Unit #5 - Quadratics in Vertex Form

direction of opening

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

step pattern

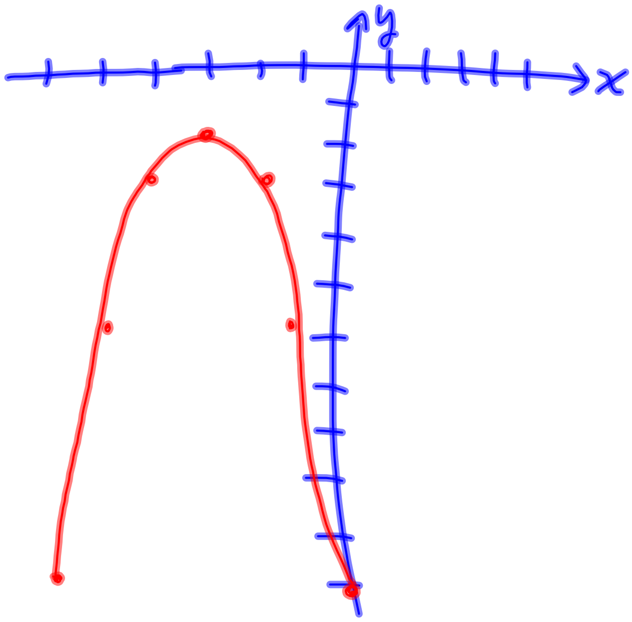
(h, K) vertex

*h is a liar

yint when $x=0$

$$y = a(-h)^2 + K$$

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



$(-3,-2)$ vertex

opens down

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

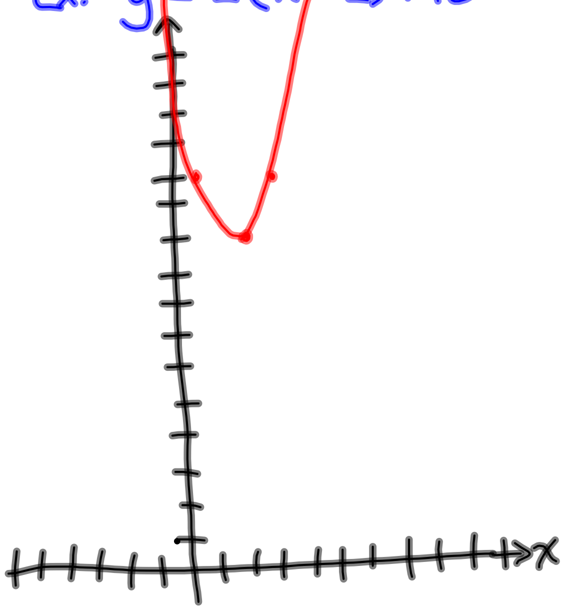
$= -11$

step $-1, -4, -9$

$1a, 4a, 9a$

over	up/down
1	1a
2	4a
3	9a
4	16a

Ex. $y = 2(x-2)^2 + 10$



vertex $(2,10)$

yint $\rightarrow y = 2(-2)^2 + 10$
$= 18$

direction - up

step pattern

$\overset{1}{2}, \overset{2}{8}, \overset{3}{18}$

$1a, 4a, 9a \quad a = 2$

$1^2 \quad 2^2 \quad 3^2$

Vertex to Standard

$y = 3(x+2)^2 + 10$
$= 3(x+2)(x+2) + 10$
$= 3(x^2 + 2x + 2x + 4) + 10$
$= 3(x^2 + 4x + 4) + 10$
$= 3x^2 + 12x + 12 + 10$
$y = 3x^2 + 12x + 22$

F first
O outer
I inner
L last

1) FOIL
2) Distribute "a" value
3) Collect Like Terms

Ex. $y = -1(x-3)^2 + 5$
$= -1(x-3)(x-3) + 5$
$= -1(x^2 - 3x - 3x + 9) + 5$
$= -1(x^2 - 6x + 9) + 5$
$= -x^2 + 6x - 9 + 5$
$= -x^2 + 6x - 4$

Standard to Vertex

$y = 3x^2 + 18x + 7$

$y = 3(x^2 + 6x) + 7$

$y = 3(\underbrace{x^2+6x+9}-9) + 7$ $\quad \frac{6}{2} = 3$

$y = 3(x^2+6x+9) - 27 + 7$ $\quad 3^2 = 9$

$y = 3(\underbrace{x^2+6x+9}) - 20$

$y = 3(x+3)^2 - 20$

$y = ax^2 + bx + c$

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

$(x+3)^2$

$(x+3)(x+3)$

$x^2 + 6x + 9$

* completing the square *

$y = 4x^2 + 32x + 2$

$= 4(x^2 + 8x) + 2$ $\quad \frac{8}{2} = 4$

$= 4(x^2 + 8x + 16 - 16) + 2$ $\quad 4^2 = 16$

$= 4(x^2 + 8x + 16) - 64 + 2$

$= 4(x^2 + 8x + 16) - 62$

$= 4(x+4)^2 - 62$

Application Problems

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

max/min $\rightarrow (h, K)$

zeros (how long is it in the air?
how far away does it land?)

↳ change to standard and find zeros with quadratic formula.

Pg. 316 #1 → completing square

pg. 225 #2 → foil

pg. 185 #13 → graphing

pg. 187 #14 → application problem

$$y = 3x^2 + 18x + 20$$
$$= 3\,(x^2 + 6x) + 20$$

$\frac{6}{2} = 3$

$$= 3(x^2 + 6x + 9 - 9) + 20$$

$3^2 = 9$

$$= 3(x^2 + 6x + 9) + 20 - 27$$
$$= 3(x^2 + 6x + 9) - 7$$
$$= 3(x+3)^2 - 7$$

$$y = -2x^2 + 12x + 9$$
$$= -2\,(x^2 - 6x) + 9$$

$-\frac{6}{2} = -3$

$$= -2(x^2 - 6x + 9 - 9) + 9$$

$(-3)^2 = 9$

$$= -2(x^2 - 6x + 9) + 18 + 9$$
$$= -2(x^2 - 6x + 9) + 27$$
$$= -2(x-3)^2 + 27$$

$(x^2 + 4x + 4)$

$= (x+2)^2$

$(x-3)^2$

$(x-3)(x-3)$

$x^2 - 3x - 3x + 9$

$x^2 - 6x + 9$

$(x^2 - 12x + 36)$

$= (x-6)^2$

$y = -2(x-2)^2 + 8$

opens down

1a, 4a, 9a

-2, -8, -18

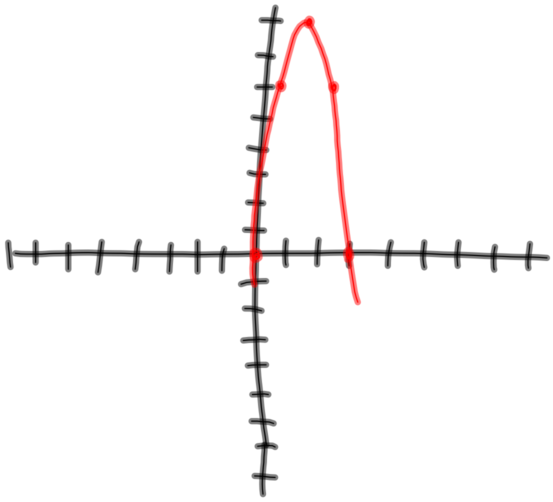
yint

$y = -2(-2)^2 + 8$

$= -8 + 8$

$= 0$

vertex (2, 8)



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

- normal step

1a, 4a, 9a

1, 4, 9

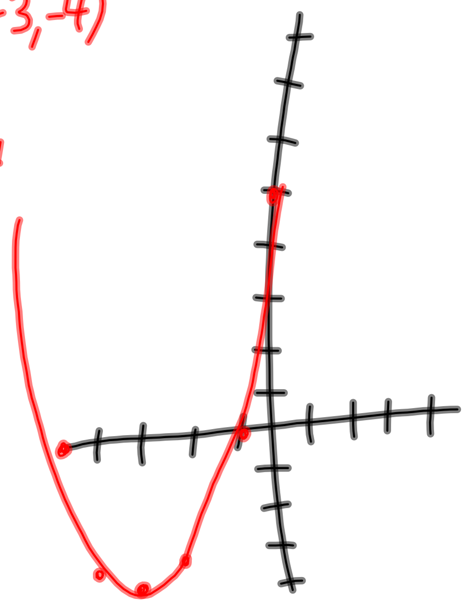
- opens up

yint

$y = (3)^2 - 4$

$= 5$

vertex (-3, -4)



pg. 187 #14

$h = -5(t-5)^2 + 127$

$(5, 127)$

time to get to max height

max height

y-int

$h = -5(-5)^2 + 127$

$= -5(25) + 127$

$= -125 + 127$

$= 2m$

pg. 205 #10

$h = -4.9t^2 + 5t + 2$ (path of a volleyball)

→ what does the h-int represent?

→ how long does it take to land? → zeros

-0.31 and 1.335

→ what is its max height?

(0.51, 3.3m)

Factoring Practice

pg. 256

9 – 12

16 – 17

19