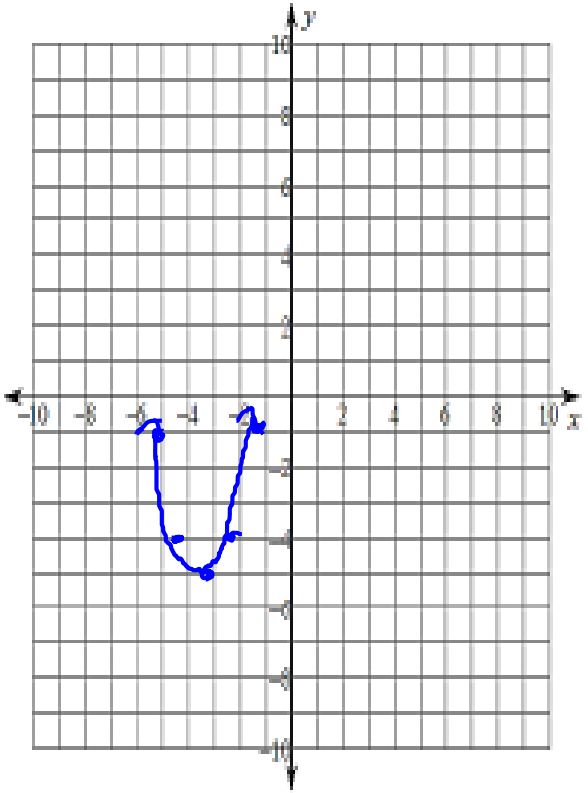
left 3

down 5

Up or Down?

Maximum or Minimum?

| x | y |
|---|---|
| -5 | -1 |
| -4 | -4 |
| -3 | -5 |
| -2 | -4 |
| -1 | -1 |



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

A = −1 H = 2 K = −5

Vertex? (2, −5)

| x | y |
|---|---|
| 0 | −9 |
| 1 | −6 |
| 2 | −5 |
| 3 | −6 |
| 4 | −9 |

Transformations?

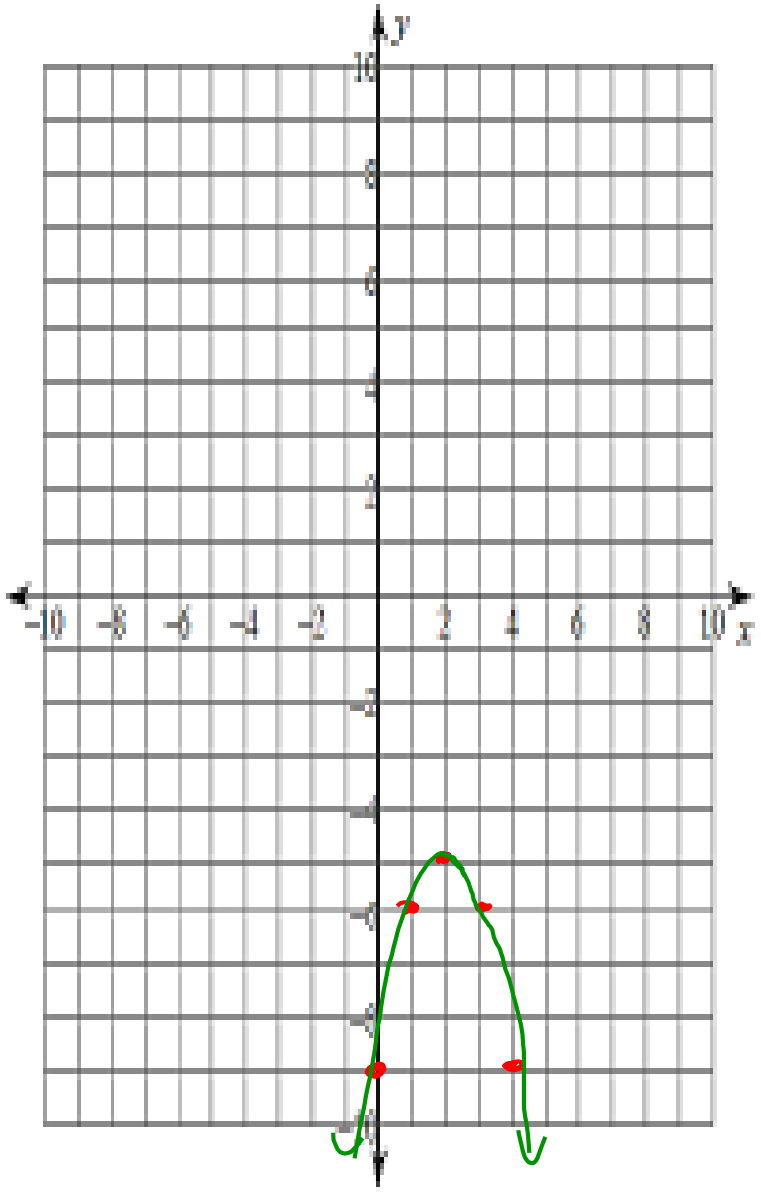
Reflect over x-axis

Right by 2 units

down by 5 units

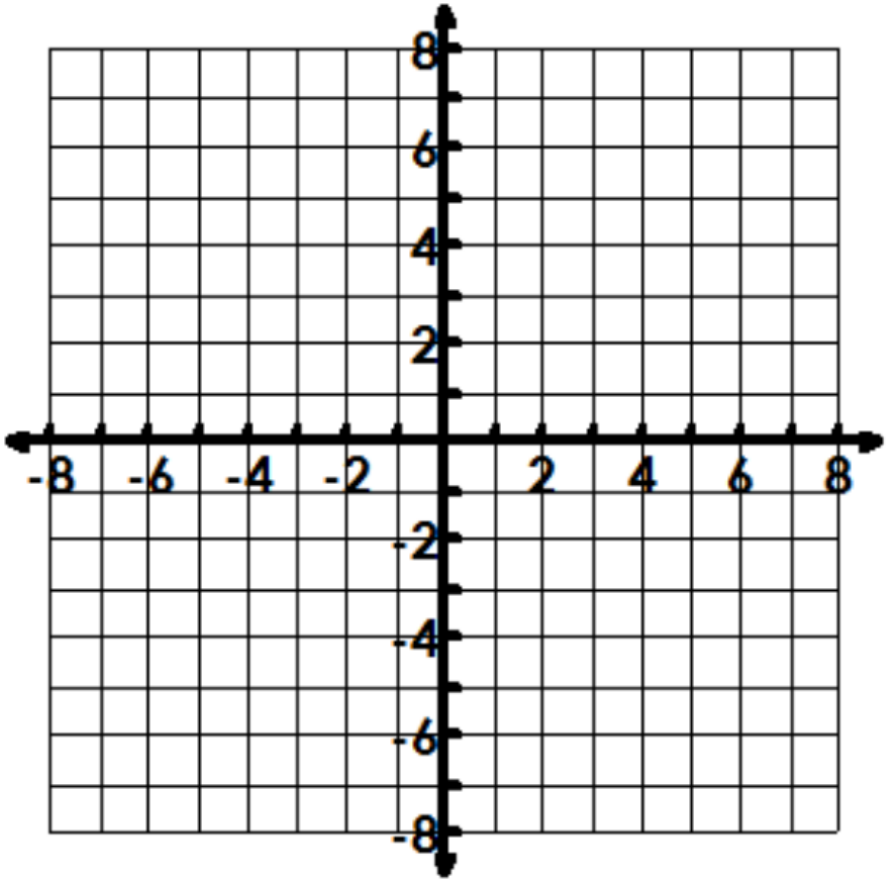
Up or Down?

Maximum or Minimum?



# POST-IT CHECK!

**Create a sketch of a graph that has a range of $y \geq -4$, an axis of symmetry of $x = -2$, and zeros at -4 and 0.**



3. $y = -2(x-7)^2 + 8$

A = -2 H = 7 K = 8

Vertex? (7, 8)

| x | y |
|---|---|
| 5 | 0 |
| 6 | 6 |
| 7 | 8 |
| 8 | 6 |
| 9 | 0 |

Transformations?

Reflect over x-axis

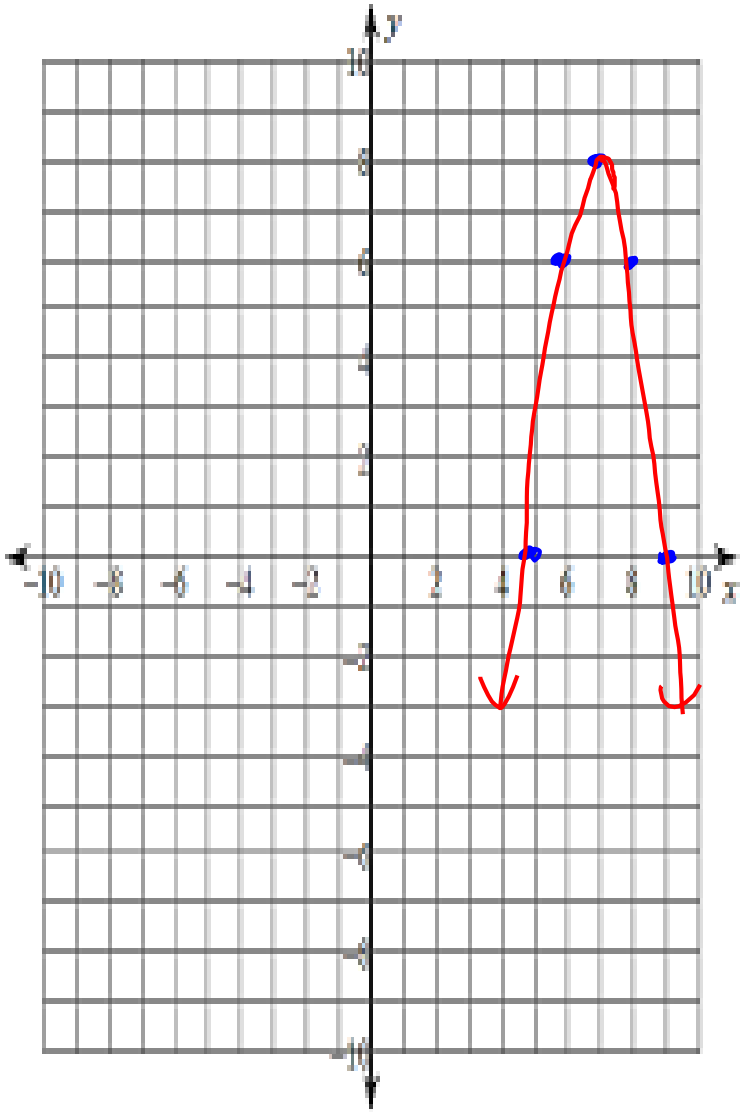
Vertical stretch by scale factor of 2

Right 7 units

Up 8 units.

Up or Down?

Maximum or Minimum?



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

A = -1 H = -2 K = 0

Vertex? (-2, 0)

| x | y |
|---|---|
| -4 | -4 |
| -3 | -1 |
| -2 | 0 |
| -1 | -1 |
| 0 | -4 |

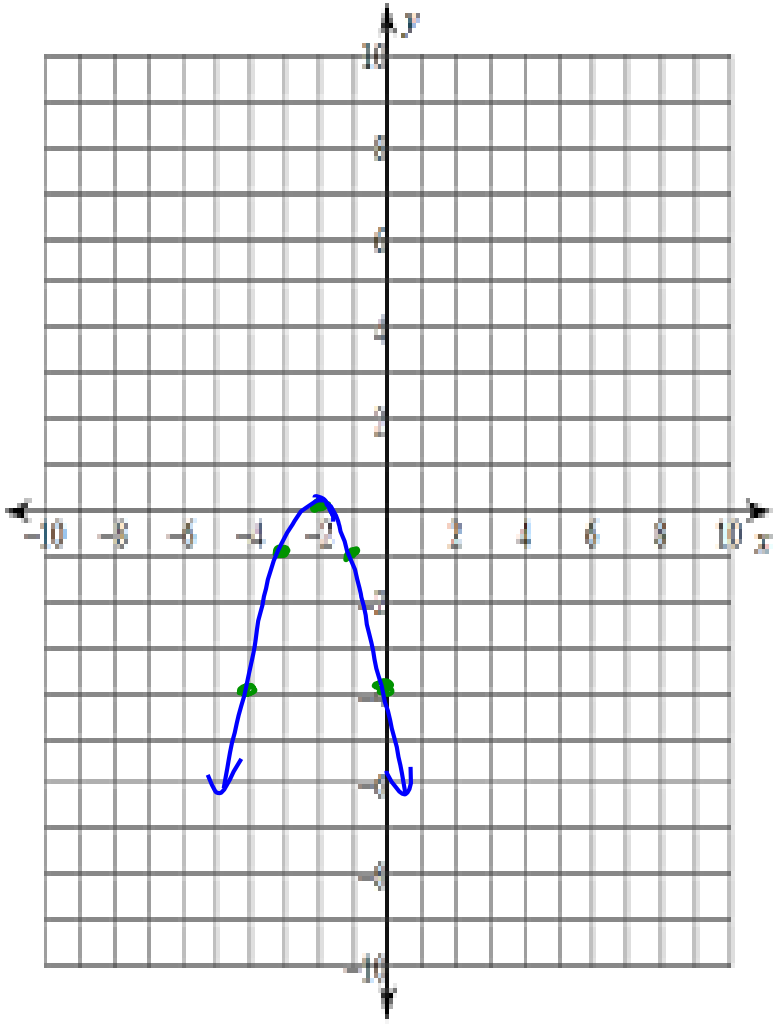
Transformations?

Reflect over x-axis

left by 2 units

Up or Down?

Maximum or Minimum?



5. $y = 2(x+3)^2 - 6$

A = H = K =

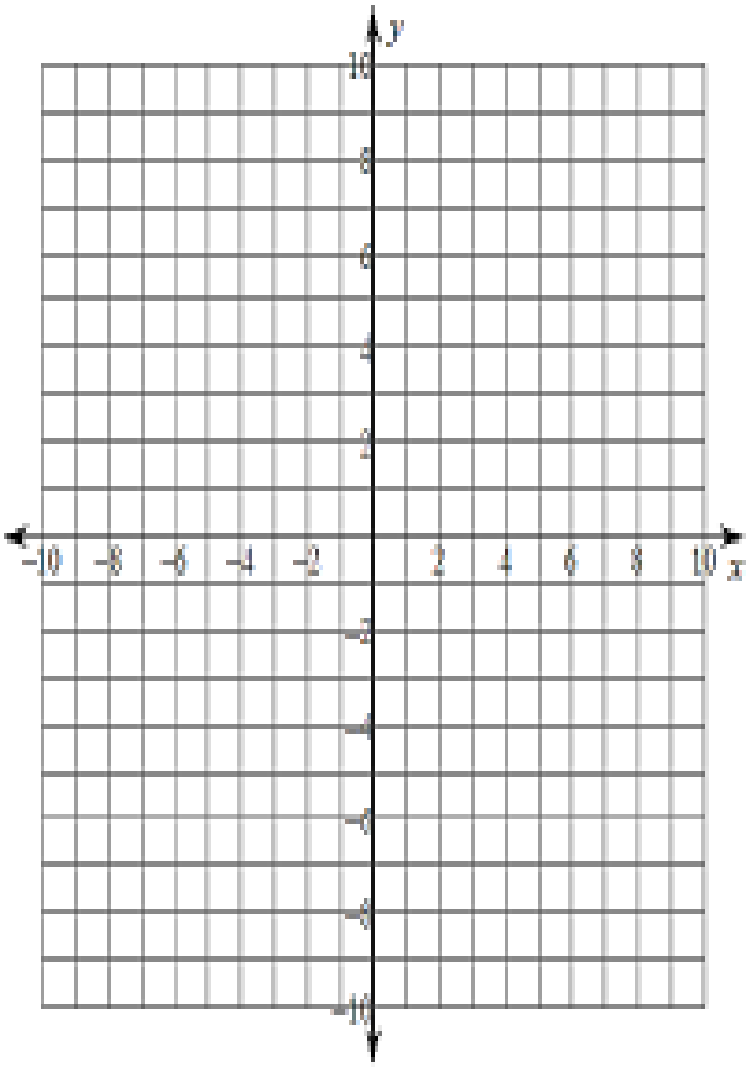
Vertex?

Transformations?

Up or Down?

Maximum or Minimum?

| x | y |
|---|---|
| | |
| | |
| | |
| | |
| | |



6. $y = -\frac{1}{2}(x+4)^2 + 7$

A = H = K =

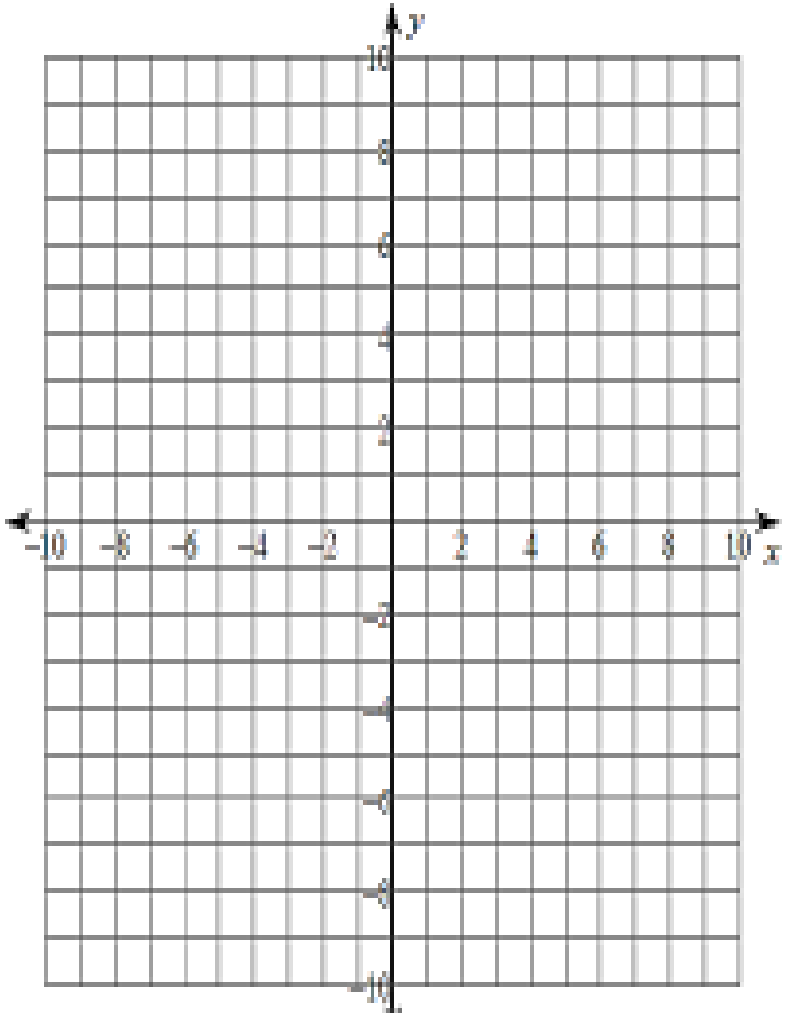
Vertex?

Transformations?

Up or Down?

Maximum or Minimum?

| x | y |
|---|---|
| | |
| | |
| | |
| | |
| | |



# USING A GRAPHING CALCULATOR

Use a graphing calculator to graph our last example problem, example 4: $y= -(x - 3)^2$

1. Hit **Y =** and enter the equation into $y_1$.

2. Hit **Graph** (Hit **Zoom,** then **6** to get back to a standard viewing window, if necessary).

3. You can also use the table on the graphing calculator to compare to your table and note the symmetry along the vertex. Hit **2nd** followed by **Graph** (you really want the Table feature). Scroll through the table until you find where the $y_1$ values stop decreasing and begin increasing, the point it switches at is our vertex.