

Date: _____

Vertex Form to Standard Form

- Yesterday, we learned how to take a vertex and a point to write the vertex form of a quadratic. Today, we are going to expand on that knowledge to change the vertex form to the standard form for a quadratic.

Vertex Form: $f(x) = a(x-h)^2 + k$

Standard Form: $f(x) = ax^2 + bx + c$

To Convert from Vertex Form to Standard Form:

1. Square the binomial first.
2. Distribute to get rid of parentheses.
3. Combine like terms.

Examples: *Convert each vertex form to standard form.* Find the vertex and the axis of symmetry of the graph of the quadratic function.

1) $f(x) = -4(x+3)^2 - 5$

$$\begin{aligned} (x+3)^2 &= (x+3)(x+3) \\ &= x^2 + 3x + 3x + 9 \\ &= x^2 + 6x + 9 \\ f(x) &= -4(x^2 + 6x + 9) - 5 \\ f(x) &= -4x^2 - 24x - 36 - 5 \\ f(x) &= -4x^2 - 24x - 41 \end{aligned}$$

2) $f(x) = -4(x-1)^2 - 2$

$$\begin{aligned} (x-1)^2 &= (x-1)(x-1) \\ &= x^2 - 1x - 1x + 1 \\ &= x^2 - 2x + 1 \\ f(x) &= -4(x^2 - 2x + 1) - 2 \\ f(x) &= -4x^2 + 8x - 4 - 2 \\ f(x) &= -4x^2 + 8x - 6 \end{aligned}$$

3) $g(x) = \frac{1}{3}(x-3)^2$

$$\begin{aligned} (x-3)^2 &= (x-3)(x-3) \\ &= x^2 - 3x - 3x + 9 \\ &= x^2 - 6x + 9 \\ g(x) &= \frac{1}{3}(x^2 - 6x + 9) \\ g(x) &= \frac{1}{3}x^2 - 2x + 3 \end{aligned}$$

- 4) Write the vertex form of the quadratic equation, then convert it into the standard form of the quadratic equation for a vertex of $(-5, -1)$ and a point at $(-2, 2)$.

vertex form

$$\begin{aligned} y &= a(x-h)^2 + k \\ y &= a(x+5)^2 - 1 \\ (x+5)(x+5) \\ &= x^2 + 5x + 5x + 25 \\ &= x^2 + 10x + 25 \\ y &= a(x^2 + 10x + 25) - 1 \\ y &= ax^2 + 10ax + 25a - 1 \end{aligned}$$

Standard form

$$\begin{aligned} y &= \frac{1}{3}x^2 + \frac{10}{3}x + \frac{25}{3} \\ \text{or} \\ y &= \frac{1}{3}x^2 + 3\frac{1}{3}x + 8\frac{1}{3} \end{aligned}$$

$$\begin{aligned} 2 &= a(2+5)^2 - 1 \\ 2 &= a(3^2) - 1 \\ 2 + 1 &= 9a \\ 3 &= 9a \\ \frac{3}{9} &= \frac{9a}{9} \\ \frac{1}{3} &= a \end{aligned}$$