## 4.4 Quadratic Functions of the Form $y = a(x-p)^2 + q$ Part II

**Example #1**: For the quadratic function $y = \frac{1}{4}(x-3)^2 + 1$

$\rightarrow 3 \quad \uparrow 1$

a) Identify:

I. the direction of opening

up

II. the vertex

$(3, 1)$

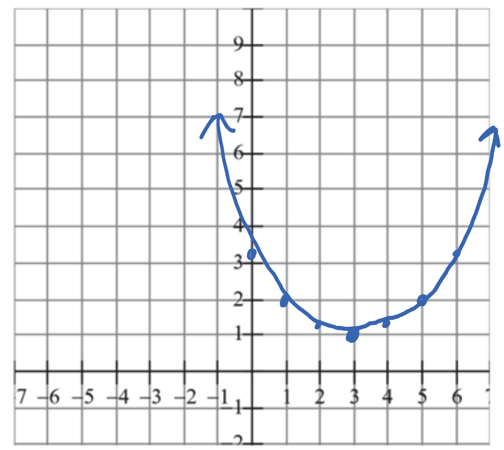
III. the equation of the axis of symmetry

$x = 3$

IV. the domain and range of the function

$x \in \mathbb{R}$ $\quad$ $y \geq 1$

b) Sketch the graph



steps: 1, 3, 5

$\times \frac{1}{4}$ : 0.25, 0.75, 1.25

**Example #2**: Determine a quadratic function that has a vertex at $(-1, -3)$ and passes through the point $(1, 5)$.

$p \quad q$

$x \quad y$

$y = a(x-p)^2 + q$ $\rightarrow$ sub in vertex $(-1,-3)$ and point $(1,5)$

$5 = a(1-(-1))^2 - 3$

$5 = a(2)^2 - 3$

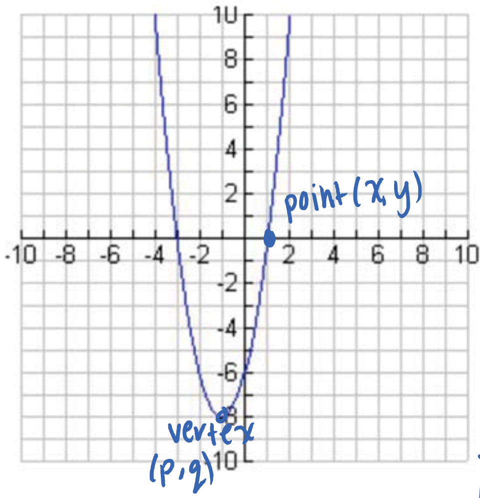
$+3 \qquad +3$

$\frac{8}{4} = \frac{4a}{4}$

$\boxed{a = 2}$

$\boxed{y = 2(x+1)^2 - 3}$

**Example #3:** The graph of a quadratic function is shown. What is the equation of the function?




vertex: $(-1,-8)$

point: $(1,0)$

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

$0=a(1-(-1))^2-8$

$+8 \qquad\qquad +8$

$\frac{8}{4}=\frac{4a}{4}$

$\boxed{a=2}$

$\boxed{\therefore y=2(x+1)^2-8}$

## 4.5 Equivalent Forms of the Equation of a Quadratic Function

When the equation of a quadratic function is in general form $y=ax^2+bx+c$, most characteristics of the graph cannot be identified. For this reason, we will convert from general form to standard form $y=a(x-p)^2+q$ by completing the square.

**Example #1:** Determine the coordinates of the vertex of the parabola with equation $y=3x^2-12x+7$

*Always factor out leading coefficient on $x^2$*

$\frac{1}{2}(-4)=-2$

$(-2)^2=4$

$y=3(x^2-4x)+7$

$y=3(x^2-4x+4-4)+7$

$y=3(x^2-4x+4)-12+7$

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

"p" (opposite) "q"

$\boxed{\therefore \text{vertex } (2,-5)}$