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

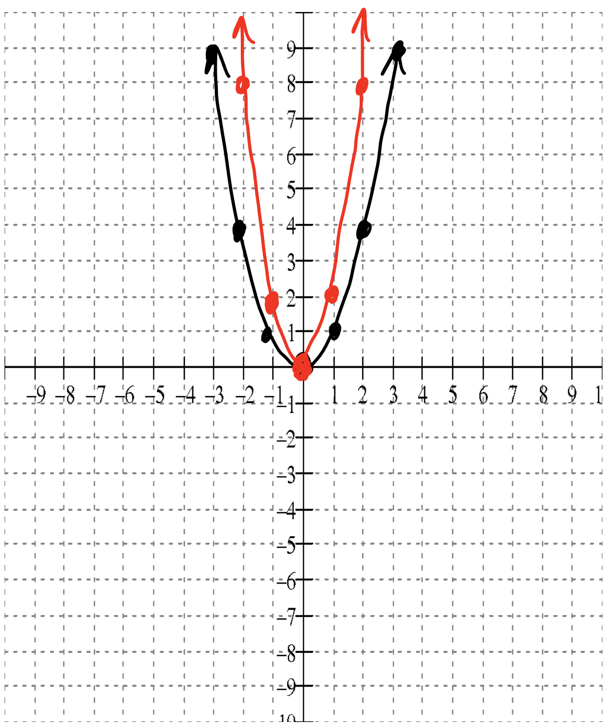
Vertex Form: Again!

Investigating $y = ax^2$

Graph the following equations on the axes provided.

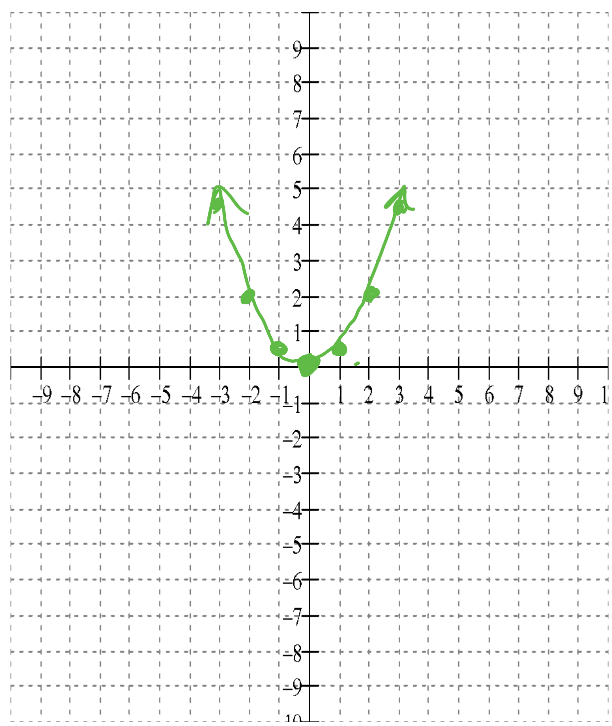
$y = x^2$

$y = 2x^2$



$y = x^2$

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



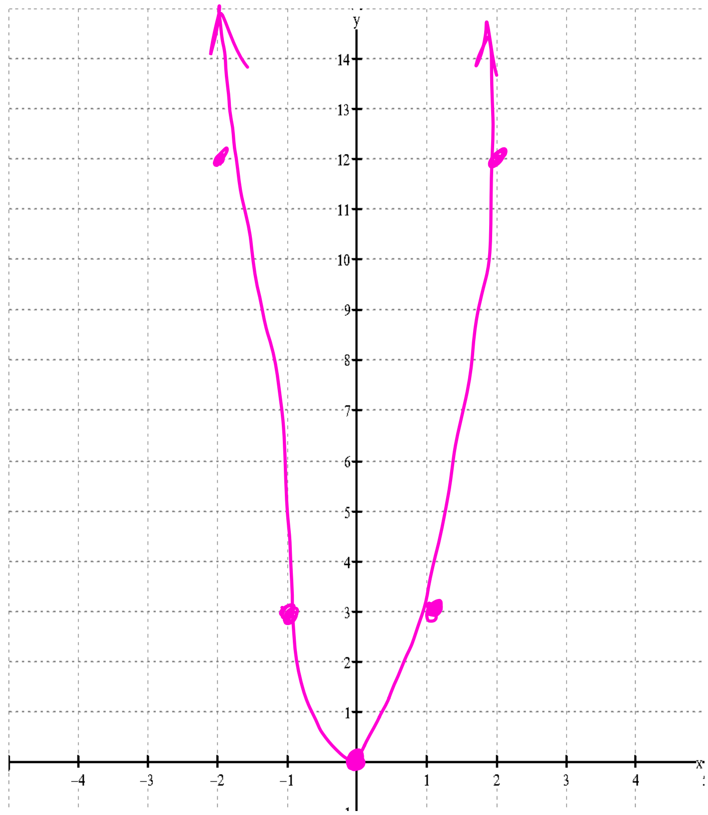
$\boxed{-1 < a < 1}$

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

In general if $a < 1$ 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 x^2 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: Min

Axis of Symmetry:

$x = 0$

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

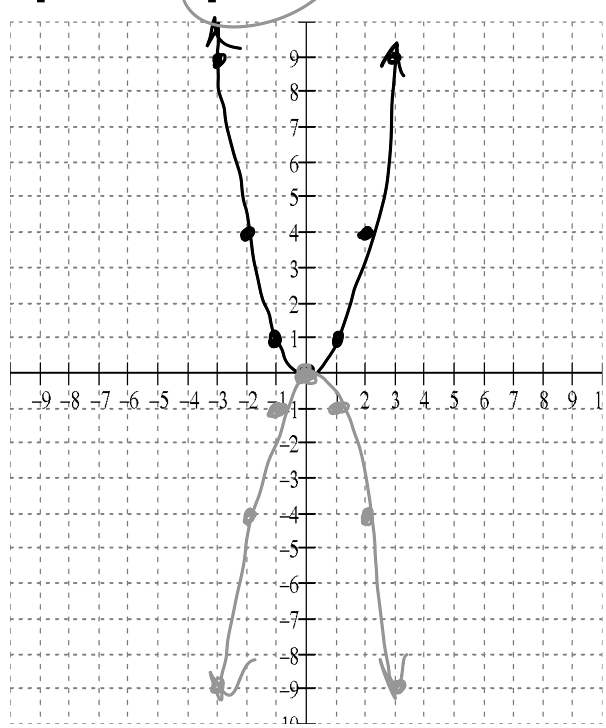
Range: $\{y \mid y \geq 0, y \in \mathbb{R}\}$

Investigating $y = -x^2$

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

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

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



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

x	y
0	0
3	

Vertex: (0, 0)

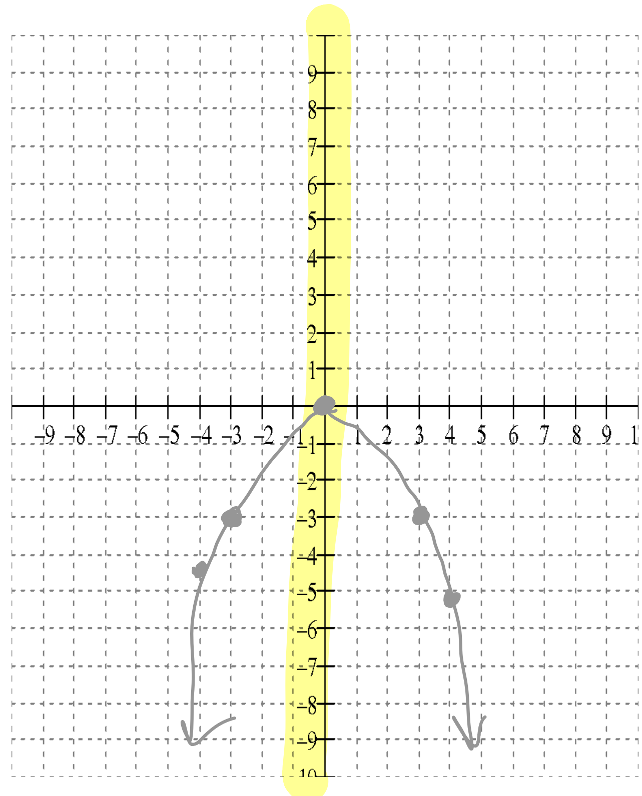
Max or Min: ___________

Axis of Symmetry:

x = 0

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

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



Steps:

if a +ive parabola opens up
-ive " " down.

a >1 skinny (big)
a <1 fat (small)

Summary

p +ive shift right →
-ive shift left. ←

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

q +ive ↑ up
q -ive ↓ down

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

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

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

(x, y)

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

p q

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

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

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

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

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

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

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

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