

## Vertex Form: Again!

### Investigating $y = ax^2$

Graph the following equations on the axes provided.

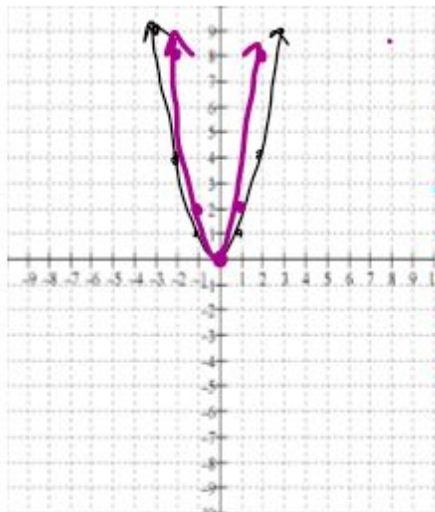
$$y = x^2$$

$$y = x^2$$

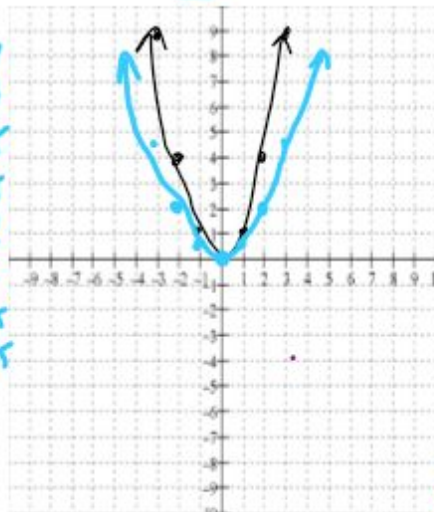
$$y = 2x^2$$

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

x	y
0	0
1	1
2	4
-1	1
-2	4



x	y
0	0
1	1
2	4
-1	1
-2	4
3	9
4	16
-3	9
-4	16



In general if  $a > 1$  the parabola is thinner / stretched.

In general if  $-1 < a < 1$  the parabola is fatter.

In general, for the function  $y = x^2$  the graph of  $y = ax^2$ , where  $a$  is any real number,

is obtained by multiplying 'normal' parabola by  $a$ .

**Ex. #1:** Sketch the graph of  $y = 3x^2$  on the grid provided and answer the following questions.

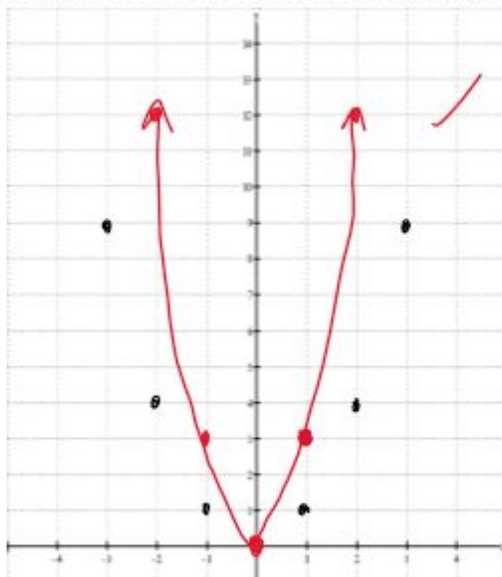
Vertex:  $(0, 0)$

Max or Min:  $y = 0$

Axis of Symmetry:  $x = 0$

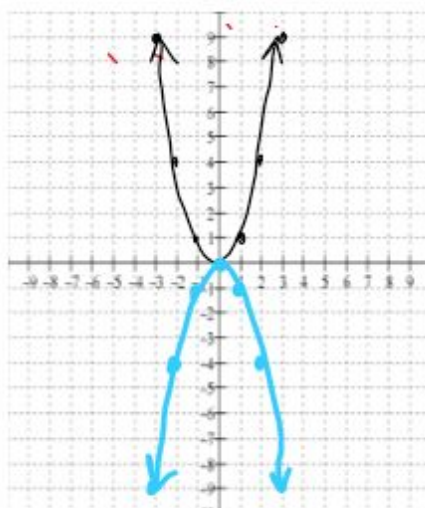
Domain:  $\{x \mid x \in \mathbb{R}\}$

Range:  $\{y \mid y \geq 0, y \in \mathbb{R}\}$



Investigating  $y = -x^2$

On the grid provided sketch the graph of  $y = x^2$  and  $y = -x^2$



**Ex. #2:** Sketch the graph of  $y = -\frac{1}{3}x^2$  on the grid provided and answer the following questions.

Vertex:  $(0, 0)$

Max or Min: ~~Max~~  
 $y = 0$

Axis of Symmetry:  
 $x = 0$

Domain:  $\{x \mid x \in \mathbb{R}\}$

Range:  $\{y \mid y \leq 0, y \in \mathbb{R}\}$

- Steps:
- 1) left/right ( $p$ )
  - 2) up/down ( $q$ )
  - 3) multiply by ( $a$ )

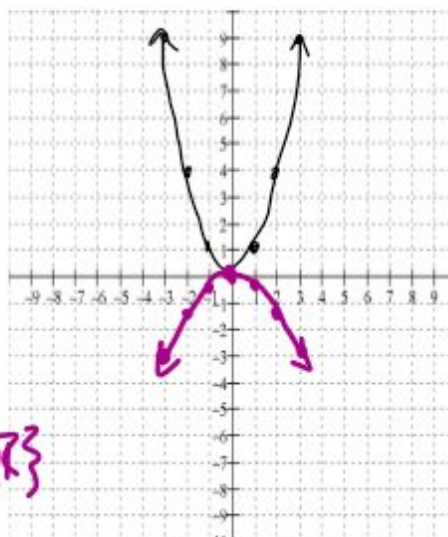
**Summary**

A quadratic function can be expressed in vertex form as follows:

$p = 3$

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

The coordinates of the vertex of the parabola are  $(p, q)$   
 $(x, y)$



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

$(-2, 2)$

Ex. #3: Determine a quadratic function in vertex form that has the given characteristics.

(a) Vertex at  $(-1, -3)$ , passing through the point  $(1, 5)$ .

$$y = a(x-p)^2 + q$$
$$y = a(x - (-1))^2 + (-3)$$
$$y = a(x+1)^2 - 3$$
$$5 = a(1+1)^2 - 3$$
$$5 = a(4) - 3$$
$$5+3 = 4a$$
$$8 = 4a$$
$$a = \frac{8}{4}$$
$$a = 2$$
$$y = 2(x+1)^2 - 3$$

(b) Vertex at  $(4, 1)$ , passing through the point  $(8, -3)$ .

$$y = a(x-p)^2 + q$$
$$y = a(x - (4))^2 + (1)$$
$$y = a(x-4)^2 + 1$$
$$-3 = a(8-4)^2 + 1$$
$$-3 = a(16) + 1$$
$$-3 - 1 = 16a$$
$$-4 = 16a$$
$$-\frac{1}{4} = a$$
$$y = -\frac{1}{4}(x-4)^2 + 1$$

HU: p 5 157  
1, 7



