

Converting Quadratic Equations between Standard and Vertex Forms

What am I learning today?

How to convert a quadratic between different equation types

How will I show that I learned it?

Convert a quadratic equation from vertex form to standard form and from standard form to vertex form

Forms of quadratics:

Standard: $y = ax^2 + bx + c$ $y = 5x^2 + 3x - 2$

Vertex: $y = a(x - h)^2 + k$ $y = -2x^2 + 5$

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

$y = 6x^2 + 7$

Converting Quadratics from Vertex to Standard Form

Let's Review – How did we multiply a binomial by a binomial?

Ex. 1 $(2x+7)(3x+1)$

Ex. 2 $(2x-5)(x+3)$

Ex. 3 $(2x-3)^2$

$$\begin{array}{l}
 \text{1. } 2x(3x+1) + 7(3x+1) \\
 6x^2 + 2x + 21x + 7 \\
 6x^2 + 23x + 7 \\
 \text{2. } 2x(x+3) - 5(x+3) \\
 2x^2 + 6x - 5x - 15 \\
 2x^2 + x - 15 \\
 \text{3. } 2x(2x-3) - 3(2x-3) \\
 4x^2 - 6x - 6x + 9 \\
 4x^2 - 12x + 9
 \end{array}$$

To convert from VERTEX FORM to STANDARD FORM: $y = a(x-h)^2 + k \rightarrow y = ax^2 + bx + c$

1. Rewrite the squared term as 2 BINOMIALS. $(x-h)(x-h)$
2. Multiply the BINOMIALS. Combine all like terms to create an expression.
3. Place the expression from the binomials back in a parentheses behind the "a" value.
4. DISTRIBUTE "a" TO THE EXPRESSION IN PARENTHESES. Do not distribute to a value outside the parentheses.
5. Add any values outside the parentheses to the expression.

Example 1 $f(x) = (x - 3)^2 + 8$

$$\begin{aligned}
 &= (x-3)(x-3) + 8 \\
 &= [x(x-3) - 3(x-3)] + 8 \\
 &= [x^2 - 3x - 3x + 9] + 8 \\
 &= (x^2 - 6x + 9) + 8
 \end{aligned}$$

$$f(x) = x^2 - 6x + 17$$

Vertex: $(3, 8)$
V.F.Y-Int: $(0, 17)$
S.F.Example 2 $f(x) = 2(x + 4)^2 + 1$

$$\begin{aligned}
 &= 2(x+4)(x+4) + 1 \\
 &= 2[x(x+4) + 4(x+4)] + 1 \\
 &= 2[x^2 + 4x + 4x + 16] + 1 \\
 &= 2[x^2 + 8x + 16] + 1
 \end{aligned}$$

$$= 2x^2 + 16x + 32 + 1$$

$$f(x) = 2x^2 + 16x + 33$$

Vertex: $(-4, 1)$ Y-Int: $(0, 33)$

Example 3

$$f(x) = -(x-7)^2$$

$$= -(x-7)(x-7)$$

$$= -[x(x-7) - 7(x-7)]$$

$$= -[x^2 - 7x - 7x + 49]$$

$$= -[x^2 - 14x + 49]$$

$$f(x) = -x^2 + 14x - 49$$

Vertex: $(7, 0)$ Y-Int: $(0, -49)$

Example 4

$$f(x) = -\frac{1}{2}(x+8)^2 + 14$$

$$= -\frac{1}{2}(x+8)(x+8) + 14$$

$$= -\frac{1}{2}[x(x+8) + 8(x+8)] + 14$$

$$= -\frac{1}{2}[x^2 + 8x + 8x + 64] + 14$$

$$= -\frac{1}{2}[x^2 + 16x + 64] + 14$$

$$= -\frac{1}{2}x^2 - 8x - 32 + 14$$

$$f(x) = -\frac{1}{2}x^2 - 8x - 18$$

Vertex: $(-8, 14)$ Y-Int: $(0, -18)$