Converting Quadratic Equations between Standard and Vertex Form

Standard Form: $y = ax^2 + bx + c$ Vertex Form: $y = a(x - h)^2 + k$

Convert from Standard Form to Vertex Form:

$y = ax^2 + bx = c \Longrightarrow y = a(x - h)^2 + k$

know a, b, c want a, h, k

a = a

$x = \frac{-b}{2a}$ = h

Solve for y = k

Substitute the values and rewrite.

Example 1:

$y = 8x^2 - 16x + 27$

We know *a*, *b*, *c* and want *a*, *h*, *k*

a = 8 ⇦ ***a*** is the coefficient of the x^2 term

$h = x = \frac{-b}{2a} = \frac{-(-16)}{2(8)} = \frac{16}{16} = 1$ ⇦ use the formula to find the value of ***h***

k = $y = 8(1)^2 - 16(1) + 27 = 8 - 16 + 27 = 19$ ⇦ substitute the value found for ***h*** into the original equation and solve for ***k***

$y = 8(x - 1)^2 + 19$

Example 2:

$y = 5x^2 - 40x + 67$

We know *a*, *b*, *c* and want *a*, *h*, *k*

a = 5 ⇦ ***a*** is the coefficient of the x^2 term

$h = x = \frac{-b}{2a} = \frac{-(-40)}{2(5)} = \frac{40}{10} = 4$ ⇦ use the formula to find the value of ***h***

k = $y = 5(4)^2 - 40(4) + 67 = 80 - 160 + 67 = -13$ ⇦ substitute the value found for ***h*** into the original equation and solve for ***k***

$y = 5(x - 4)^2 - 13$

Practice: *Convert the following quadratics from standard to vertex form.*

1. $y = 5x^2 - 10x + 37$
2. $y = 7x^2 + 28x + 19$
3. $y = -2x^2 - 24x - 75$

Convert from Vertex Form to Standard Form:

$$y = a(x - h)^2 + k \quad \Longrightarrow \quad y = ax^2 + bx = c$$

Example 1:

$y = 5(x + 2)^2 - 9$

$y = 5(x + 2)(x + 2) - 9$ ⟸ Rewrite $(x + 2)^2$

$y = 5(x^2 + 4x + 4) - 9$ ⟸ Simplify $(x + 2)(x + 2)$

$y = 5x^2 + 20x + 20 - 9$ ⟸ Distribute the 5

$y = 5x^2 + 20x + 11$ ⟸ Combine Like Terms

Example 2:

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

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

$y = -3(x^2 - 8x + 16) + 7$ ⟸ Simplify $(x - 4)(x - 4)$

$y = -3x^2 + 24x - 48 + 7$ ⟸ Distribute the -3

$y = -3x^2 + 24x - 41$ ⟸ Combine Like Terms

Practice: *Convert the following quadratics from vertex to standard form.*

1. $y = (x - 2)^2 + 6$
2. $y = 3(x - 3)^2 - 12$
3. $y = -2(x + 1)^2 + 3$