

# 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:

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

know  $a, b, c$       want  $a, h, k$

$$a = a$$

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

$$\text{Solve for } y = k$$

Substitute the values and rewrite.

Example 1:

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

$$a = 8$$

$$h = x = \frac{-b}{2a} = \frac{-(-16)}{2(8)} = \frac{16}{16} = 1$$

$$k = y = 8(1)^2 - 16(1) + 27 = 8 - 16 + 27 = 19$$

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

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

←  $a$  is the coefficient of the  $x^2$  term

← use the formula to find the value of  $h$

← substitute the value found for  $h$  into the original equation and solve for  $k$

Example 2:

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

$$a = 5$$

$$h = x = \frac{-b}{2a} = \frac{-(-40)}{2(5)} = \frac{40}{10} = 4$$

$$k = y = 5(4)^2 - 40(4) + 67 = 80 - 160 + 67 = -13$$

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

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

←  $a$  is the coefficient of the  $x^2$  term

← use the formula to find the value of  $h$

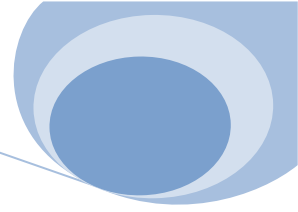
← substitute the value found for  $h$  into the original equation and solve for  $k$

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:

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

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