Graphs of Quadratic Equations

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Note Title 11/16/2007

Focus: Graph an equation of the form $y = a(x-h)^2 + k$

Omit: Domain & Range

Quadratic Equations: $ax^2+bx+c=0$

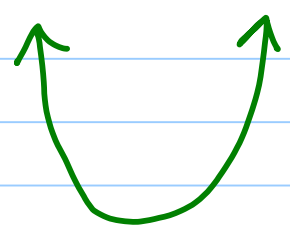
Quadratic Functions: $y=ax^2+bx+c$

$f(x)$

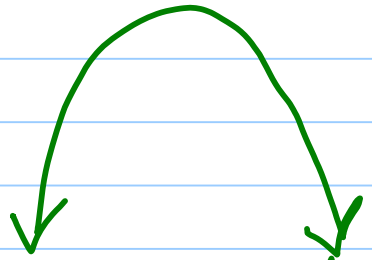
$y=a(x-h)^2+k$

Graphs of quadratic functions:

parabolas

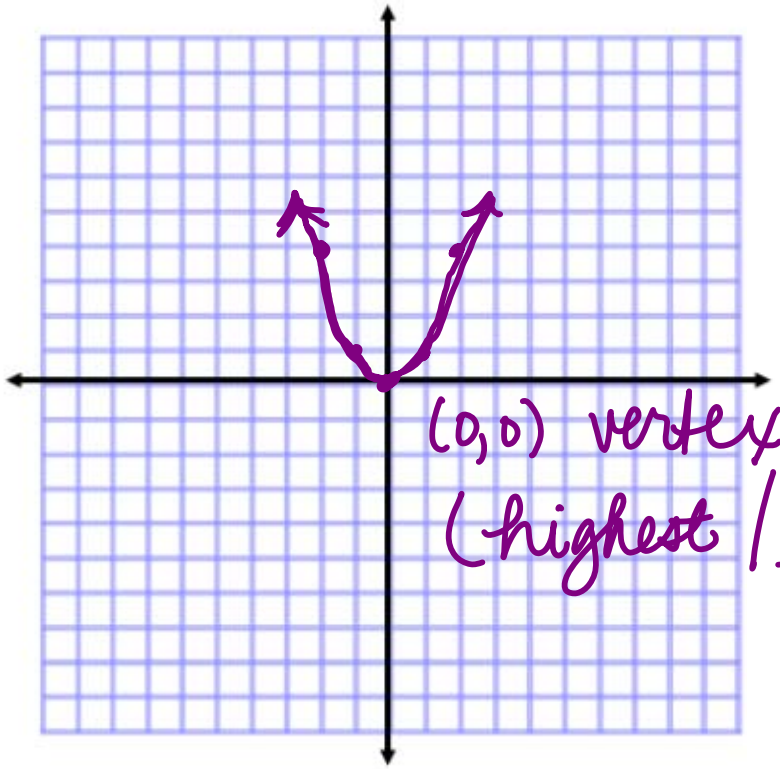


opens up



opens down

Basic Quadratic Function: $y = x^2$



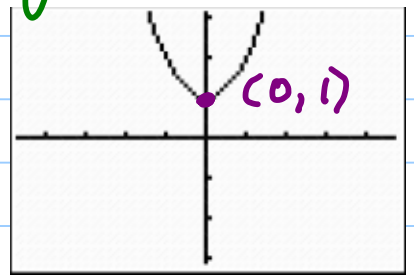
(0,0) vertex
(highest / lowest point)

x	y
−2	$(-2)^2 = 4$
−1	$(-1)^2 = 1$
0	$(0)^2 = 0$
1	$(1)^2 = 1$
2	$(2)^2 = 4$

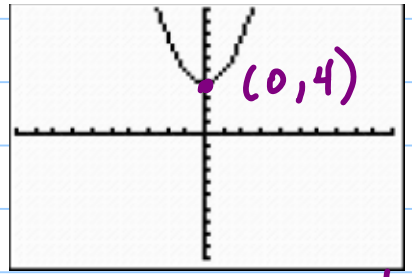
Graphs of the form: $y = x^2 + k$, k a real #.

① $y = x^2 + 1$

up 1

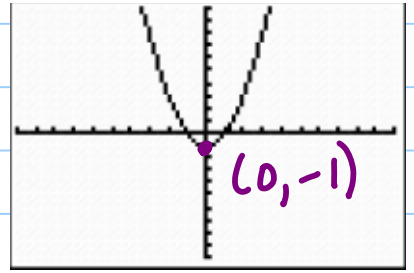


② $y = x^2 + 4$



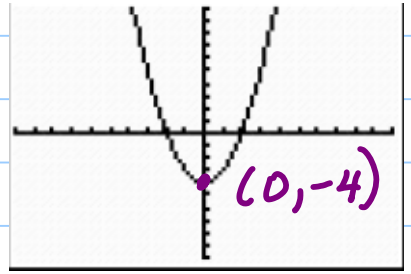
up 4

③ $y = x^2 - 1$



down 1 unit

④ $y = x^2 - 4$



down 4

Conclusion:

$y = x^2 + k$ has vertex $(0, k)$.

If $k > 0$, shifts up k units.

If $k < 0$, shifts down k units.

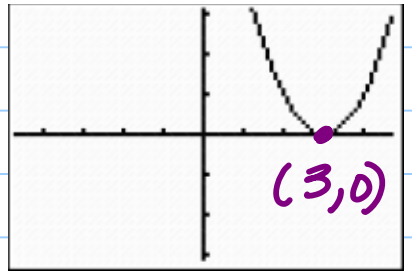
Graphs of the form: $y = (x - h)^2$, h a real #.

Ex. $y = (x - 3)^2$

$h = 3$

$x - 3 = 0$

$x = 3$



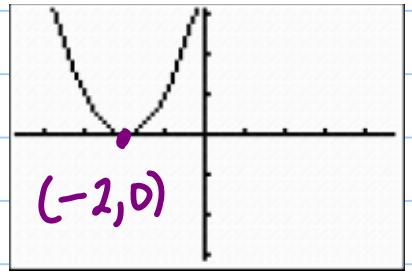
shift right 3

$y = (x + 2)^2$

$h = -2$

$x + 2 = 0$

$x = -2$



shift left 2

Conclusion: $y = (x-h)^2$ has vertex $(h, 0)$.

If $h > 0$, shift right. $(x - \#)^2$

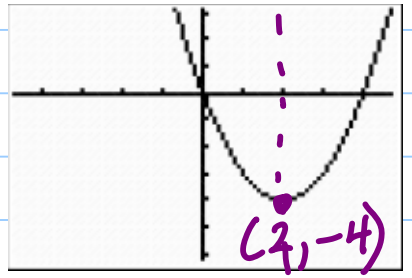
If $h < 0$, shift left $(x - (-\#))^2 = (x + \#)^2$

$y = x^2 - 5 \Rightarrow (0, -5)$
$y = (x-5)^2 \Rightarrow (5, 0)$
} vertex

Graphs of form: $y = (x-h)^2 + k$

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

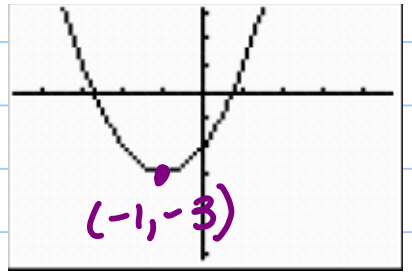
$h = 2, k = -4$



vertex (h, k)

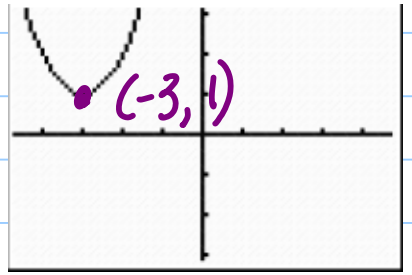
$y = (x+1)^2 - 3$

$h = -1, k = -3$



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

$h = -3, k = 1$



Conclusion:

$y = (x-h)^2 + k$ has vertex (h, k).

$y = (x+2)^2 - 6$ $(-2, -6)$

$y = (x-6)^2 - 2$ $(6, -2)$

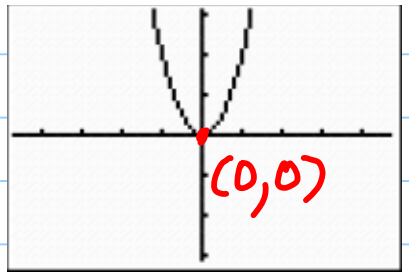
$y = (x+4)^2 + 3$ $(-4, 3)$

$y = (x-9)^2$ $(9, 0)$

$y = x^2 - 7$ $(0, -7)$

Graphs of form $y = ax^2$, a is a real #.

$y = 2x^2$



a positive

⇒ ↑↓

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

a negative

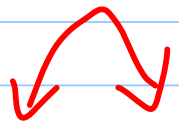
⇒ ↓

direction

left/right

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

$a > 0 \Rightarrow$ 

$a < 0 \Rightarrow$ 

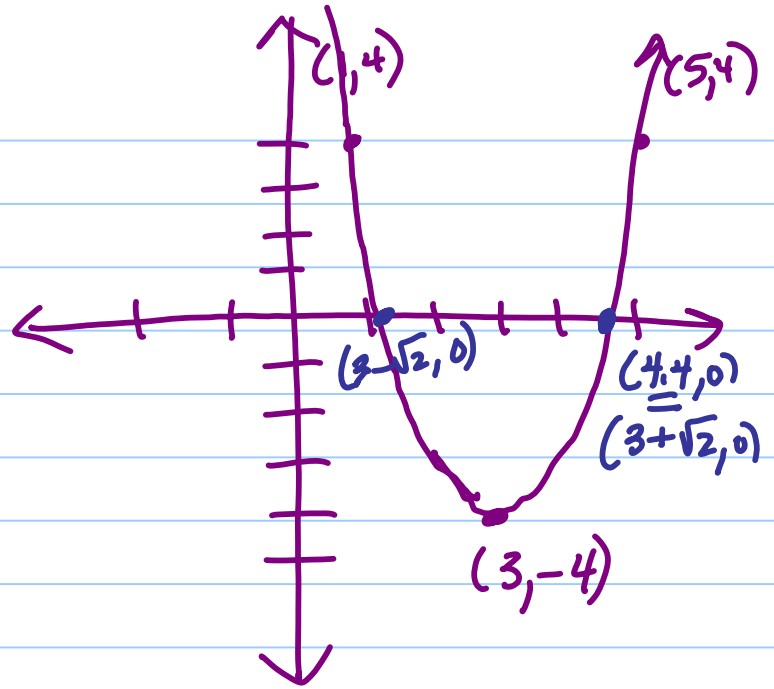
vertex $= (h, k)$

Graph by hand:

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

$a = 2 > 0$ ∪

$h = 3,\ k = -4 \Rightarrow$ vertex $(3,-4)$



x	y
1	4
3	−4
5	4

y-int:

$y = 2(0-3)^2 - 4$

$y = 2(-3)^2 - 4$

$y = 2(9) - 4 = 14$

$(0,14)$

X-int:

$2(x-3)^2 - 4 = 0$

$2(x-3)^2 = 4$

$(x-3)^2 = 2$

$x - 3 = \pm\sqrt{2}$

$x = 3 \pm \sqrt{2}$

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

$y = 2(5-3)^2 - 4 = 2(2)^2 - 4 = 2(4) - 4 = 4$

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