Transforming the Graph of a Quadratic Function

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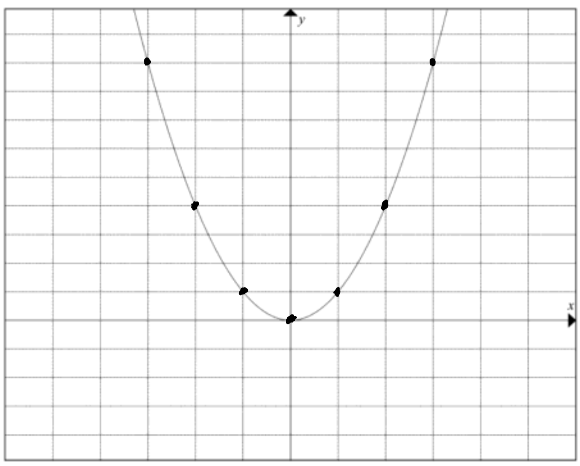
PRE-CALCULUS 11
QUADRATIC FUNCTIONS
TRANSFORMING THE GRAPH OF A QUADRATIC FUNCTION

A. The Different Properties of a Quadratic Function

The simplest quadratic function of all is the function $y = x^2$ and is referred to as **The Parent Graph**. All other transposed parabolas are based on this simplest one.

$$y = x^2$$



Over 1, Up 1
Over 2, Up 4
Rule

Vertex (0, 0)

Left or Right	Up
1 Right	1 Up.
1 Left	1 Up
2 Right	4 Up.
2 Left	4 Up.
3 Right	9 Up.
3 Left.	9 Up.

Comparing the function $y = x^2$ to the function $y = (x-p)^2$.

Function	Value of p	Opening Up/Down	Vertex	Axis of Symmetry	Congruent to $y = x^2$?
$y = x^2$	0	Up	(0,0)	x = 0	Yes
$y = (x-4)^2$	4	Up.	(4,0)	x = 4	Yes
$y = (x+4)^2$	-4	Up.	(-4,0).	x = -4	Yes.
$y = (x-7)^2$	7	Up.	(7,0)	x = 7	Yes
$y = (x+7)^2$	-7	Up.	(-7,0)	x = -7	Yes.

What does the "p" value do to the vertex of the function?

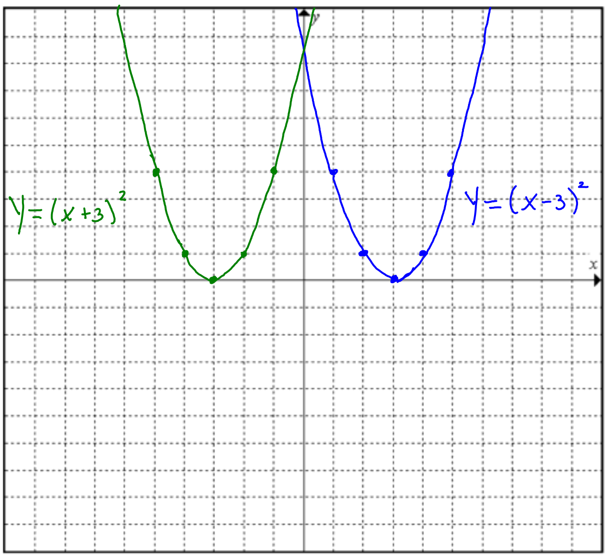
The "p" value shifts the vertex left or right

Graph the following functions:

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

$y = (x-3)^2$
$p = 3$
vertex (3,0)
Over 1, Up 1
Over 2, Up 4

$y = (x+3)^2$
$p = -3$
vertex (-3,0)
Over 1, Up 1
Over 2, Up 4



Comparing the function $y=x^2$ to the function $y=x^2+q$.

Function	Value of q	Opening Up/Down	Vertex	Axis of Symmetry	Congruent to $y=x^2$?
$y=x^2$	0	Up	(0,0)	x = 0	Yes
$y=x^2+4$	4	Up.	(0,4)	x = 0	Yes.
$y=x^2-4$	-4	Up	(0,-4)	x = 0	Yes
$y=x^2+7$	7	Up	(0,7)	x = 0	Yes.
$y=x^2-7$	-7	Up	(0,-7)	x = 0	Yes

What does the "q" value do to the vertex of the function?

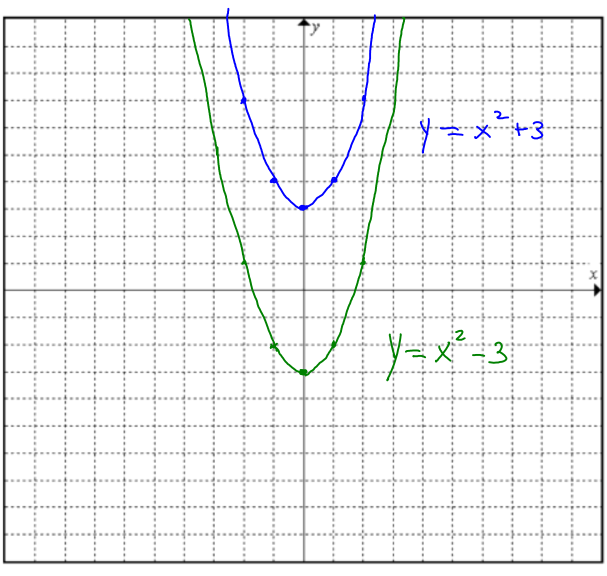
The "q" value shifts the vertex up or down.

Graph the following functions:

$y=x^2+3$ and $y=x^2-3$

$y=x^2+3$
q = 3
vertex (0,3).
Over 1, Up 1
Over 2, Up 4

$y=x^2-3$
q = -3
vertex (0,-3)
Over 1, Up 1
Over 2, Up 4



Comparing the function $y = x^2$ to the function $y = ax^2$.

Function	Value of a	Opening Up/Down	Vertex	Axis of Symmetry	Congruent to $y = x^2$?
$y = x^2$	1	Up.	(0,0)	$x = 0$	Yes
$y = -x^2$	-1	Down	(0,0)	$x = 0$	Yes but inverted
$y = 3x^2$	3	Up	(0,0)	$x = 0$	No it is vertically expanded.
$y = -3x^2$	-3	Down	(0,0).	$x = 0$	No it is inverted and vertically expanded.
$y = \frac{1}{3}x^2$	$\frac{1}{3}$	Up	(0,0)	$x = 0$	No it is vertically compressed.

What does the "a" value do to the graph of the function?

The "a" value causes the graph to be vertically compressed, vertically expanded, or inverted.

$a > 1$ vertical expansion
$0 < a < 1$ vertical compression
$a < 0$ inverted.

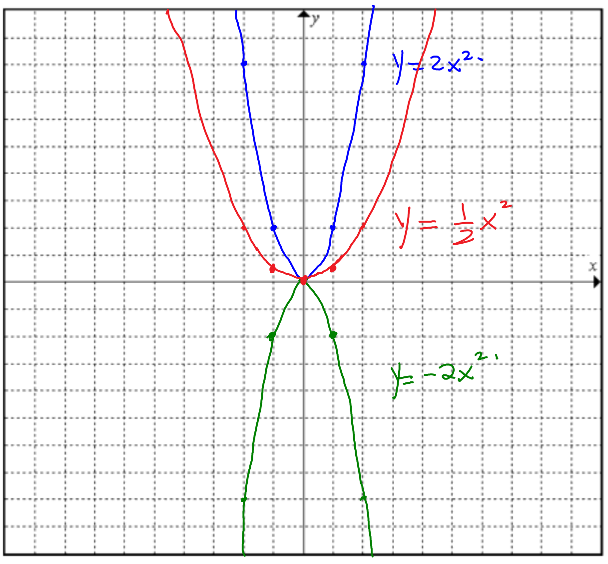
Graph the following functions:

$y = 2x^2$, $y = -2x^2$ and $y = \frac{1}{2}x^2$

$y = 2x^2$
$a = 2.$
vertex (0,0)
Over 1, Up $1(2) = 2$
Over 2, Up $4(2) = 8$

$y = -2x^2.$
$a = -2$
vertex.
Over 1, Up $1(-2) = -2$
Over 2, Up $4(-2) = -8$

$y = \frac{1}{2}x^2$
$a = \frac{1}{2}$
Over 1, Up $1(\frac{1}{2}) = \frac{1}{2}.$
Over 2, Up $4(\frac{1}{2}) = 2.$



B. Translating Functions

The graph of $y = x^2$ is translated as below. Without graphing, write the equation of the graph in its new position.

1) a translation of 10 units down.

$q = -10$

$\boxed{y = x^2 - 10}$

2) a translation of 4 units to the right.

$p = 4$

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

3) a vertical compression of $\frac{1}{5}$.

$a = \frac{1}{5}$

$\boxed{y = \frac{1}{5}x^2}$

4) an vertical expansion of 6, and reflected in the x-axis.

inverted

$a = -6$

$\boxed{y = -6x^2}$

Assignment : Pg. 270 #2 & 3