5.3 Transforming Parabolas

Most basic form is parent function $y=x^2$

Vertex form $\Rightarrow$ $y=a(x-h)^2+k$

$\Rightarrow$ vertex (h,k)

$a>1$ $\Rightarrow$ leading coeff $\Rightarrow$ vertical stretch (skinnier)

$0<a<1$ $\Rightarrow$ fraction $\Rightarrow$ vertical shrink (wider)

a negative $\Rightarrow$ reflection across x-axis

$h>0$ $(x-h)$ $\Rightarrow$ horizontal shift right!

$h<0$ $(x-(-h))$ $\Rightarrow$ $(x+h)$ horizontal left!!

$k>0$ $\Rightarrow$ $+k$ up k units

$k<0$ $\Rightarrow$ $-k$ down k units

vertex $\Rightarrow$ (h,k)

axis of symmetry $\Rightarrow$ $x=h$

minimum / maximum $\Rightarrow$ $y=k$

standard form $y=ax^2+bx+c$ vertex $\left(\frac{-b}{2a}, f\left(\frac{-b}{2a}\right)\right)$

What if $\Rightarrow$ $y=a(\underbrace{nx-h}_{\text{vertex}})^2+k$ (coefficient with x)

$nx-h=0$

$nx=h$

$\underline{\underline{x=h/n}}$

y: $y=a\left(n\left(\frac{h}{n}\right)-h\right)^2+k$

$\underline{\underline{y=k}}$

What is the vertex for $=(-6/5, 9)$

$y=(\underbrace{5x+6})^2-9$

$5x+6=0$

$-6 \quad -6$

$5x=-6$

$\underline{\underline{x=-6/5}}$

$y=\left(5\left(\frac{-6}{5}\right)+6\right)^2-9$

$0-9$

$y=-9$

y-intercept

$\underline{\underline{y=27}}$

$y=(5x+6)^2-9$ $\Rightarrow (5x+6)(5x+6)$

$y=25x^2+60x+36-9$

$y=25x^2+60x+\underline{\underline{27}}$

p2.

Leading Coefficient:

Graph $y = 3x^2$

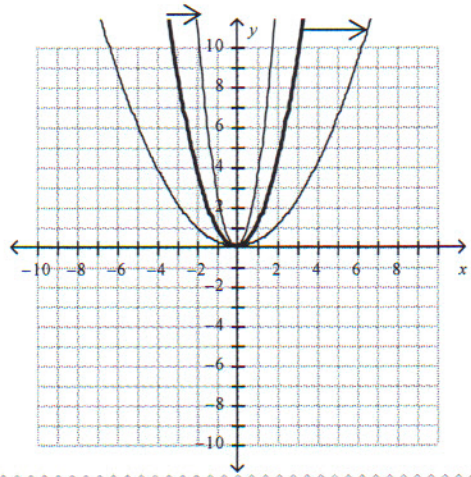
Notice the effect of a number in front of a quadratic equation: the graph got skinnier (compressed).

Graph $y = \frac{1}{4}x^2$,

The graph gets fatter (stretches).

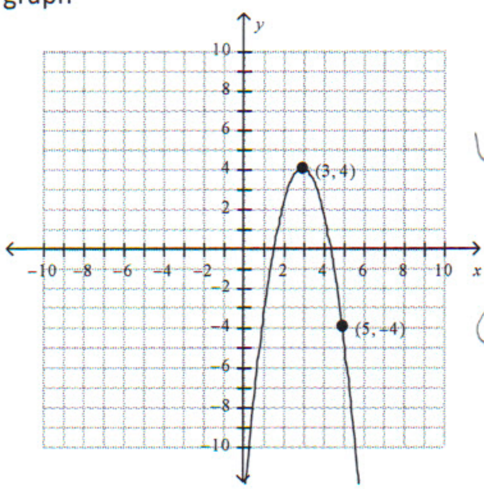
In general, if the constant, "a", is larger than 1 the graph will get skinny.

For values between 0 and 1 the graph will get wider.



Examples –

Write an equation of a parabola in vertex form from a graph



vertex

(3, 4)

(h, k)

(x, y)

(5 -4)

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

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

$-4 = a(5-3)^2 + 4$

$-4 = a(4) + 4$

$-4 \quad -4$

$-8 = 4a$

$\frac{-8}{4} = a = -2$

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

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

$(-1, -4)$

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

Vertex

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

$x = 0$

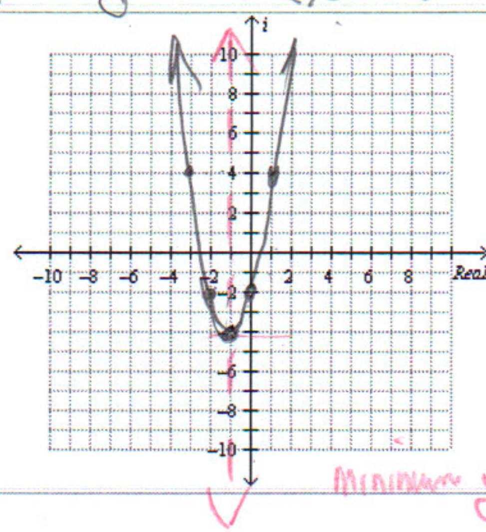
$y = 2(1)^2 - 4$

$y = -2$

$x = 2$

$18 - 4$

14



Minimum $y = -4$

$x = -1$

Convert an equation to vertex form:

$y = -3x^2 + 12x + 5$ ~~y-intercept~~

$a = -3$

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

$x = \frac{-b}{2a} = \frac{-12}{2(-3)} = \frac{-12}{-6} = 2$

$y = 3(x-2)^2 + 17$

$y = -3(2^2) + 12(2) + 5$
$-12 + 24 + 5$
$12 + 5 = 17$

Ans $\Rightarrow y = -3(x-2)^2 + 17$

$y = \frac{9}{4}x^2 + 3x - 1$

a leading coeff

y-intercept

vertex $\left(\frac{-b}{2a}, f\left(\frac{-b}{2a}\right)\right)$

$x = \frac{-3}{2\left(\frac{9}{4}\right)} = \frac{-3}{\frac{9}{2}} \div = -\cancel{3} \cdot \frac{2}{\cancel{9}} = \frac{-2}{3}$

$y = \frac{9}{4}\left(\frac{-2}{3}^2\right) + 3\left(\frac{-2}{3}\right) - 1$

$y = \frac{9}{4}\left(\frac{4}{9}\right) + 3\left(\frac{-2}{3}\right) - 1$

$= 1 + (-2) - 1$

$y = -1 - 1$

$y = -2$

vertex $\left(-\frac{2}{3}, -2\right)$

Ans $\Rightarrow y = \frac{9}{4}\left(x + \frac{2}{3}\right)^2 - 2$

How do I know if my vertex form is correct??

Check with calculator.

Plug original (standard form) into $y_1 =$ &

put vertex form into $y_2 =$

1. will graph the same
2. table will show y_1 & y_2 as same values.