

Unit 7: Quadratics

Name: Key

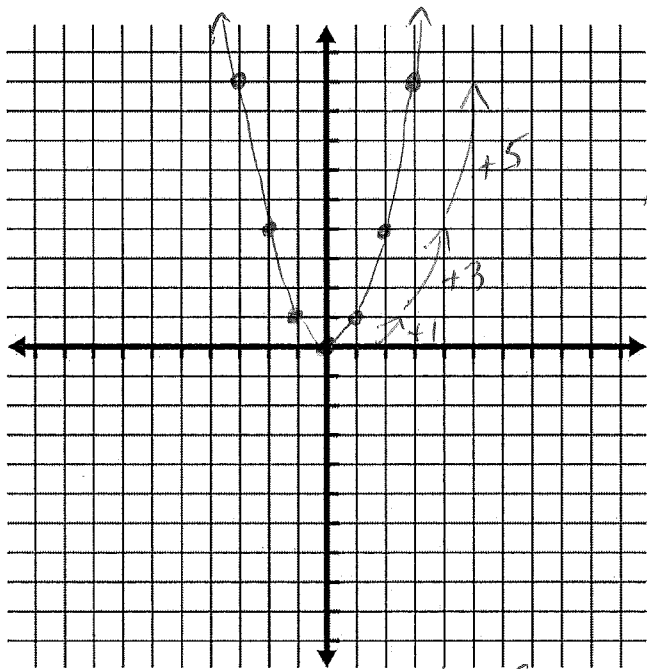
Lesson 4.1 - The Parabola

Graphing quadratic functions by hand

1) The Basic Shape

$$y = x^2$$

x	y
0	$0^2 = 0$
1	$1^2 = 1$
2	$2^2 = 4$
3	$3^2 = 9$
-1	$(-1)^2 = 1$
-2	$(-2)^2 = 4$
-3	$(-3)^2 = 9$



Regular Pattern
+1, +3, +5, ...

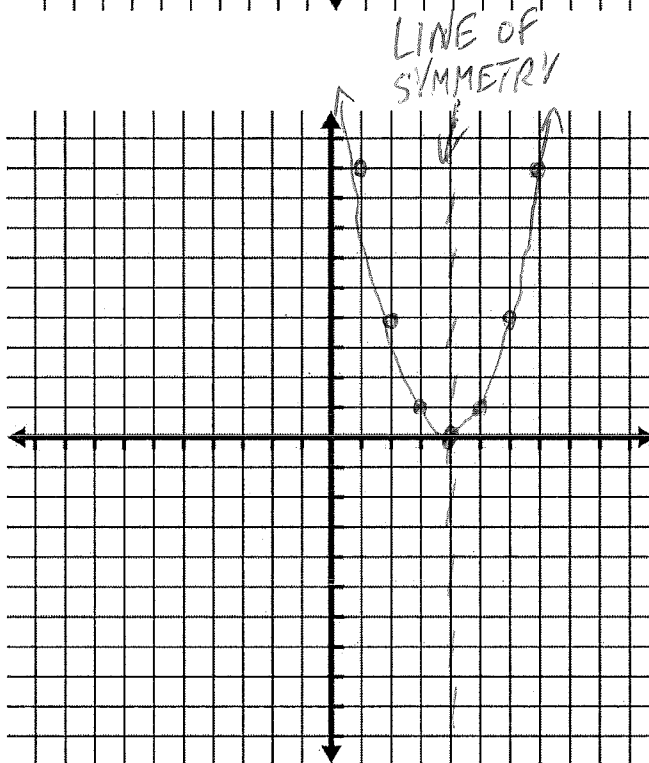
2) The Horizontal Shift

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

Example: if $p = 4$

The equation is $y = (x - 4)^2$

x	y
4	$(4-4)^2 = 0$
5	$(5-4)^2 = 1$
6	$(6-4)^2 = 4$
7	$(7-4)^2 = 9$
3	$(3-4)^2 = 1$
2	$(2-4)^2 = 4$
1	$(1-4)^2 = 9$



CONCLUSION: The variable p will move the parabola right/left $(x-4) = 4$ right
 $(x+4) = 4$ left

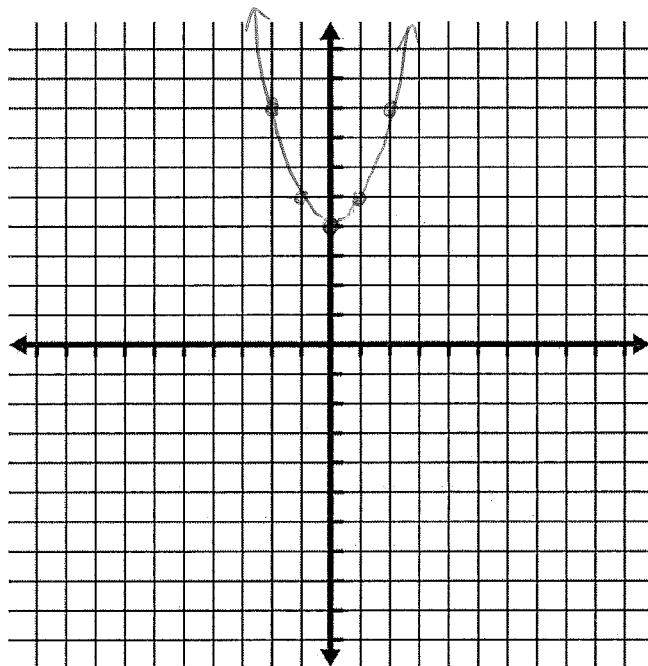
3) The Vertical Shift

$$y = x^2 + q$$

Example: if $q = 4$

The equation is $y = x^2 + 4$

x	y
0	4
1	5
2	8
-1	5
-2	8



CONCLUSION: The variable q will move the parabola up/down $x^2 + 4$ up 4, $x^2 - 4$ down 4

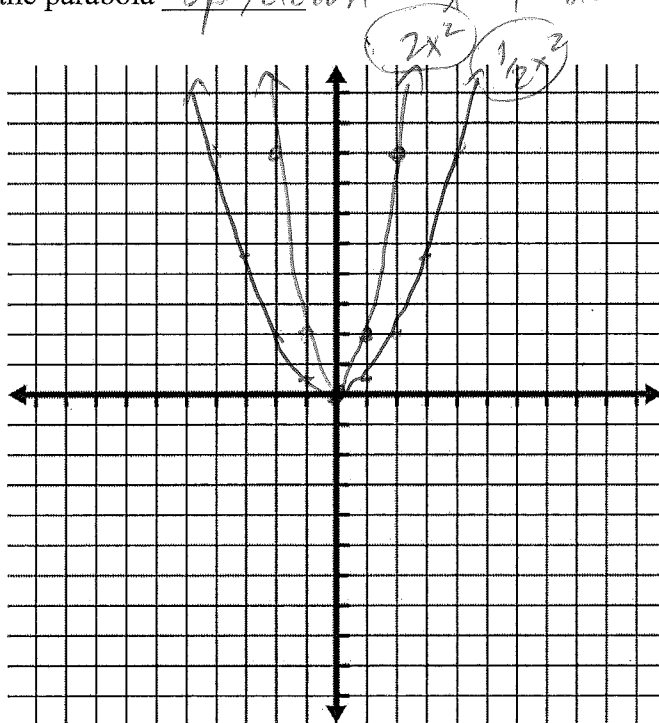
4) The Stretch Factor

$$y = ax^2$$

Examples: if $a = 2$, or $a = \frac{1}{2}$

The equations are $y = 2x^2$, $y = \frac{1}{2}x^2$

$2x^2$		$\frac{1}{2}x^2$	
x	y	x	y
0	0	0	0
1	2	1	.5
2	8	2	2
-1	2	3	4.5
-2	8	4	8



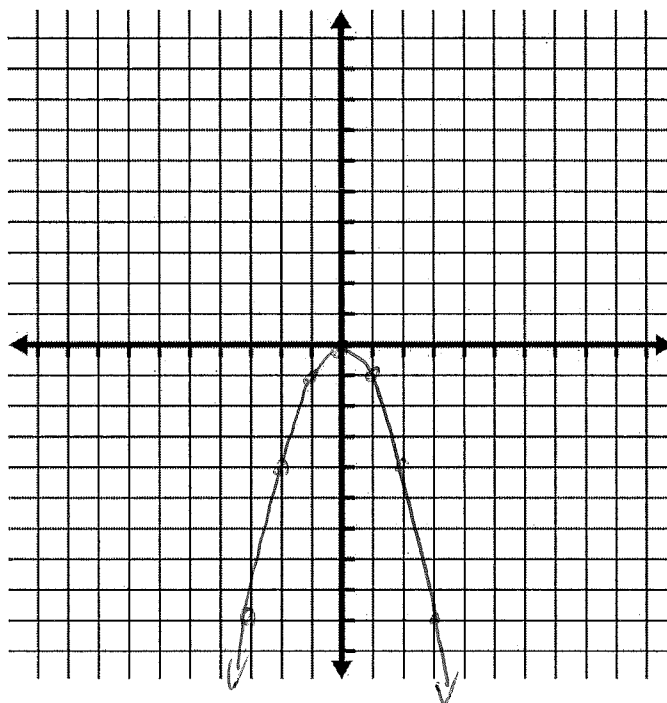
CONCLUSION: The variable a will stretch the parabola $2x^2$ skinny, $\frac{1}{2}x^2$ fat (fraction fat)

5) Negative a

Examples: if $a = -1$

The equation is now $y = -x^2$

x	y
0	0
1	$-1^2 = -1$
2	$-2^2 = -4$
3	$-3^2 = -9$
-1	$-(-1)^2 = -1$
-2	$-(-2)^2 = -4$



CONCLUSION: The negative a will flip the parabola

Putting it all together

$$y = a(x - p)^2 + q$$

$p =$ horizontal shift

$q =$ vertical shift

$a =$ stretch factor

$(p, q) =$ vertex

Example:

Analyze the following quadratic before graphing:

$$y = \frac{1}{2}(x - 3)^2 - 4$$

a) $p = \underline{3}$ $q = \underline{-4}$

b) where will the vertex of the parabola be? $\underline{(3, -4)}$

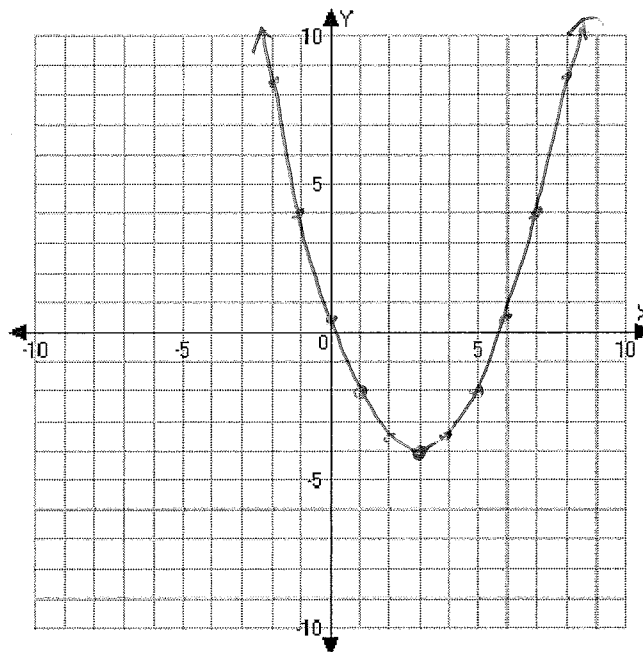
c) has the parabola been compressed vertically/or stretched vertically? fraction = fat

d) does the parabola have a maximum or a minimum? minimum ✓

e) make a table of values, starting with the vertex and including three points on each side.

x	y
3	-4
4	-3.5
5	-2
6	4

f) graph the parabola



Assignment

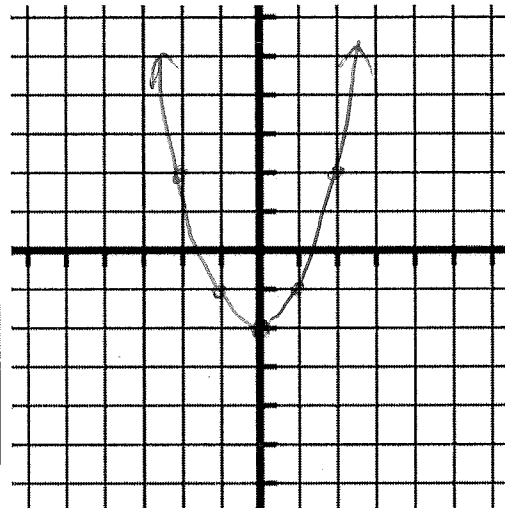
$$y = a(x-p)^2 + q$$

Starting with the vertex, use 2-4 more points in each direction to accurately draw the following quadratics and fill out the chart below

1) $y = x^2 - 2$

Horizontal shift (p)	0
Vertical shift (q)	-2
Vertex	(0, -2)
Stretch factor (a)	1
Compressed Vertically OR Stretched Vertically	n/a
Minimum (opens up) OR Maximum (opens down)	min

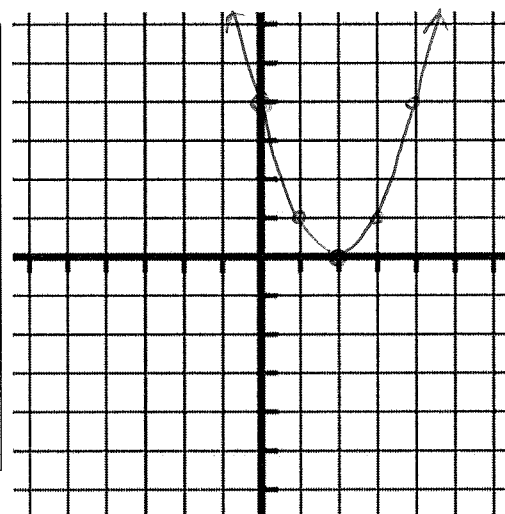
x	y
0	-2
1	-1
2	2



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

Horizontal shift (p)	2
Vertical shift (q)	0
Vertex	(2, 0)
Stretch factor (a)	1
Compressed Vertically OR Stretched Vertically	n/a
Minimum (opens up) OR Maximum (opens down)	min

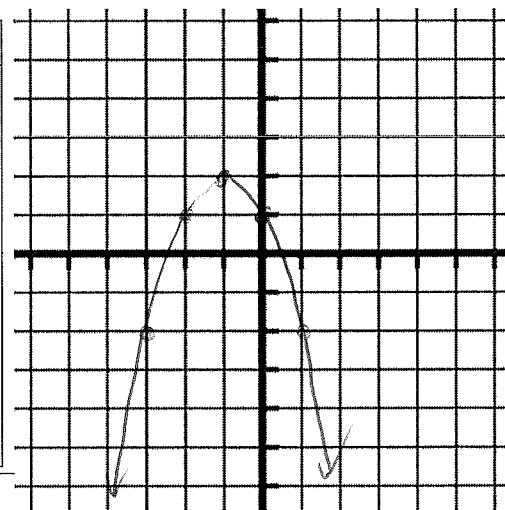
x	y
2	0
3	1
4	4



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

Horizontal shift (p)	-1
Vertical shift (q)	2
Vertex	(-1, 2)
Stretch factor (a)	-1
Compressed Vertically OR Stretched Vertically	n/a
Minimum (opens up) OR Maximum (opens down)	max

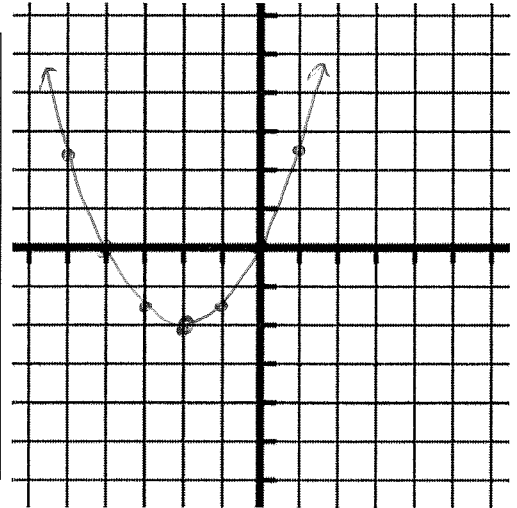
x	y
-1	2
0	1
1	-2



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

Horizontal shift (p)	-2
Vertical shift (q)	-2
Vertex	(-2, -2)
Stretch factor (a)	$\frac{1}{2}$
Compressed Vertically OR Stretched Vertically	fat
Minimum (opens up) OR Maximum (opens down)	min

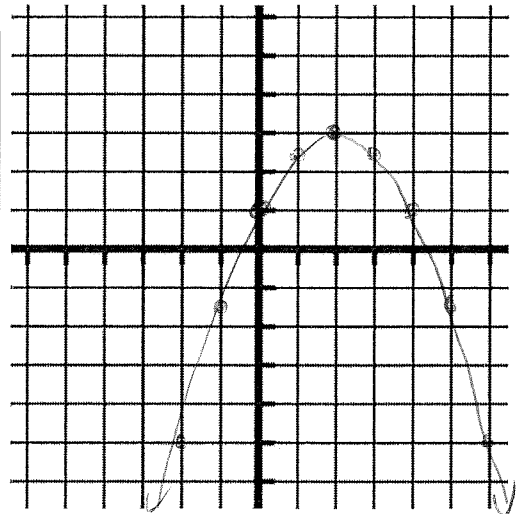
x	y
-2	-2
-1	-1.5
0	0
1	2.5



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

Horizontal shift (p)	2
Vertical shift (q)	3
Vertex	(2, 3)
Stretch factor (a)	$-\frac{1}{2}$
Compressed Vertically OR Stretched Vertically	fat
Minimum (opens up) OR Maximum (opens down)	max

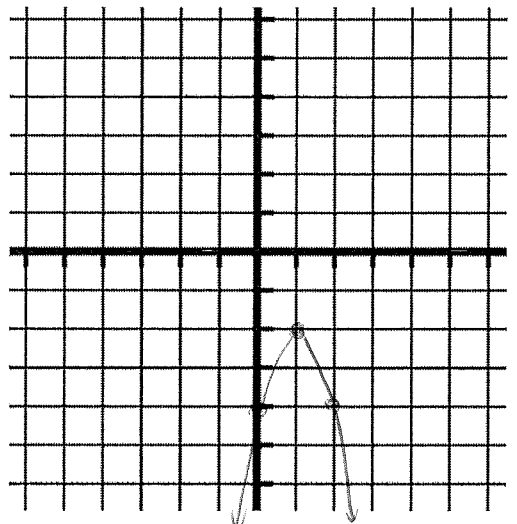
x	y
2	3
3	2.5
4	1
5	-1.5



6) $y = -2(x - 1)^2 - 2$

Horizontal shift (p)	1
Vertical shift (q)	-2
Vertex	(1, -2)
Stretch factor (a)	-2
Compressed Vertically OR Stretched Vertically	skinny
Minimum (opens up) OR Maximum (opens down)	max

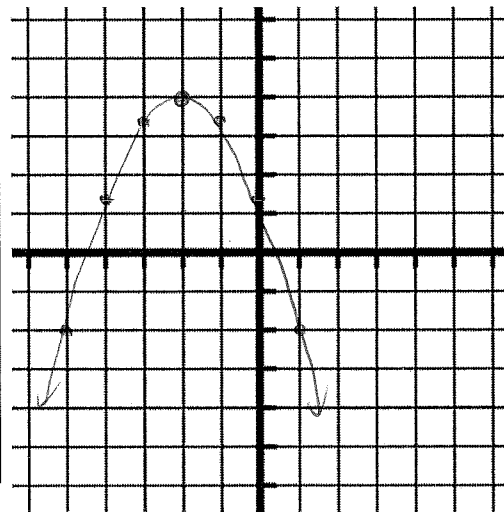
x	y
1	-2
2	-4



$$7) \quad y - 4 = -\frac{2}{3}(x + 2)^2 + 4$$

Horizontal shift (p)	-2
Vertical shift (q)	4
Vertex	(-2, 4)
Stretch factor (a)	$-\frac{2}{3}$
Compressed Vertically OR Stretched Vertically	fat
Minimum (opens up) OR Maximum (opens down)	max

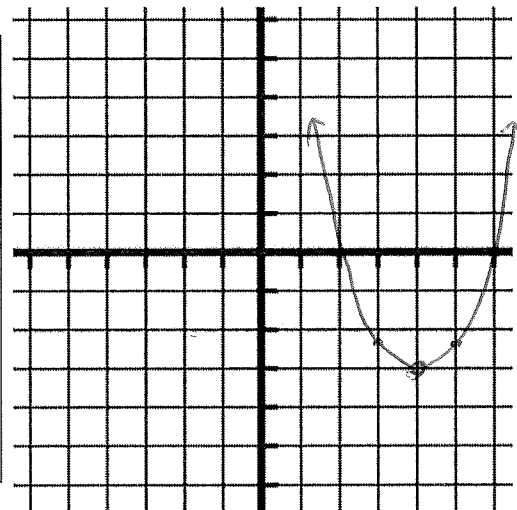
x	y
-2	4



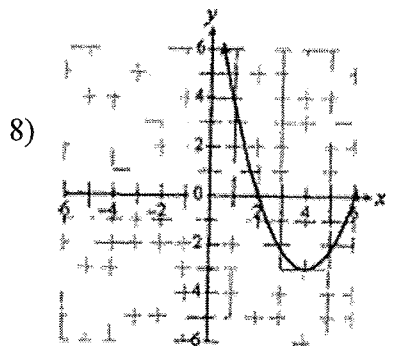
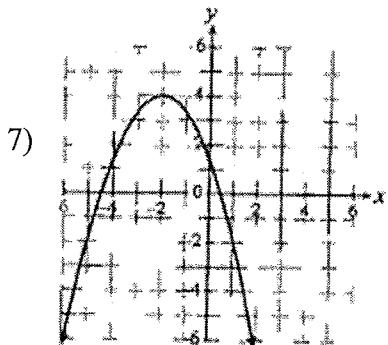
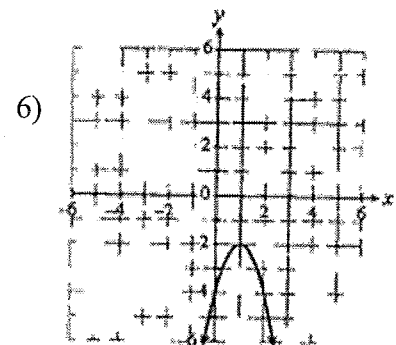
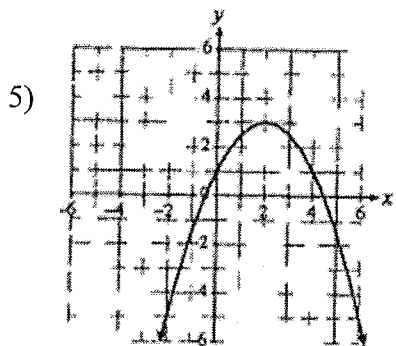
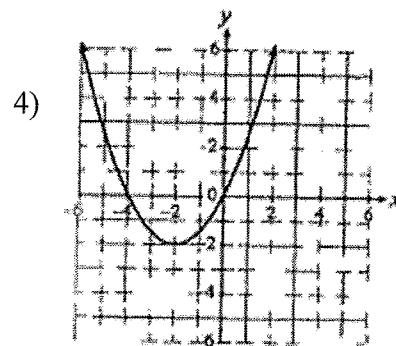
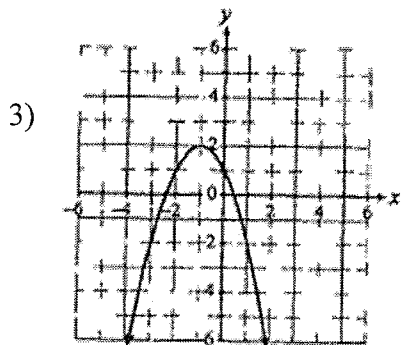
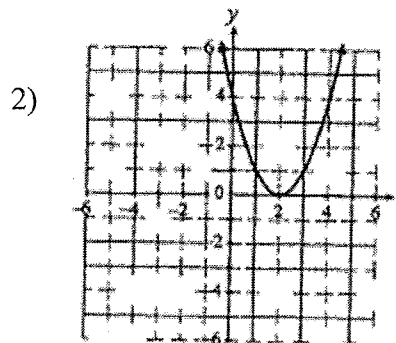
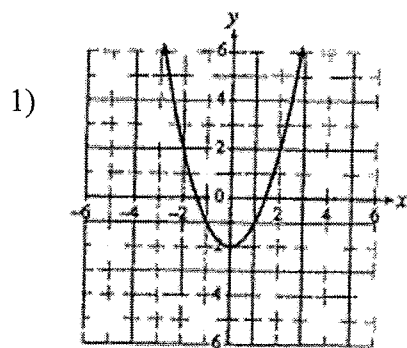
$$8) \quad y + 3 = \frac{3}{4}(x - 4)^2 - 3$$

Horizontal shift (p)	4
Vertical shift (q)	-3
Vertex	(4, -3)
Stretch factor (a)	$\frac{3}{4}$
Compressed Vertically OR Stretched Vertically	fat
Minimum (opens up) OR Maximum (opens down)	min

x	y
4	-3



Answer Key



Practice Quiz

Draw the parabola using at least **seven** points:

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

x	y
2	-4
3	-3.5
4	-2
5	0.5
6	4
1	-3.5
0	-2

