Quadratic Functions in Vertex Form

A **quadratic function** can be written in different forms.

Ex :	Standard form	$y = ax^2 + bx + c$	ex : $f(x) = 3x^2 - 5x + 1$
	Factored form	$y = a(x - x_1)(x - x_2)$	ex : $g(x) = 2(x-1)(x+3)$

The **Vertex Form** looks like : $y = a(x-p)^2 + q$

Ex : $y = 2(x-3)^2 + 5$ → $a = 2$, $p = 3$, $q = 5$

$y = (x+1)^2 + 3$ → $a = 1$, $p = -1$, $q = 3$

$y = \frac{1}{2}(x-3)^2 - 2$ → $a = \frac{1}{2}$, $p = 3$, $q = -2$

When a quadratic function is in Vertex Form, p **and** q **are the coordinates of the vertex.**

Ex : $y = 2(x-3)^2 + 5$ → vertex : $(3,5)$

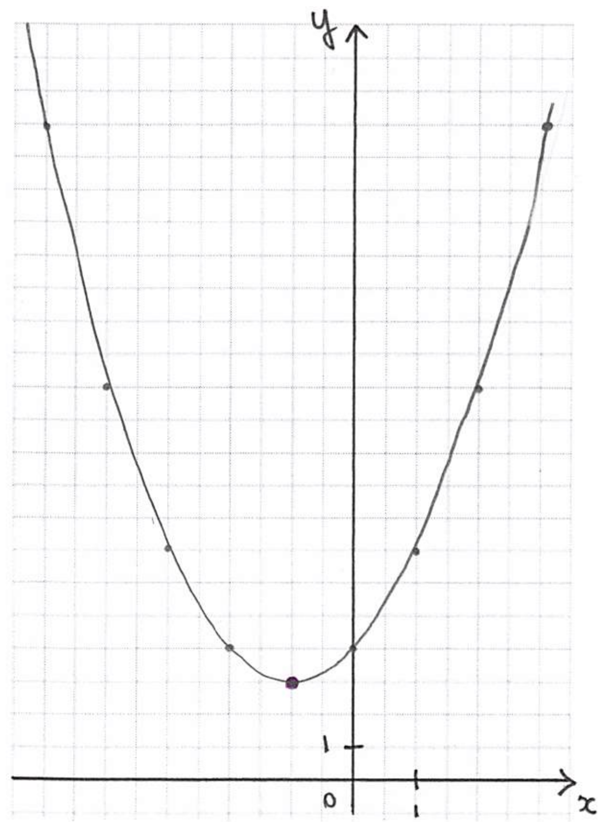
$y = (x+1)^2 + 3$ → vertex : $(-1,3)$

$y = \frac{1}{2}(x-3)^2 - 2$ → vertex : $(3,-2)$

Coefficient a still tells us the direction of the opening and its "speed".

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

vertex : $(-1,3)$
opens upward
same "speed" as $y = x^2$
y-int : 4 (replace x by 0)



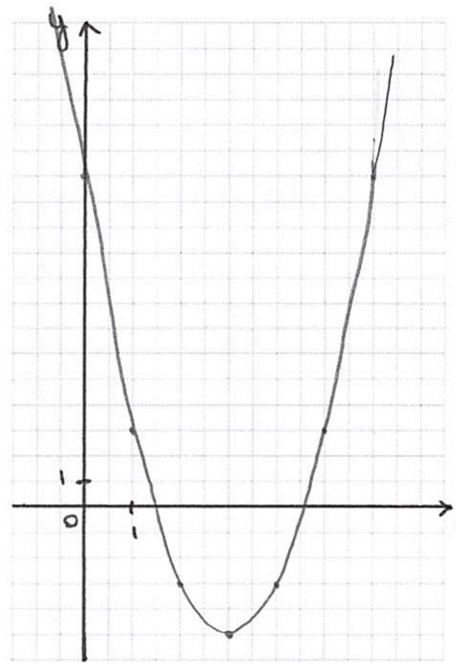
<u>Example 2</u> : $y = 2(x-3)^2 - 5$

vertex : (3, -5)

opens upward

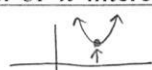
2x faster than $y = x^2$

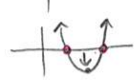
y-int : 13



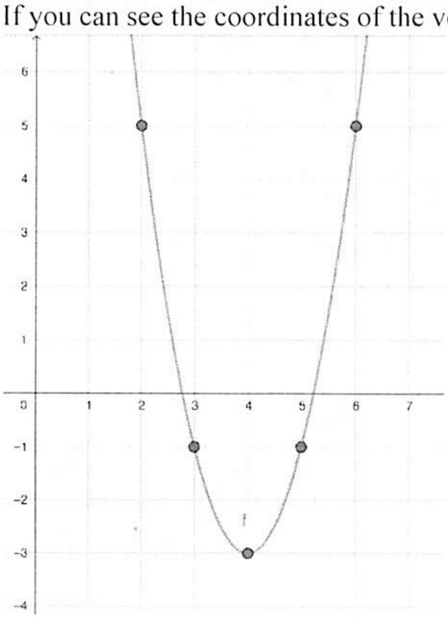
From the vertex, you can use the "speed of opening" compared to the reference quadratic function of a table of values (choosing preferably one side of the vertex)…

<u>Note</u> : If you know the sign of q and the direction of opening (a), you can easily know <u>the number of x-intercepts</u>

Ex : If $a > 0$ and $q > 0$,  no x-int

If $a > 0$ and $q < 0$,  2 x-int

<u>Determining an equation of a parabola</u> :
If you can see the coordinates of the vertex on a graph, the easiest is to use the vertex form:



$y = a(x-p)^2 + q$

to be determined using an other point ex: (2,5)

can be read on the graph : 4 & -3

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

replace x by 2
y by 5
in the equation ⇒ $5 = a(2-4)^2 - 3$

$5 = 4a - 3$

$8 = 4a$

$a = 2$

⇒ $\boxed{y = 2(x-4)^2 - 3}$

<u>Hwk :</u> p 157 # 4, 7, 8, 9, 12, 15, 16, 18, 20 + 21