3.1 Quadratic Functions in Vertex Form – Part 1

A quadratic function is a polynomial of the ___2nd___ degree.

The graph of a quadratic function is called a ___parabola___.
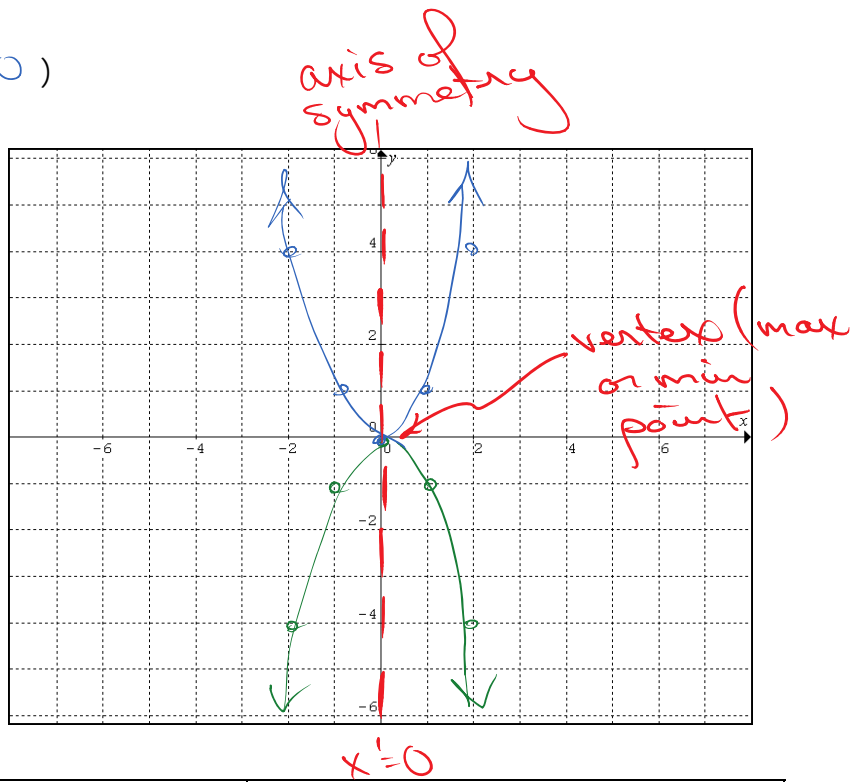
Graphs of Quadratic Functions in Vertex Form:
$$y = a(x-p)^2 + q$$

(p, q) are coordinates of the vertex

Part I: ___$y = x^2$___ Vertex (0 , 0)

Graph $y = x^2$ and $y = -x^2$ using a table of values.

x	$y = (\ )^2$
-2	4
-1	1
0	0
1	1
2	4

x	$y = -(\ )^2$
-2	-4
-1	-1
0	0
1	-1
2	-4

axis of symmetry

vertex (max or min point)

$x = 0$

	$y = x^2$	$y = -x^2$
Coordinates of the Vertex	$(0, 0)$	$(0, 0)$
Direction of Opening	(a is positive) upward	(a is negative) downward
Equation of the Axis of Symmetry	$x = 0$	$x = 0$
Minimum/Maximum Value	Min. value @ $y = 0$	Max. value @ $y = 0$
Range	$y \geq 0$	$y \leq 0$

values of y

Graph the following Quadratic Functions. These graphs will have a _____

a) $y = 2x^2$
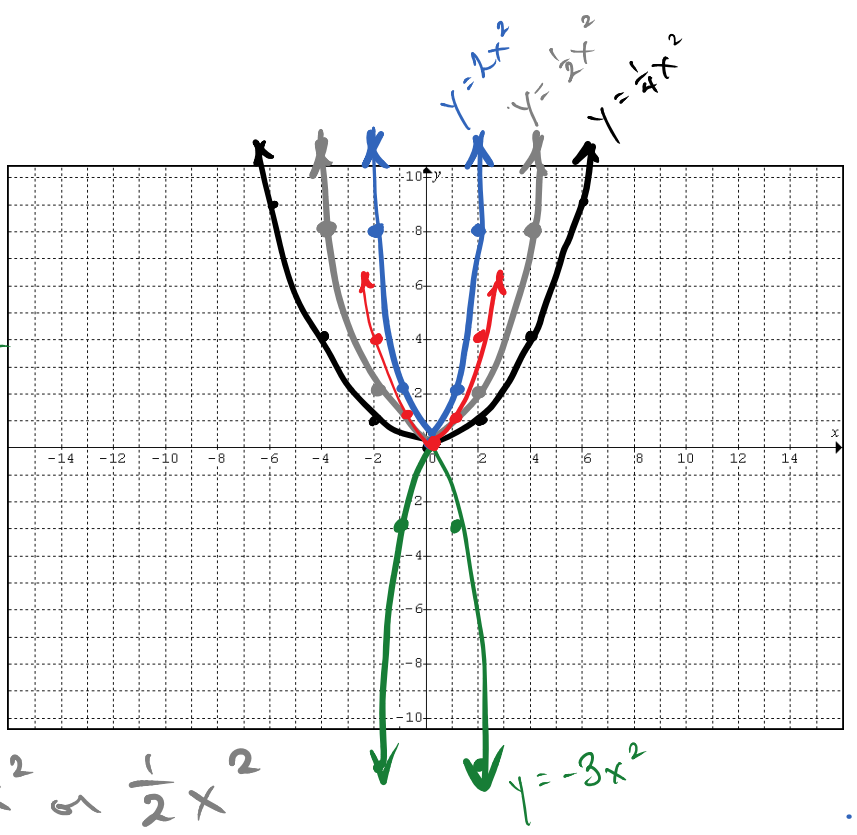
x	$y = 2x^2$
-2	8
-1	2
0	0
1	2
2	8

vertical stretch

b) $y = -3x^2$

x	$y = -3x^2$
-2	-12
-1	-3
0	0
1	-3
2	-12

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

$y = -3x^2$

c) $y = 0.5x^2$

x	$y = .5x^2$ or $\frac{1}{2}x^2$
-4	8
-2	2
0	0
2	2
4	8

vertical compression

For $y = ax^2$...

if $a > 1 \rightarrow$ vertical stretch

if $0 < a < 1 \rightarrow$ vertical compression

'a' is proper fraction

d) $y = \frac{1}{4}x^2$

x	$y = \frac{1}{4}x^2$ or $.25x^2$
-4	4
-2	1
0	0
2	1
4	4

vertical compression

Pre-Calc 11

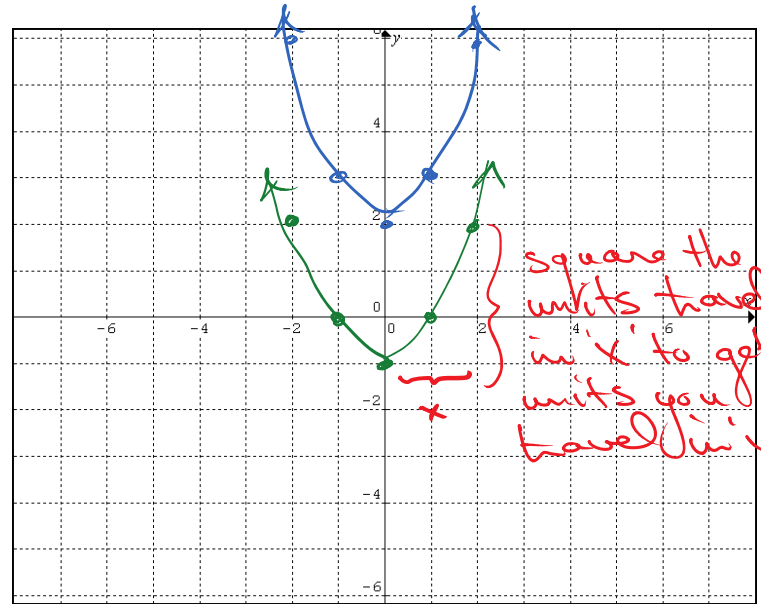**Part II**: $\underline{y = x^2 + q}$ Vertex (0 , q) These graphs will have a vertical shift by 'q' up or down (+) (−)

$y = x^2 + 2$

Coordinates of the vertex	$(0, 2)$
Axis of symmetry	$x = 0$
Opening	up
Min/Max y value of vertex	$y = 2$
Range	$y \geq 2$

a is positive

square the units travelled in 'x' to get units you travel in 'y'.

$y = x^2 - 1$

Coordinates of the vertex	$(0, -1)$
Axis of symmetry	$x = 0$
Opening	up
Min/Max	$y = -1$
Range	$y \geq -1$

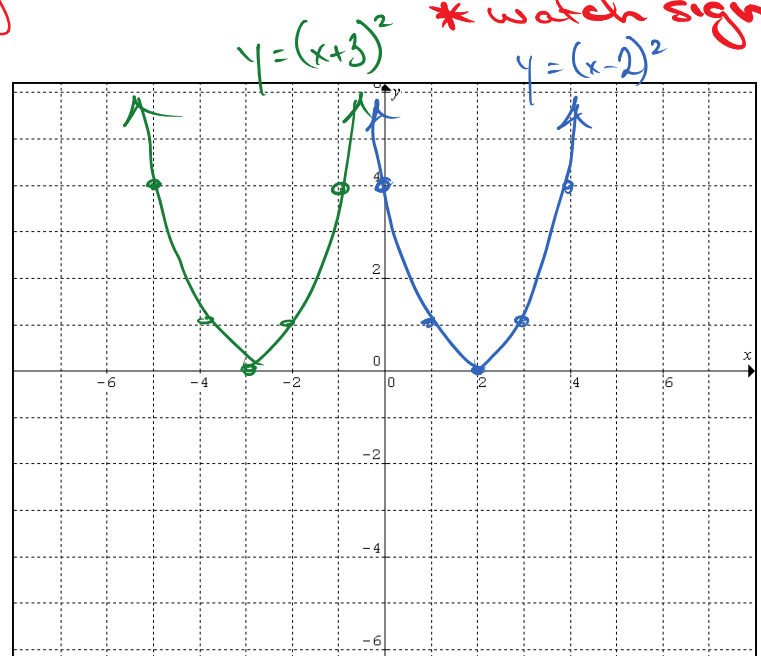**Part III**: $\underline{y = (x - p)^2}$ Vertex (p , 0) These graphs will have a horizontal shift by 'p' to left or right (−) (+)

Use opposite sign for 'p'

* watch sign

$y = (x - 2)^2$

Coordinates of the vertex	$(2, 0)$
Axis of symmetry	$x = 2$
Opening	up
Min/Max	$y = 0$
Range	$y \geq 0$

$y = (x + 3)^2$

Coordinates of the vertex	$(-3, 0)$
Axis of symmetry	$x = -3$
Opening	up
Min/Max	$y = 0$
Range	$y \geq 0$

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

Practice: page: 157 # 1, 2. You will need to do all graphing questions on GRAPH paper.