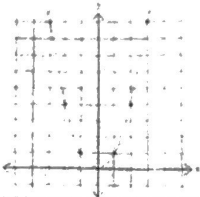


Quadratic Transformations ('h' and 'k' values): Exploring graphs and their transformations

Yesterday, we learned about the Vertex Form of a Quadratic Function: $y = a(x + h)^2 + k$. In the explorations below, we are going to learn the effect that 'h' and 'k' have on the parent graph, $y = x^2$. These effects are known as transformations.

Parent Function	Example 1	Example 2	Example 3	Example 4
$y = x^2$ 	$y = x^2 + 4$	$y = x^2 - 4$	$y = (x - 4)^2$	$y = (x + 4)^2$
$y = x^2$	$y = x^2 + 2$	$y = x^2 - 2$	$y = (x - 2)^2$	$y = (x + 2)^2$

How does the number outside of the parentheses, 'k', affect the graph?

- if k is positive, then graph shifts up
- if k is negative, then graph shifts down

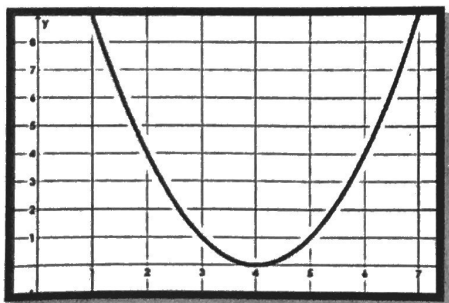
How does the number inside of the parentheses, 'h', affect the graph? * opposite

- if h is positive, then graph shifts left
- if h is negative, then graph shifts right

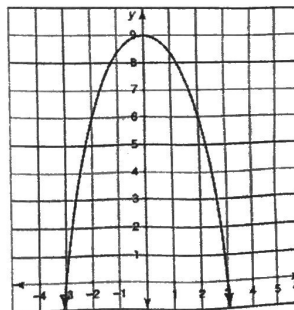
Practice: Identify the transformations and vertex from the equations below.

- | | | | |
|---|---|---|---|
| 1. $y = x^2 + 4$
up 4
$(0, 0) \rightarrow (0, 4)$ | 2. $y = x^2 - 2$
down 2
$(0, -2)$ | 3. $y = (x - 5)^2$
right 5
$(5, 0)$ | 4. $y = (x + 1)^2$
left 1
$(-1, 0)$ |
|---|---|---|---|

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



right 4
 $(x - 4)^2$



up 9
 $x^2 + 9$

parentheses

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

1. Shifted up 4 units

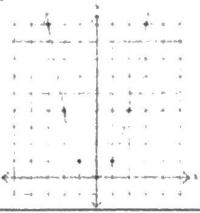
$x^2 + 4$

2. Shifted left 10 units

$(x + 10)^2$

Quadratic Transformations ('h' and 'k' values): Exploring graphs and their transformations

We just learned the effects that 'h' and 'k' have on the parent graph separately, now let's discover what happens when we put it all together!

Parent Function	Example 1	Example 2	Example 3	Example 4
$y = x^2$ 	$y = (x - 2)^2 + 4$ -right 2 -up 4 (2, 4)	$y = (x - 2)^2 - 4$	$y = (x - 4)^2 + 2$	$y = (x + 4)^2 + 2$
$y = x^2$	$y = (x - 3)^2 + 2$	$y = (x - 3)^2 - 2$	$y = (x - 2)^2 + 3$	$y = (x + 2)^2 + 3$

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

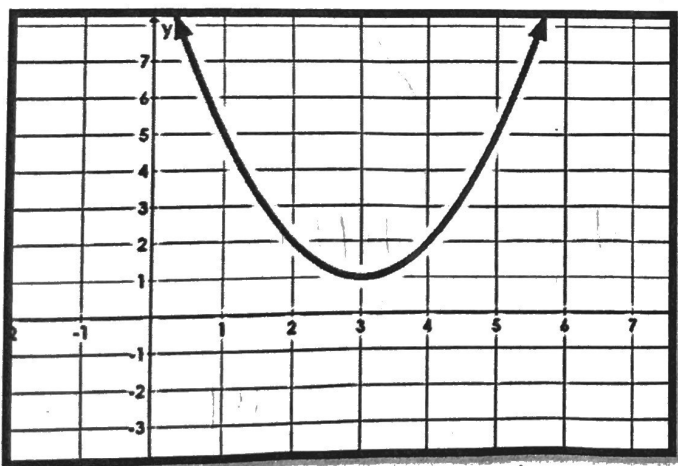
1. $y = (x - 2)^2 + 4$
 -right 2
 -up 4
 (2, 4)

2. $y = (x + 3)^2 - 2$
 -left 3
 -down 2
 (-3, -2)

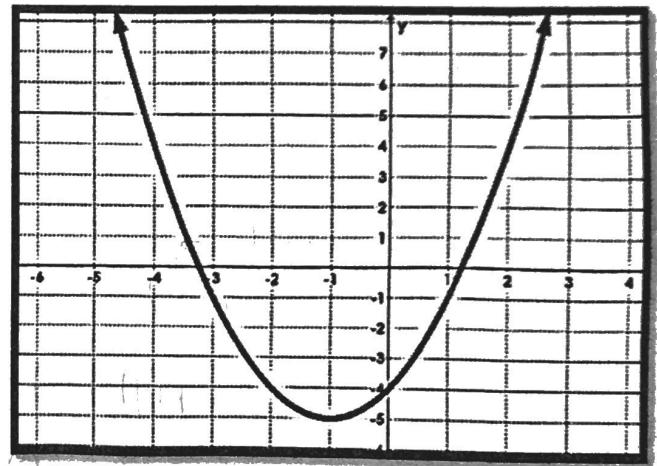
3. $y = (x - 9)^2 - 5$
 -right 9
 -down 5
 (9, -5)

4. $y = (x + 5)^2 + 6$
 -left 5
 -up 6
 (-5, 6)

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



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



left 1, down 5 (-1, -5)
 $y = (x + 1)^2 - 5$

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

1. Shifted left 8 units and down 1 unit

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

2. Shifted up 5 units and right 9 units

$y = (x - 9)^2 + 5$