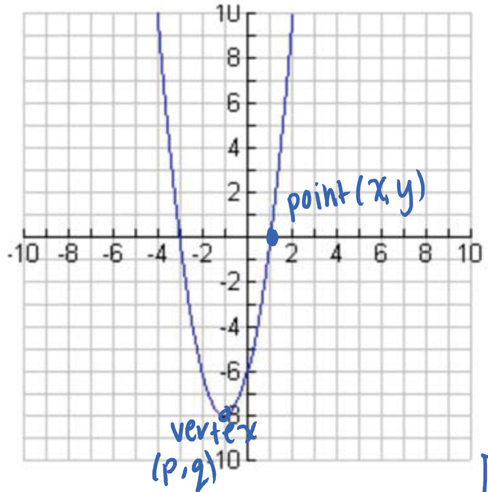
Example #3: The graph of a quadratic function is shown. What is the equation of the function?



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"

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

<u>Example #2</u>: Determine the equation of the axis of symmetry of the parabola with equation $y = -2x^2 + 5x - 3$.

$\frac{1}{2}\left(-\frac{5}{2}\right) = \frac{-5}{4}$

$\left(-\frac{5}{4}\right)^2 = \frac{25}{16}$

$y = -2\left(x^2 - \frac{5}{2}x\right) - 3$

$y = -2\left(x^2 - \frac{5}{2}x + \frac{25}{16} - \frac{25}{16}\right) - 3$

$y = -2\left(x^2 - \frac{5}{2}x + \frac{25}{16}\right) + \frac{50}{16} - 3$

$y = -2\left(x - \frac{5}{4}\right)^2 + \frac{25}{8} - \frac{24}{8}$

$y = -2\left(x - \frac{5}{4}\right)^2 + \frac{1}{8}$

"opposite p"

$\boxed{\therefore \text{Axis of symmetry is } x = \frac{5}{4}}$

<u>Example #3</u>: Determine the y-coordinate of the vertex of the graph $y = \frac{1}{5}x^2 + 2x - 1$

$\frac{1}{2}(10) = 5$

$5^2 = 25$

$y = \left(\frac{1}{5}x^2 + \frac{10x}{5}\right) - 1$

$y = \frac{1}{5}\left(x^2 + 10x\right) - 1$

$y = \frac{1}{5}\left(x^2 + 10x + 25 - 25\right) - 1$

$y = \frac{1}{5}\left(x^2 + 10x + 25\right) - 5 - 1$

$y = \frac{1}{5}(x + 5)^2 - 6$

q

$\boxed{\therefore \text{y-coordinate of vertex is } -6}$