

## 2.3 Transforming Graphs of Quadratic Functions

Complete hand out investigation

### A. Comparing the graphs of $y = x^2$ and $y = (x - p)^2$

Function	Value of $p$	Direction of Opening	Vertex	Axis of Symmetry	Congruent to $y = x^2$ ?
$y = x^2$	0	up	(0, 0)	$x = 0$	yes
$y = (x - 2)^2$	-2	↓	(2, 0)	$x = 2$	↓
$y = (x + 2)^2$	+2	↓	(-2, 0)	$x = -2$	↓
$y = (x - 4)^2$	-4	↓	(4, 0)	$x = 4$	↓
$y = (x + 4)^2$	+4	↓	(-4, 0)	$x = -4$	↓

$+p \rightarrow$  moves our graph left  
 $-p \rightarrow$  . . . . . right  
 $(x-2)^2 = 0$   
 $x = 2$

### B. Comparing the graphs of $y = x^2$ and $y = x^2 + q$

Function	Value of $q$	Direction of opening	Vertex	Axis of symmetry	Congruent to $y = x^2$ ?
$y = x^2$	0	up	(0, 0)	$x = 0$	yes
$y = x^2 - 1$	-1	↓	(0, -1)	$x = 0$	↓
$y = x^2 + 2$	2	↓	(0, 2)	↓	↓
$y = x^2 - 3$	-3	↓	(0, -3)	↓	↓
$y = x^2 + 4$	4	↓	(0, 4)	↓	↓

$+q \rightarrow$  moves up  
 $-q \rightarrow$  moves down.

C. Comparing the graphs of  $y = x^2$  and  $y = ax^2$ 

Function	Value of $a$	Direction of opening	Vertex	Axis of symmetry	Congruent to $y = x^2$ ?
$y = x^2$	1	up	(0, 0)	$x = 0$	yes
$y = 2x^2$	2	up			No
$y = 0.5x^2$	0.5	up			
$y = -x^2$	-1	down			
$y = -2x^2$	-2				
$y = -0.5x^2$	-0.5				

$a > 0$  opened up

$a < 0$  opened down

$a > 1$  graph is compressed  
 $0 < a < 1$  expanded.

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

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

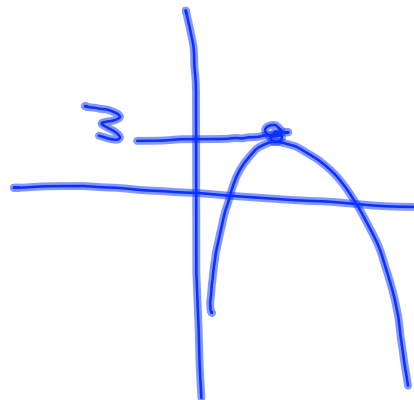
1) Vertex: (2, 3) (p, q)

3) down

4)  $x = 2$

5)

6)  $D: x \in \mathbb{R}$   
 $R: y \leq 3$



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

State the vertex and axis of symmetry of the following

$$y = 2(x - 3)^2 + 7$$

V: (3, 7)

axis:  $x = 3$

$$x - 3 = 0$$

$$x = 3$$

$$y = -1(x + 1)^2 - 9$$

V: (-1, -9)

axis:  $x = -1$

Graph the following

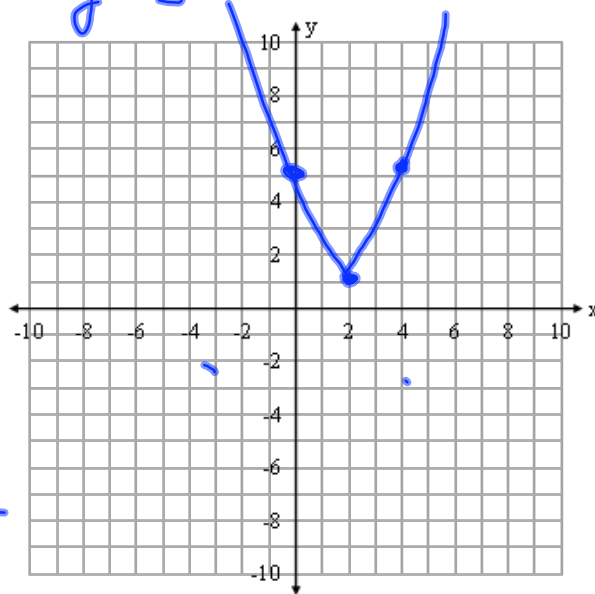
$$\underline{y = (x-2)^2 + 1}$$

$$\underline{V: (2, 1)}$$

pick an x value  
2 units from your  
vertex. Substitute  
the x-value into  
your eqn and determine  
the y-value.

$$y = (4-2)^2 + 1$$

$$x=4 \quad y=5$$

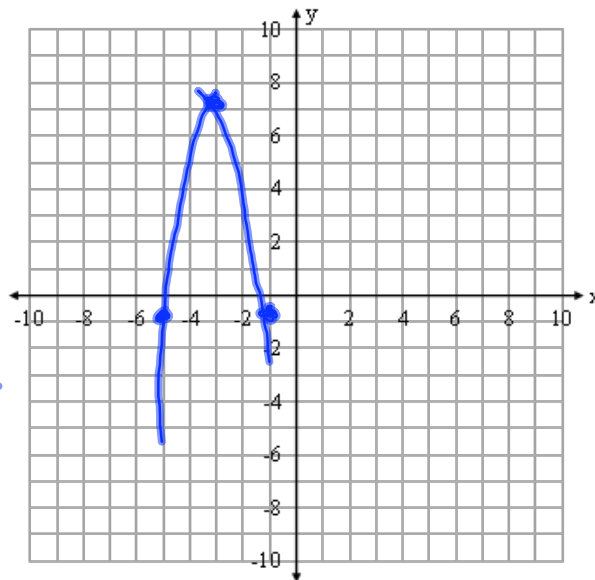


$$y = -2(x+3)^2 + 7$$

$$\underline{V: (-3, 7)}$$

$$y = -2(-1+3)^2 + 7$$

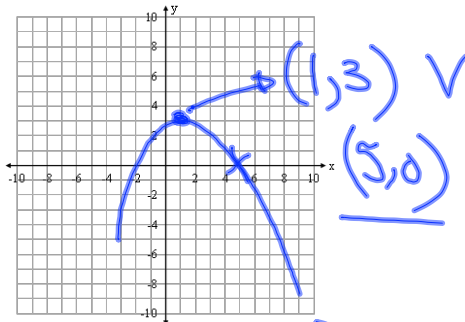
$$y = -1 \quad x = -1$$



Determine the equation of the quadratic with vertex  $(1, -8)$  and passing through the point  $(0, -5)$

$$\begin{aligned} (x, y) \quad y &= a(x-p)^2 + q \\ y &= a(x-1)^2 - 8 \\ -5 &= a(0-1)^2 - 8 \\ -5 &= 1a - 8 \\ a &= 3 \\ y &= 3(x-1)^2 - 8 \end{aligned}$$


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$$\begin{aligned} (5, 0) \quad (x, y) \quad y &= a(x-p)^2 + q \\ y &= a(x-1)^2 + 3 \\ 0 &= a(5-1)^2 + 3 \\ 0 &= 16a + 3 \\ -3 &= 16a \\ \frac{-3}{16} &= \frac{16a}{16} \\ a &= \frac{-3}{16} \\ y &= \frac{-3}{16}(x-1)^2 + 3 \end{aligned}$$


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Pg. 115 3, 4, 7, 8, 12, 14ac, 15ac