key

Pre-Calculus 11

3.1 Quadratic Functions in Vertex Form $y = a(x-p)^2 + q$

Having examined the effects that a, p, and q can have on a quadratic function individually, we will now consider examples that incorporate all three values simultaneously.

A function written in the form $y = a(x-p)^2 + q$ is said to be in vertex form.

- "a" affects direction of opening and vertical expansion/compression
- "p" translates the function horizontally. (left OR right)
- "q" translates the function vertically (up OR down)

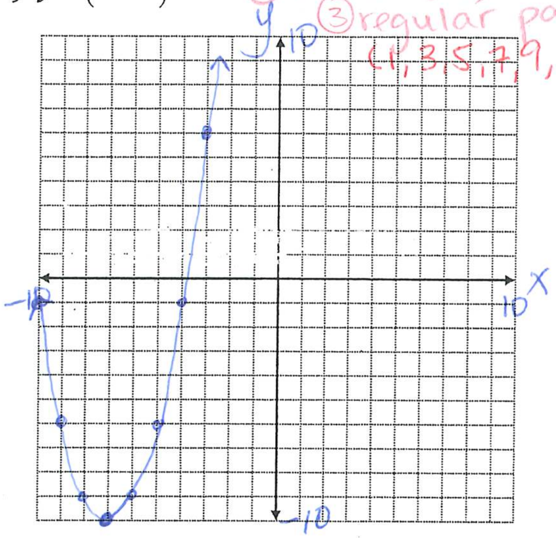
NOTE: The vertex has coordinates (p, q).

① Note direction of opening.
② Determine vertex
③ Apply vertical exp/comp to "pattern" (1, 3, 5, 7, 9, ..)

Example #1: Sketch the graph of each function. Do not use a table of values.

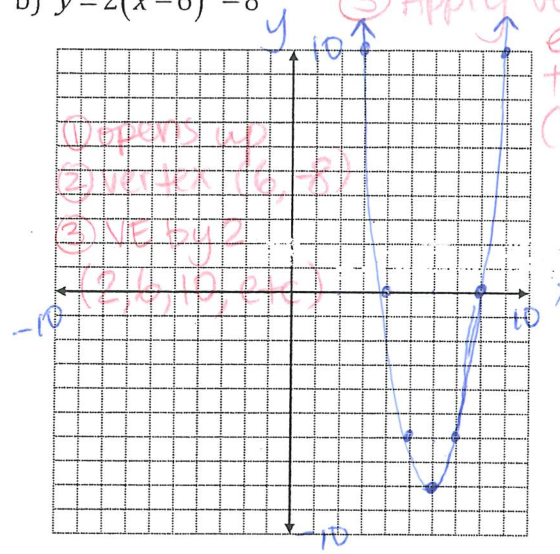
a) $y=(x+7)^2-10$

① opens up
② vertex (−7, −10)
③ regular pattern (1, 3, 5, 7, 9, ...)



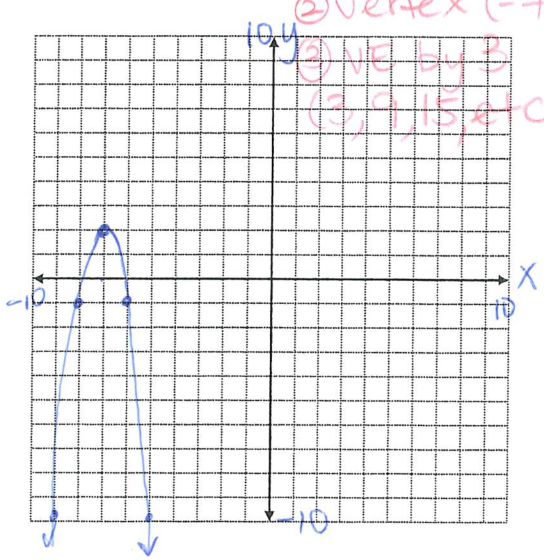
b) $y=2(x-6)^2-8$

① opens up
② vertex (6, −8)
③ VE by 2
(2, 6, 10, etc)



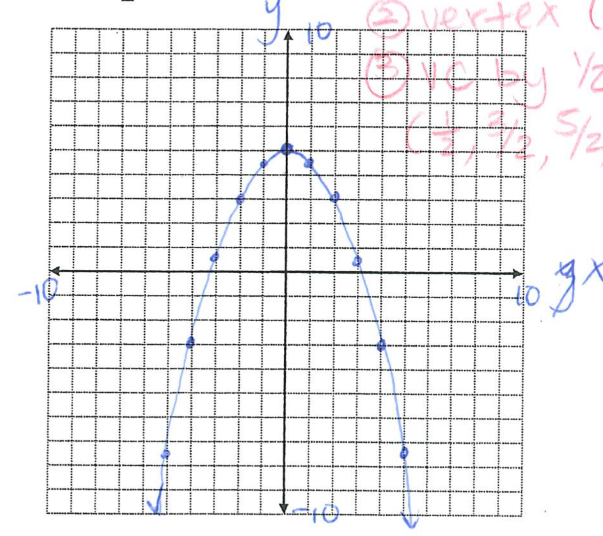
c) $y=-3(x+7)^2+2$

① opens down
② vertex (−7, 2)
③ VE by 3
(3, 9, 15, etc)



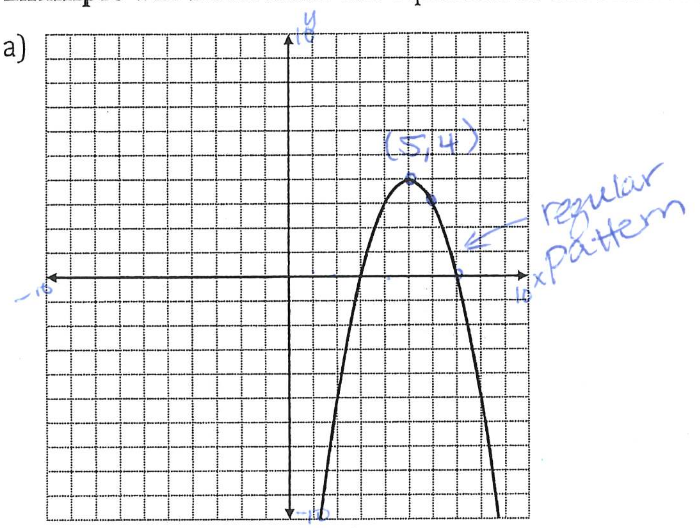
d) $y=-\frac{1}{2}x^2+5$

① opens down
② vertex (0, 0)
③ VC by ½
(½, 3/2, 5/2, 7/2, ...)

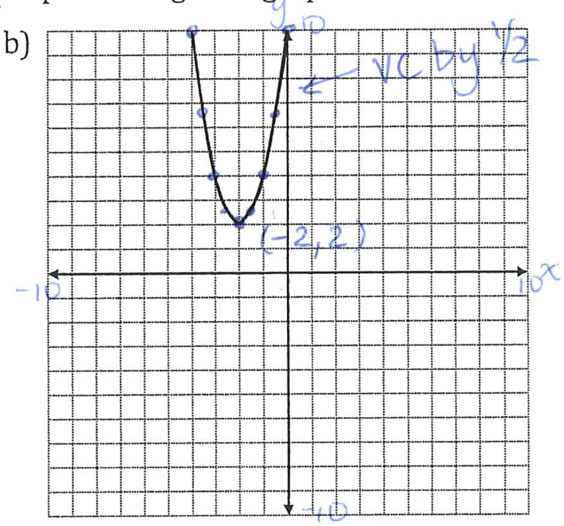


Example #2: Determine the equation of the function representing each graph.

a)



b)



a) $y = -(x-5)^2 + 4$

b) $y = \frac{1}{2}(x+2)^2 + 2$

Example #3: Write the equation representing a parabola with the following properties.

a) vertex at $(9,-4)$ congruent to $y = 3x^2$

same size VE by 3

a) $y = 3(x-9)^2 - 4$

OR

$y = -3(x-9)^2 - 4$

b) vertex at $(-2,-6)$ through point $(4,3)$

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

Now use $(4,3)$:

$3 = a(4+2)^2 - 6$

$3 = 36a - 6$

$9 = 36a \rightarrow a = \frac{9}{36} = \frac{1}{4}$

b) $y = \frac{1}{4}(x+2)^2 - 6$

c) vertex at $(4,-1)$ with y–intercept $(0,-9)$

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

use $(0,-9)$

$-9 = a(0-4)^2 - 1$

$-9 = 16a - 1$

$-8 = 16a$

$a = -\frac{1}{2}$

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