Consider $y=x^2$

x	$y=x^2$
⋮	⋮
-2	4
-1	1
0	0
1	1
2	4
3	9
4	16
5	25
⋮	⋮

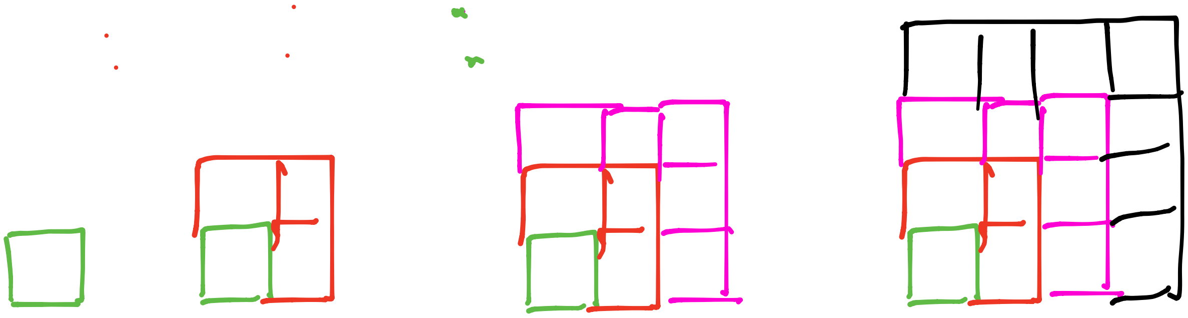
⋮
-5, -3, -1, $+1$, $+3$, $+5$, $+7$, $+9$
⋮

$+2$, $+2$, $+2$, $+2$, $+2$, $+2$, $+2$

$\leftarrow$ if all 2nd differences are the same, then the sequence is quadratic.

Note:
$y=x^2$ is symmetric "mirrored"

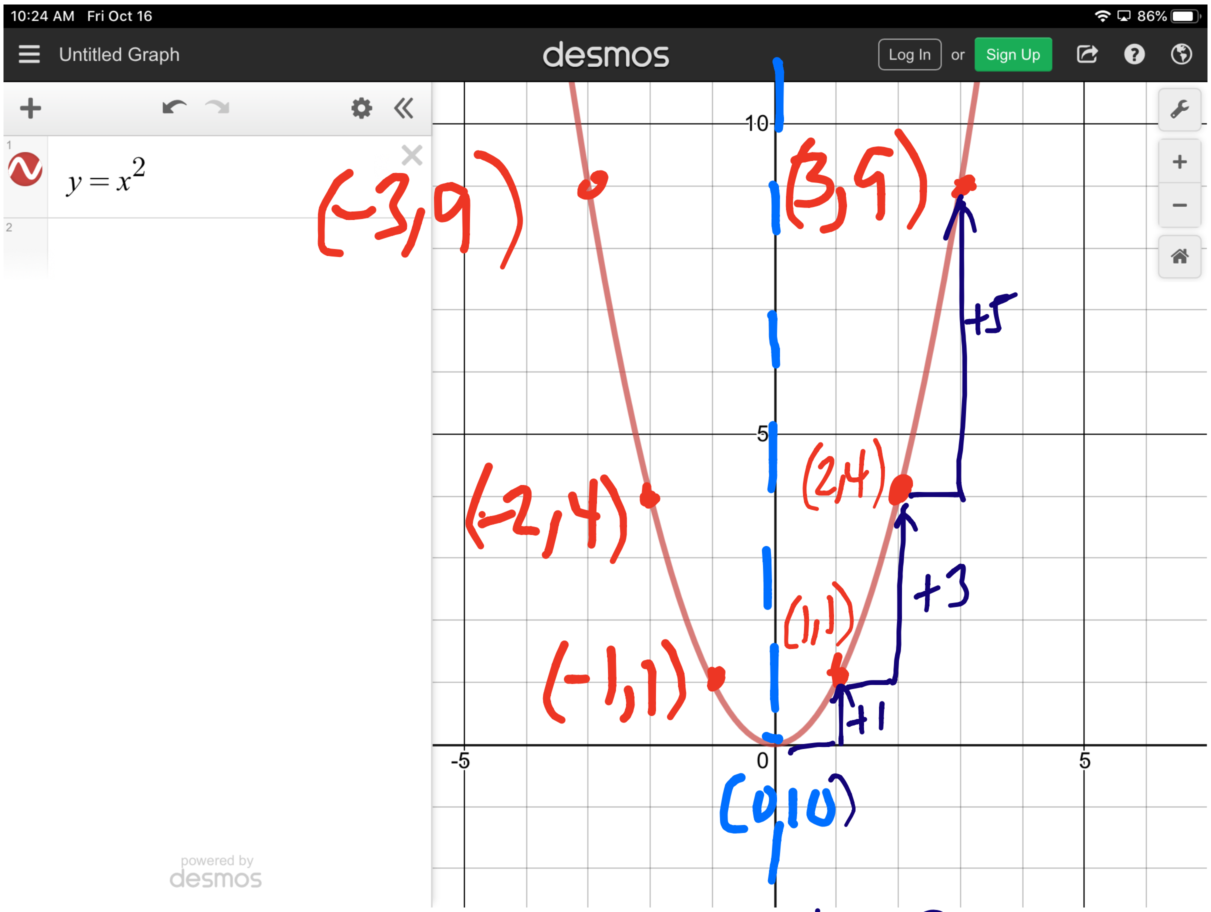
axis of symmetry @ $x=0$



1   4   9   16   . . .

$1+3$ $1+3+5$ $1+3+5+7$

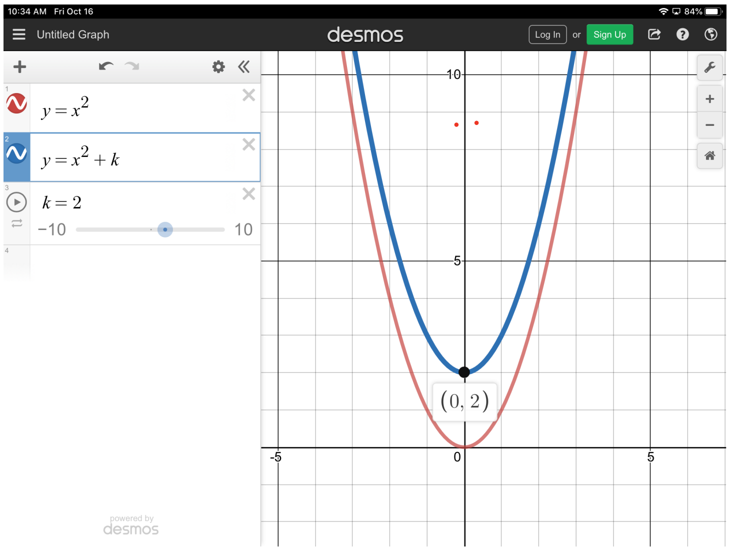
To find the next x^2 in sequence
- x^2 (multiply number by itself)
- add next odd number.

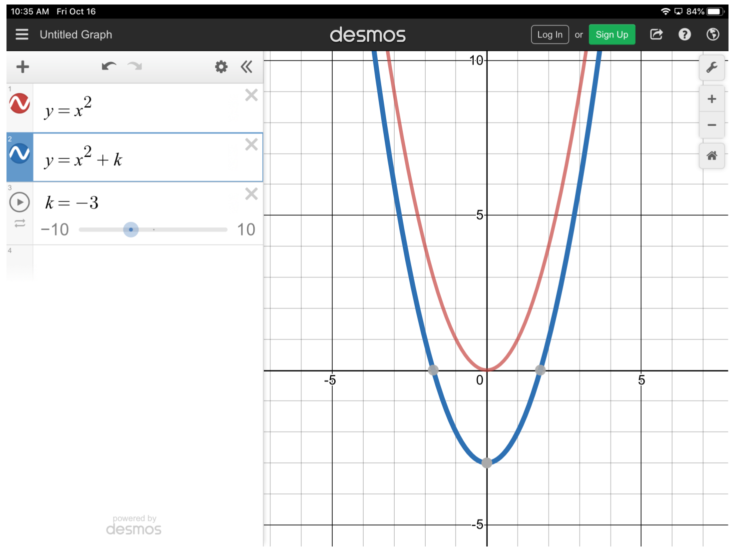


axis of symmetry @ $x=0$

Shifting $y=x^2$

The case of $y=x^2+k$

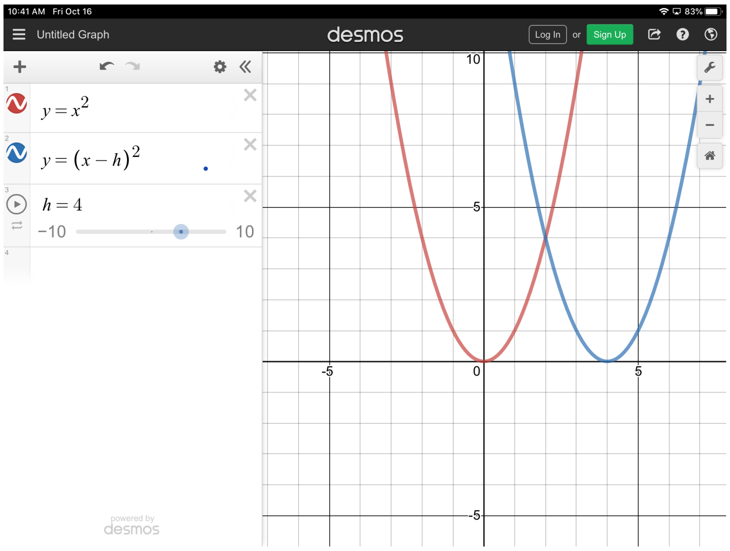


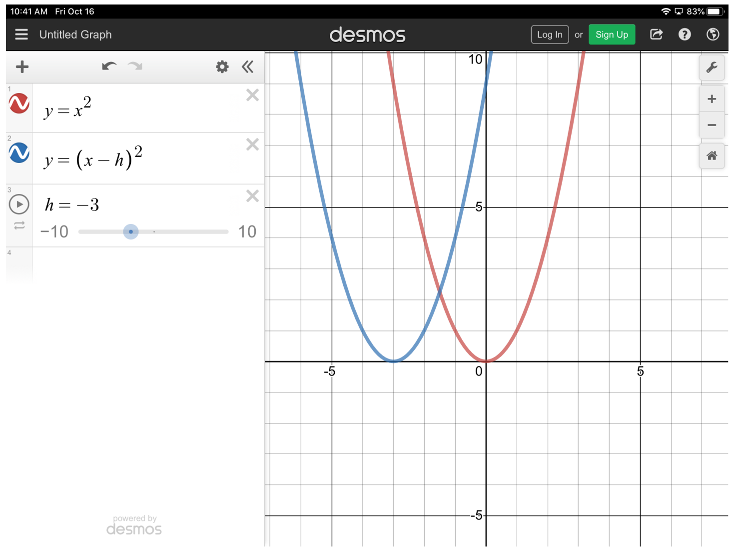


if k is positive, translate $y=x^2$ ↑ k

is negative, translate $y=x^2$ ↓ k

Consider the case of $y=(x-h)^2$ (horizontal shift)





if h is negative, translate $y=x^2$ $\leftarrow h$

positive, translate $y=x^2$ $\rightarrow h$

Note: this is for $y=(x-h)^2$

in the case of $y=(x+h)^2$

"$y=(x-(-h))^2$"

if h is negative, translate $y=x^2$ $\rightarrow h$

positive, translate $y=x^2$ $\leftarrow h$

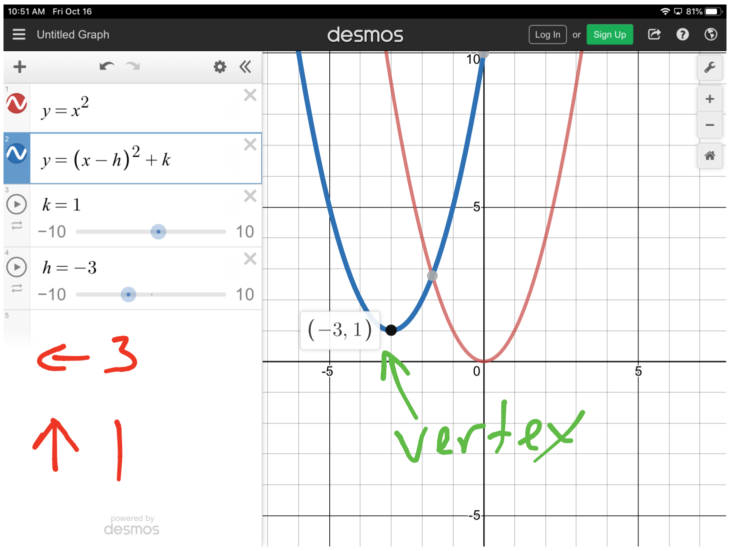
The case of $y=(x-h)^2+k$

$(-3,1)$ is vertex and translation

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

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

Translated $y=x^2$ ← 3 ↑ 1



← 3

↑ 1

vertex

inside parenthesis horizontal

outside parenthesis vertical

e.g.

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

translation of $y=x^2$ → 2 ↓ 4

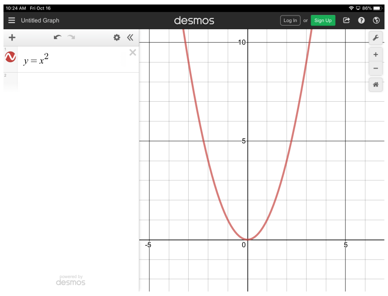
vertex $(2,-4)$

$y=(x-h)^2+k$ ← rewrite in this form.

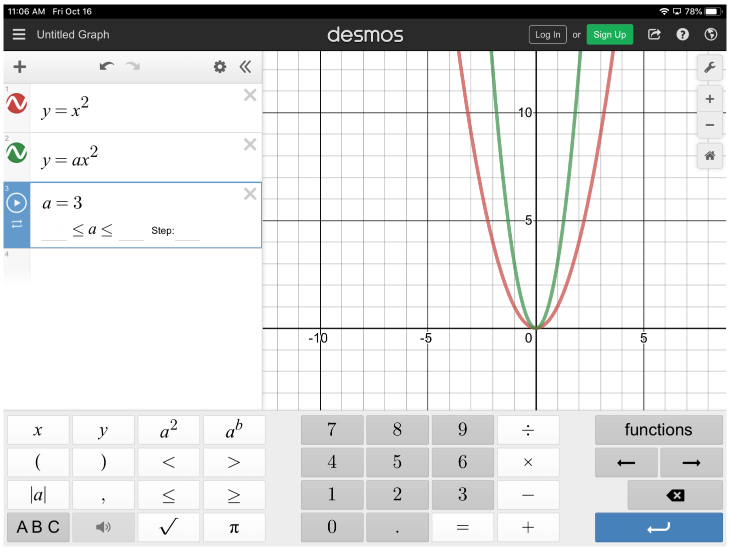
$y=(x-(2))^2+(-4)$ $(2,-4)$ is vertex

→ 2 ↓ 4 is translation.

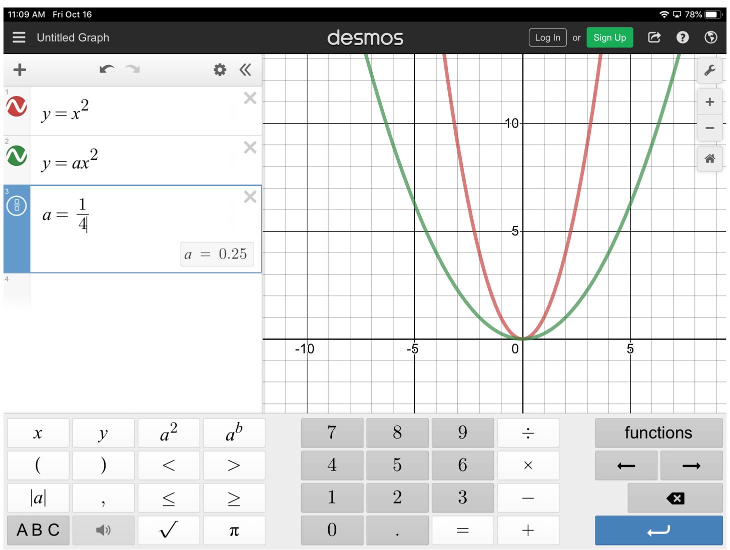
$y = ax^2$ Case



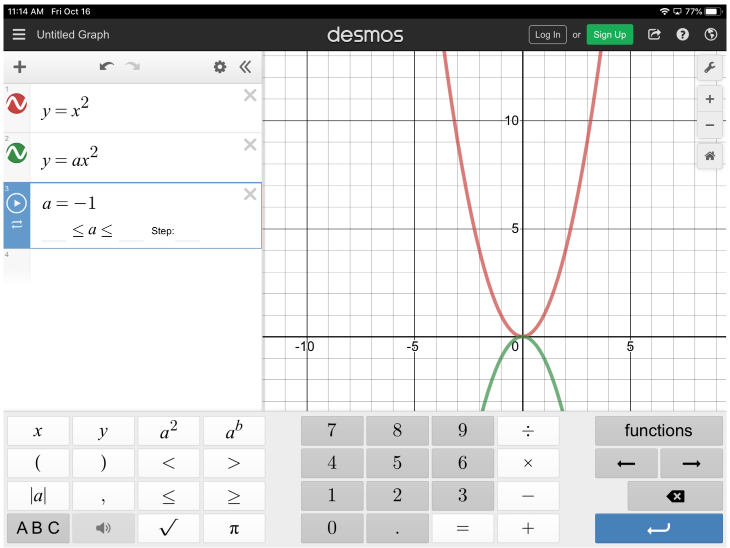
$a = 1$



if $|a| > 1$ parabola is more acute,



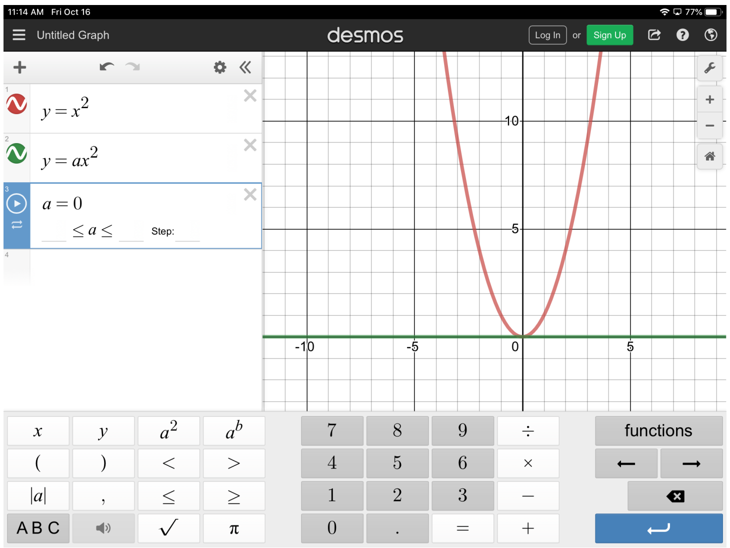
if $|a| < 1$ parabola is less acute.
"wider"



if $a < 0$, parabola "flips"

reflected over "x-axis"

the line $x = $ max/min

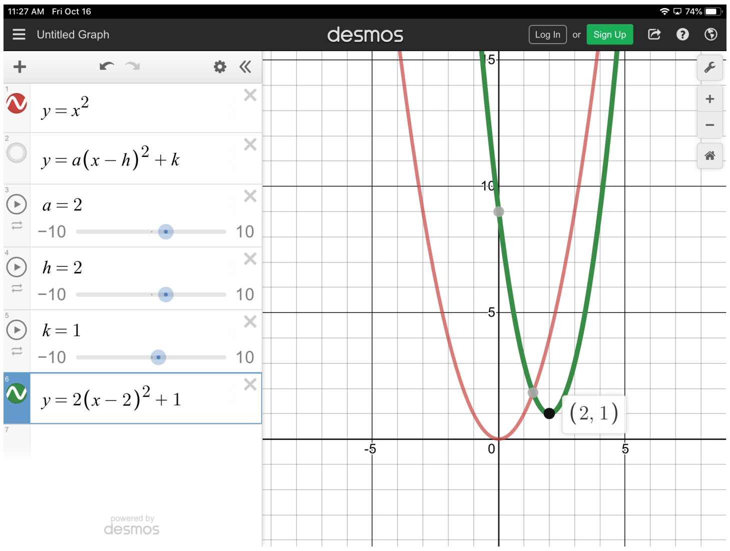


if $a = 0$, parabola

is no longer parabola

→ is line.

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



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

Looks like $y=2x^2$

translated

$\rightarrow 2 \quad \uparrow 1$

vertex $(2,1)$

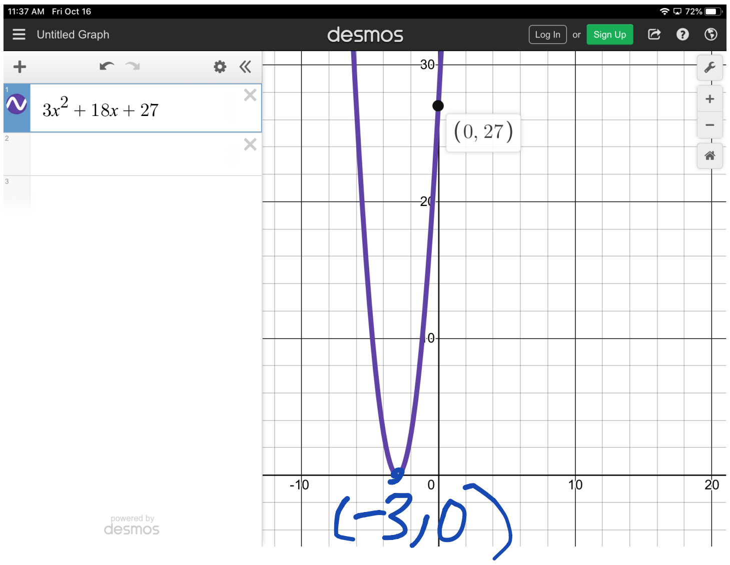
$y=a(x-h)^2+k$ "vertex form of quadratic"

Looks like $y=ax^2$

vertex (h,k)

$y = 3x^2 + 18x + 27$

$y = ax^2 + bx + c$ ← standard form of a quadratic



(-3, 0)

(0, c) is y-intercept

* only in standard form

$y = 3x^2 + 18x + 27$

$y = 3(x^2 + 6x + 9)$

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

$y = 3(x+3)(x+3)$

if $3x^2 + 18x + 27 = 0$

$3(x^2 + 6x + 9) = 0$

$3(x+3)(x+3) = 0$

$x + 3 = 0$

$x = -3$

↑

solution to $ax^2 + bx + c = 0$

root.

$y = a(x - r_1)(x - r_2)$

roots form: r_1, r_2 are solutions to $ax^2 + bx + c = 0$