6.4 Vertex Form of a Quadratic

- 1st we had standard form: $y = ax^2 + bx + c$

If $a > 0$ opens up
If $a < 0$ opens down
y-intercept is $(0, c)$
Axis of symmetry using $x = -\frac{b}{2a}$

- 2nd we had factored form: $y = a(x-r)(x-s)$

If $a > 0$ opens up
If $a < 0$ opens down
x-intercepts are $(r, 0)$ and $(s, 0)$
Axis of symmetry $x = \frac{r+s}{2}$

- Now we have vertex form: $y = a(x-p)^2 + q$

If $a > 0$ opens up
If $a < 0$ opens down
{"a" is the same in all 3 forms}

vertex (p, q)

Axis of symmetry $x = p$

Range { If $a > 0$: $\{y \mid y \geq q, y \in \mathbb{R}\}$
If $a < 0$: $\{y \mid y \leq q, y \in \mathbb{R}\}$

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

(i) what is the vertex? $(-3, 5)$

(ii) The axis of symm: $x = -3$

(iii) max or min value: max value is 5

(iv) Domain: $\{x \mid x \in \mathbb{R}\}$

(v) Range: $\{y \mid y \leq 5, y \in \mathbb{R}\}$

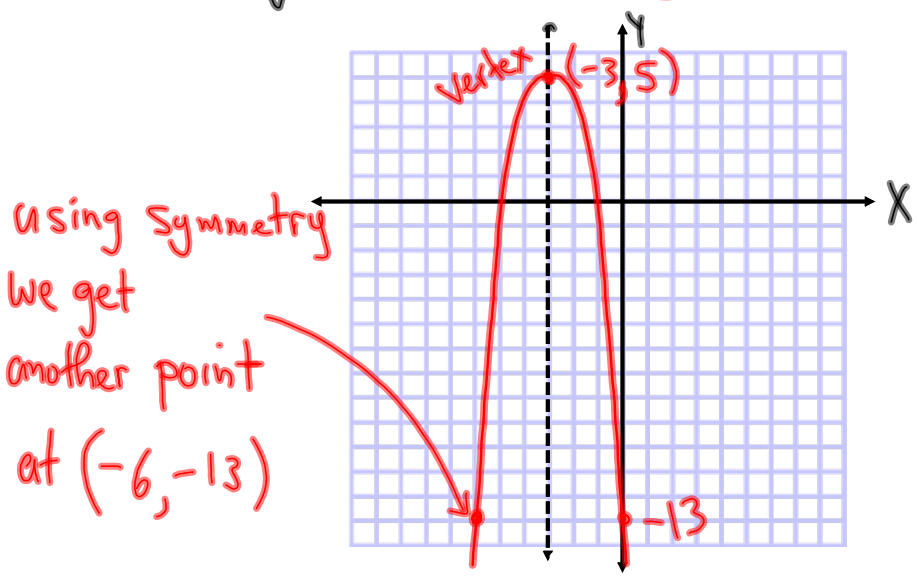
(vi) y-intercept $(0, -13)$

$y = -2(0+3)^2 + 5$

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

$y = -2(9) + 5$

$y = -18 + 5 = -13$



Ex: $y = 3(x-2)^2 - 1$

How many x-intercepts (zeros) does this function have?

Solution: need to know 2 things

1. vertex $\Rightarrow (2, -1)$
2. Direction of opening $\Rightarrow$ opens up

Since vertex is below x-axis, and the parabola opens upward, the graph must cross the x-axis twice.