# Transformations

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

**A negative out front means it reflects over the x-axis**

**Inside ( ) means horizontal shift:**
**+ moves to left**
**- moves to right**

**Outside of ( ) means vertical shift:**
**+ moves up**
**- moves down**

**>1= vertical stretch (narrow)**

**Between 0 and 1 = vertical compression/ shrink (wide)**

## Example

$f(x) = -2(x-5)^2 + 7$

1. (-) negative up front; it reflects over x axis
2. 2 is >1: there is a vertical stretch (it will be skinnier)
3. -5 is in ( ); moves right 5 spaces
4. +7 outside ( ); moves up 7 spaces

## Example

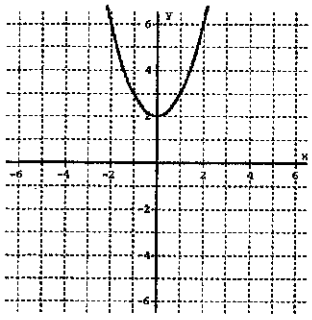
$f(x) = \frac{1}{2}(x+1)^2 - 9$

1. ½ is between 0 and 1; there is a shrink
2. +1 is in ( ); it moves left 1 space
3. -9 is outside ( ); moves down 9

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

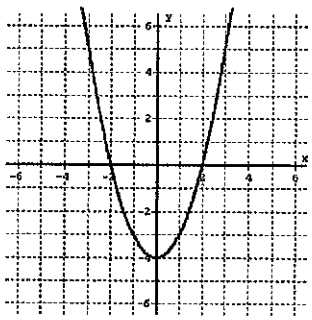
| Graph | Vertex | Describe the transformation(s) |
|---|---|---|
| $y = x^2 + 4$ | | |
| $y = x^2 - 1$ | | |
| $y = 2x^2$ | | |
| $y = -x^2 + 6$ | | |
| $y = \frac{1}{4}(x - 3)^2$ | | |
| $y = -3(x + 2)^2$ | | |
| $y = (x - 1)^2 + 3$ | | |
| $y = 2(x + 6)^2$ | | |
| $y = (x - 3)^2 - 5$ | | |
| $y =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

# Transformations of $y = f(x) = x^2$



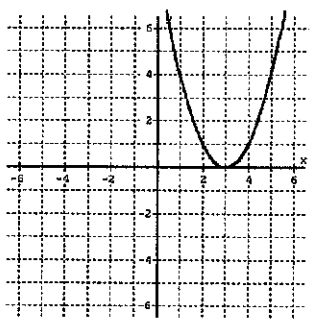
Vertical Shift – Up 2

$y = x^2 + 2$



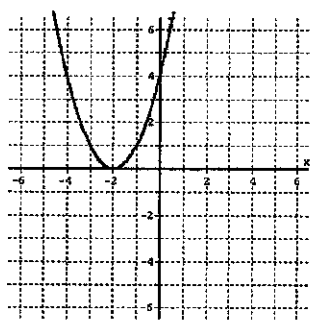
Vertical Shift – Down 4

$y = x^2 - 4$



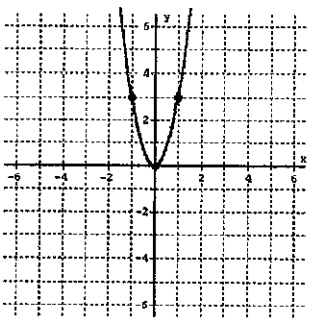
Horizontal Shift – Right 3

$y = (x - 3)^2$



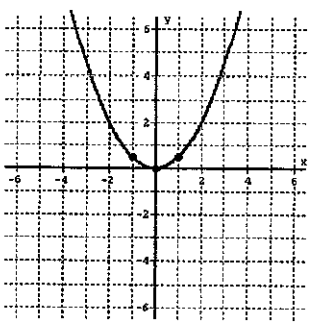
Horizontal Shift – Left 2

$y = (x + 2)^2$



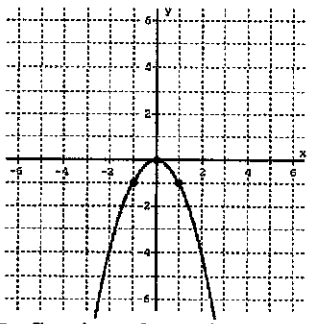
Vertical Stretch
Steeper / Narrower

$y = 3x^2$



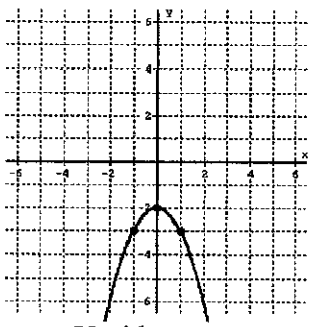
Vertical Compression
Flatter / Wider

$y = \frac{1}{2}x^2$



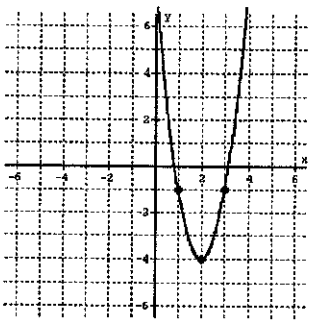
Reflection about the x-axis
Upside Down

$y = -x^2$



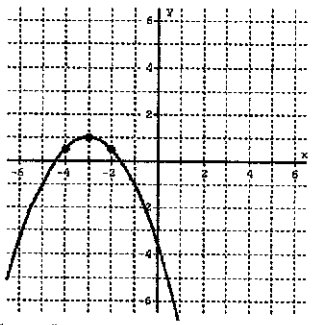
Upside Down
and Down 2

$y = -x^2 - 2$



Steeper, Opens Up, Right 2, Down 4

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



Wider, Opens Down, Left 3, Up 1

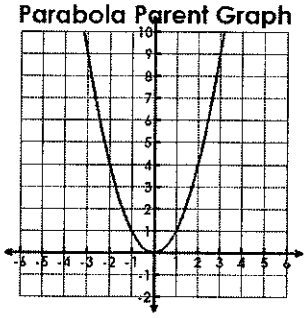
$y = -\frac{1}{2}(x + 3)^2 + 1$

Name: _____ Date: _____

# Transformations of Vertex Form

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

Parabola Parent Graph



**What does <u>a</u> do?**
- reflect across the x-axis. (–a)
- vertical stretch (a >1)
- vertical shrink (0<a<1)

**What does <u>h</u> do?**
- moves left (+h)
- moves right (–h)

**What does <u>k</u> do?**
- moves up (+k)
- moves down (–k)

**Determine what transformations are applied in the following functions.**

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

2. $f(x) = -(x-2)^2 + 7$

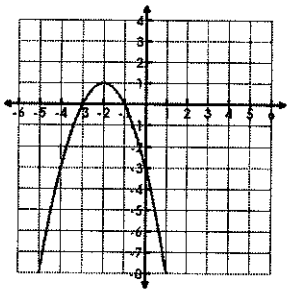
3. $f(x) = \frac{1}{3}(x+3)^2 - 2$

4. $f(x) = 4(x-3)^2 + 8$

Vertex: $(h,k)$ | Axis of Symmetry: $x = h$

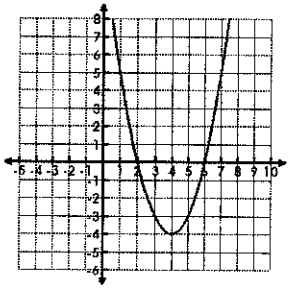
**Given the graph of the quadratic, find a, h, & k. Then write the equation in vertex form.**

5.



- a = _____
- h = _____
- k = _____
- f(x) =

6.



- a = _____
- h = _____
- k = _____
- f(x) =

GSE Algebra I | Graphing Quadratics

Name: _____ Date: _____

## Vertex Form of a Quadratic

UNIT QUESTION: How are real life scenarios represented by quadratic functions?
Today's Question: How do we graph quadratics in vertex form using transformations? MCC9-12.F.BF.3

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

**Vertex: (h,k)**

**Describe in words the transformations of the parent graph for each equation.**

1. $f(x) = x^2 + 5$
   - a:_____
   - h:_____
   - k:_____

2. $f(x) = -(x+9)^2 - 2$
   - a:_____
   - h:_____
   - k:_____

3. $f(x) = \frac{1}{2}(x-10)^2$
   - a:_____
   - h:_____
   - k:_____

4. $f(x) = -5x^2 + 2$
   - a:_____
   - h:_____
   - k:_____

5. $f(x) = \frac{2}{3}(x-8)^2$
   - a:_____
   - h:_____
   - k:_____

6. $f(x) = (x+1)^2 + 4$
   - a:_____
   - h:_____
   - k:_____

**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 17

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

Algebra 1 Quadratic Function Practice

**Quadratic Transformations (h & k)** **Name:** _____

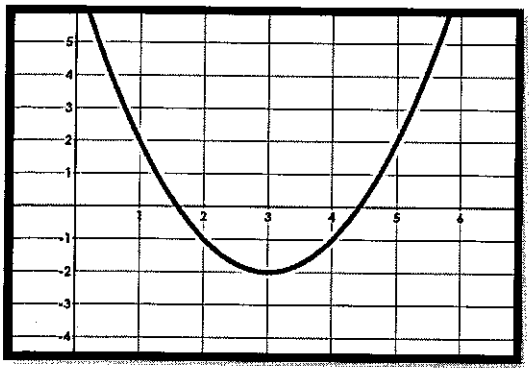
**. Match each equation with its graph, vertex, and description of its transformations by placing the appropriate letter on each line:**

| | | | | |
|---|---|---|---|---|
| **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:** | _____ | _____ | _____ | _____ |

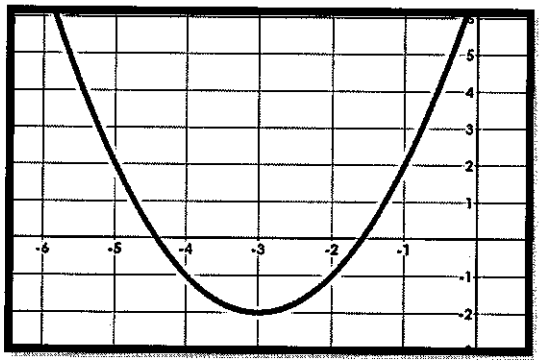
**Answer Bank:**

| | | | |
|---|---|---|---|
| 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 |

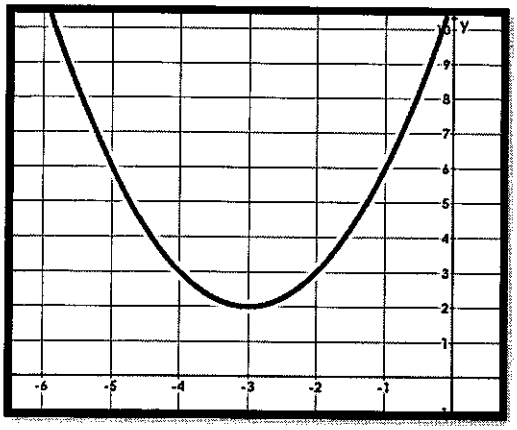
I. Graph 1



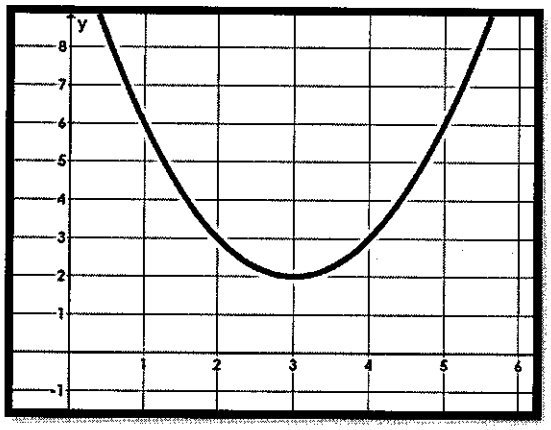
J. Graph 2



K. Graph 3



L. Graph 4



**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

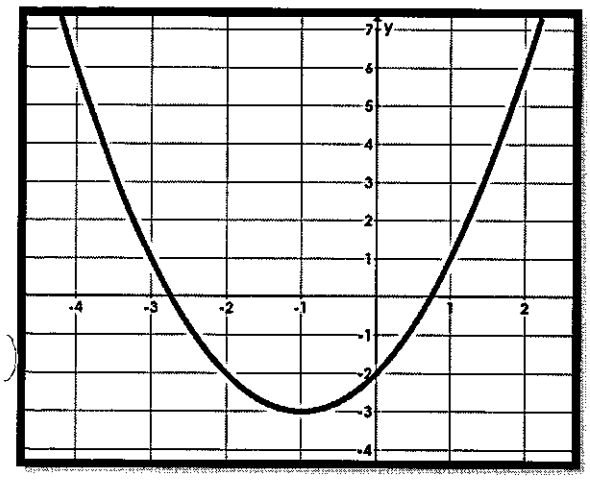
b. Shifted up 9 units and right 2 units

c. Shifted up 7 units

d. Shifted right 4 units

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

a.




b.