$$y = a|x - h| + k$$

a : $a>0$ opens up or $a<0$ opens down

$a>1$ Vertical Stretch $0<a<1$ Vertical Shrink

h: Horizontal Translation

k: Vertical Translation

Vertex:
$(h,k)$

In general, if the function $y = f(x)$ is transformed the following way:

$$y = a\,f(x - h) + k$$

<u>The parent function has been</u>:

- Streched/Shrunk vertically by a factor of $a$
- Reflected over x-axis if $a<0$
- Translated horizontally $h$ units.
- Translated vertically $k$ units.

Section 5-3:

# Transforming Parabolas

$$y = a(x - h)^2 + k$$

a : $a>0$ opens up or $a<0$ opens down

$a>1$ Vertical Stretch $0<a<1$ Vertical Shrink

h: Horizontal Translation

k: Vertical Translation

Vertex:
$(h,k)$

$y = a(x - h)^2 + k$

$\boxed{\text{Vertex Form}}$ of a Quadratic Function

This is a perfect name for this equation because you can find the coordinates of the vertex just by looking at the equation:

VERTEX: (h, k)

Describe the transformations shown in the equation and identify the vertex and the y-intercept of this quadratic:

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

- x + 2  2 units left
- \+ 7  7 units up
- Vertical stretch factor of 3 (3 times taller)
- \- Opens Down  x-axis reflection (upside down)

Vertex: (-2, 7)  LOS: x = -2

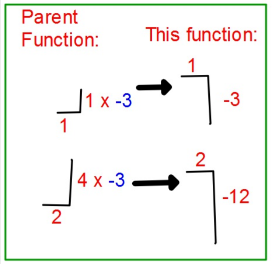
y-intercept: (0, -5) → Make x=0 then find y.

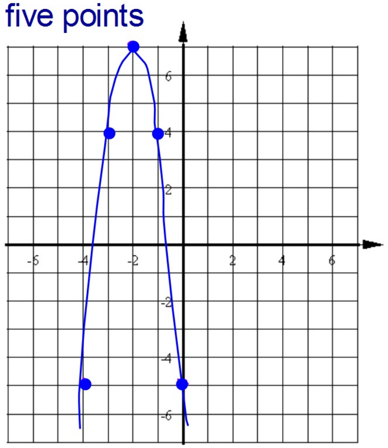
Graph this quadratic using five points

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

Vertex: ( -2, 7)

LOS: x = -2




Or, use a table of values once you know the vertex

| x | y |
|---|---|

Graph this quadratic using five points

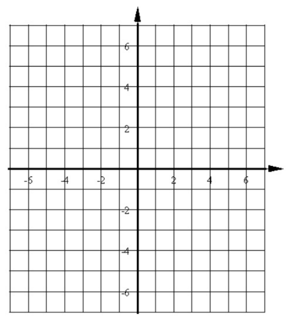
$y = -3\underbrace{(x + 2)^2}_{} + 7$

You could also graph this by first changing it into Standard Form.

$-3(x^2+4x+4) + 7$

$-3x^2 - 12x - 12 + 7$

$-3x^2 - 12x - 5$



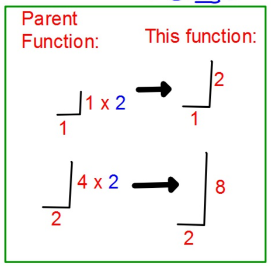

Now you could find the y-intercept, LOS, then the Vertex, and find the remaining points using a table of values or the Vertical Stretch Factor of -3.

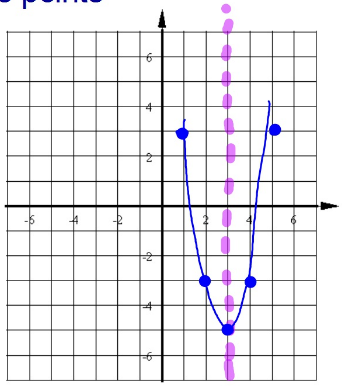
## Graph this quadratic using five points

$y = 2(x - 3)^2 - 5$

Vertex
$(3, -5)$

LOS: $x = 3$




Or, use
a table of values
once you know the vertex

| x | y |
|---|---|

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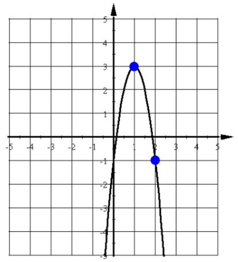
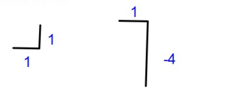
## Write the equation of this parabola in Vertex Form.

1.






1 right, 3 up

Vertex (1, 3)

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

vertical stretch/shrink factor:
Just like similarity ratio from Geometry

$a = \dfrac{\text{Image measure}}{\text{Original measure}} = \dfrac{-4}{1} = -4$

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

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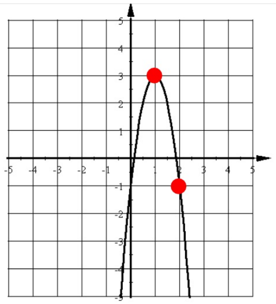

## Another way to find a:

Using the vertex of (1,3)
you can get this much
of the equation:
$y = a(x - 1)^2 + 3$

Use the coordinates of ANY other point on the graph: If you pick (2, -1)

replace x with 2 and y with -1 then solve for a. ➞ $-1 = a(2 - 1)^2 + 3$

$a(1)^2 + 3$

$-1 = a + 3$

$-3 \qquad -3$

$-4 = a$