

# Math-3A

## Lesson 2-7

### Vertex Form Quadratic Equation

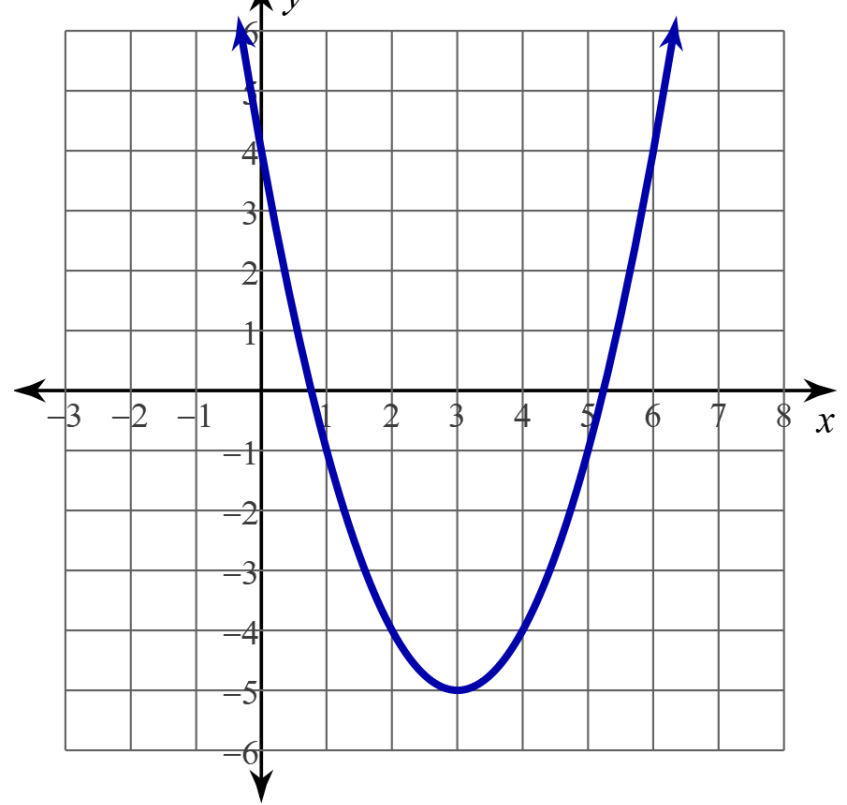
$$y = x^2 - 6x + 4$$

Can this be factored?

The x-intercepts are *“ugly”*

What is the vertex form equation?

$$y = (x - 3)^2 - 5$$



Standard Form Equation

$$y = x^2 - 6x + 4$$

Vertex Form Equation

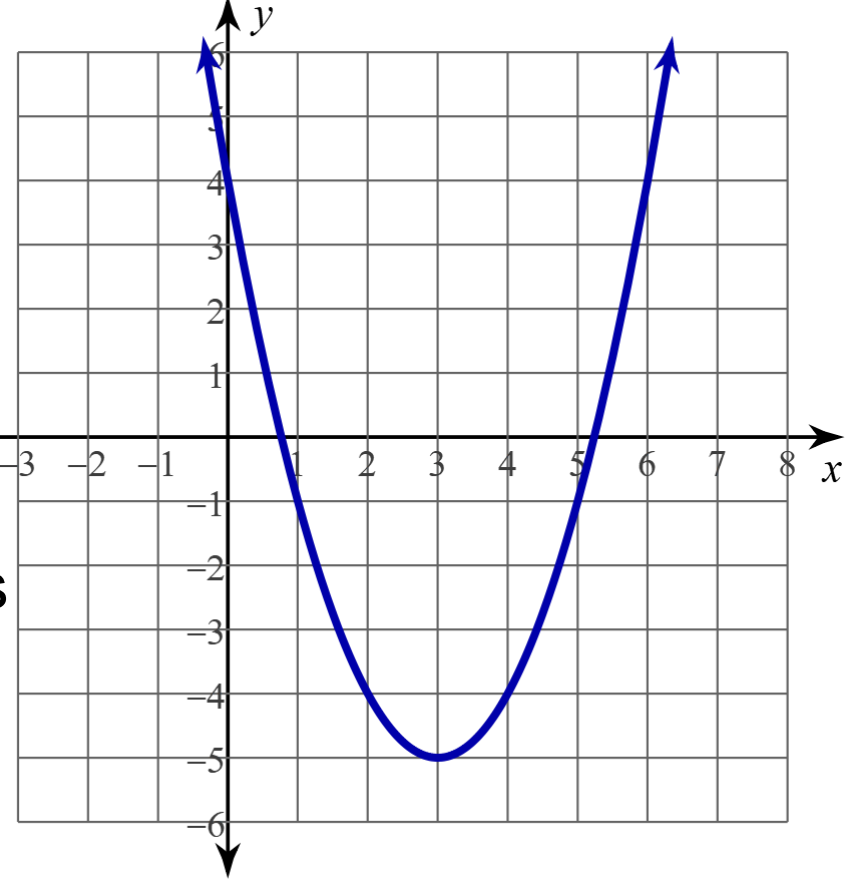
$$y = (x - 3)^2 - 5$$

How could you get the x-intercepts from the vertex form equation?

Set 'y' to zero. Isolate the square, "undo" the square.

$$0 = (x - 3)^2 - 5$$

$$5 = (x - 3)^2$$



$$\pm\sqrt{5} = x - 3$$

$$x = 3 \pm \sqrt{5}$$

# Find the X-intercepts from the Vertex Form Equations

$$y = -2(x - 3)^2 + 4 \quad \text{Set } y = 0 \text{ (y-value of an x-int. is 0)}$$

$$0 = 4(x - 5)^2 - 8 \quad \text{Add 8 (left/right)}$$

$$8 = 4(x - 5)^2 \quad \text{Divide by 4 (left/right)}$$

$$2 = (x - 5)^2$$

$$2 = (\underline{\quad})^2 \quad \text{What number, squared, equals 2?}$$

$$2 = (\sqrt{2})^2 \quad 2 = (-\sqrt{2})^2$$

$$\pm\sqrt{2} = x - 5 \quad \text{Add 5 (left/right)}$$

$$x = 5 \pm \sqrt{2}$$

## Find the X-intercepts from the Vertex Form Equations

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

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

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

## What have we learned?

1. The quadratic formula can give us x-intercepts (only if you have the standard form equation).

*There are a lot of numbers and calculations. You can easily make a mistake.*

2. If you “isolate the square, undo the square” on the vertex form equation, you can also find x-intercepts.

*You have to know how to simplify square roots.*

$$y = (x - 2)^2 - 12$$

$$x = 2 \pm \sqrt{4 * 3}$$

$$0 = (x - 2)^2 - 12$$

$$x = 2 \pm \sqrt{4}\sqrt{3}$$

$$12 = (x - 2)^2$$

$$x = 2 \pm 2\sqrt{3}$$

$$x = 2 \pm \sqrt{12}$$

3. You can convert standard form quadratic equations into intercept form quadratic equations by: **factoring**

$$y = 2x^2 + 16x + 24 \quad \rightarrow \quad y = 2(x + 6)(x + 2)$$

4. You can convert intercept form quadratic equations into vertex form quadratic equations by:

**a) Finding the x-coordinate of the vertex (half way between x-intercepts)**  $x = -6, -2$  Vertex:  $(-4, f(-4))$

**b) Substituting the x-value into the equation to find the y-coordinate of the vertex.**  $f(-4) = 2(-4 + 6)(-4 + 2)$

$$d(-4) = 2(2)(-2) = -8 \quad \text{Vertex: } (-4, -8)$$

**c) Using the VSF and the vertex to write the vertex form equation.**

$$\text{VSF} = 2, \text{ Vertex: } (-4, -8)$$

$$y = 2(x + 4)^2 - 8$$

How can we convert Standard Form Quadratic Equations directly into Vertex form? (without converting to Intercept Form first?)

*Remember the quadratic formula gave us these x-intercepts.*

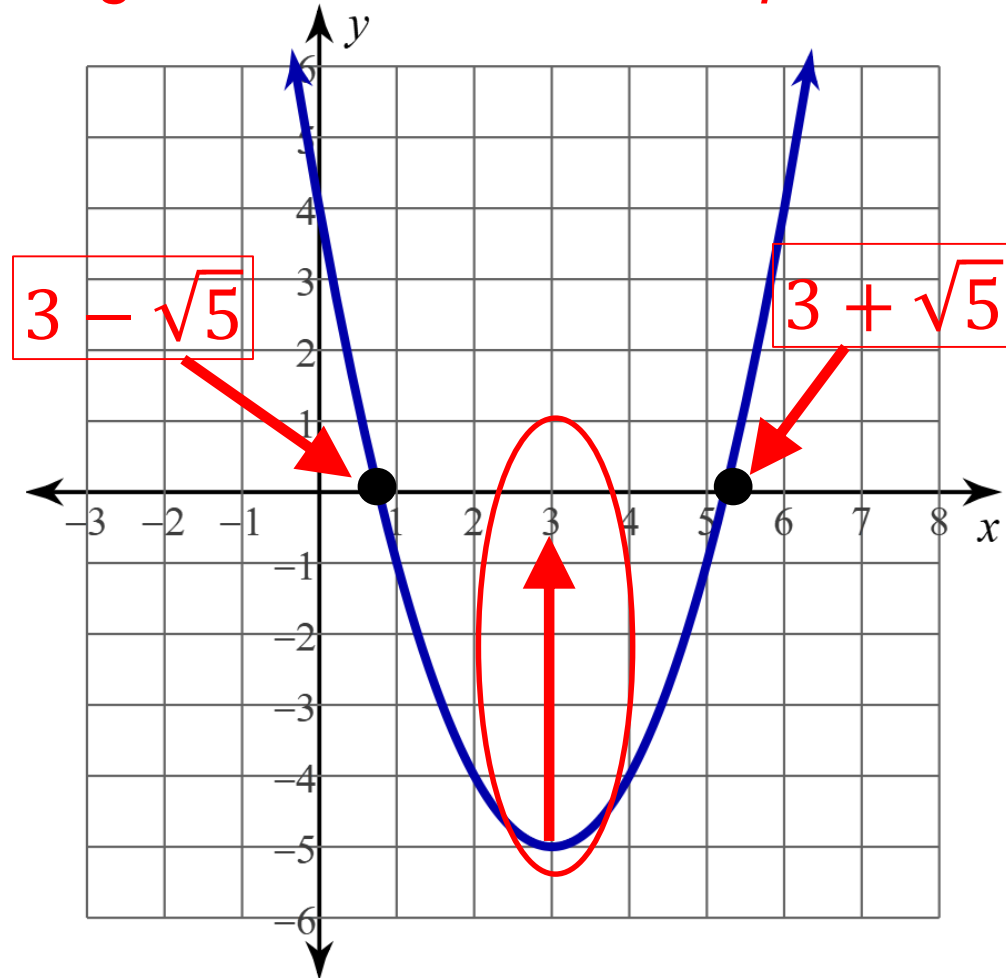
$$y = x^2 - 6x + 4$$

$$x = \frac{-b}{2a} \pm \frac{\sqrt{b^2 - 4ac}}{2a}$$

$$x = 3 \pm \sqrt{5}$$

*The x-coordinate of the vertex is 3.*

$$\text{x-coord. of vertex} = \frac{-b}{2a}$$





What is the vertex form equation?

$$y = 2x^2 + 16x + 24$$

$a = 2$        $b = 16$

Vertex:  $(-4, f(-4))$

$$\text{x-coord. of vertex} = \frac{-b}{2a}$$

$$\frac{-b}{2a} = \frac{-16}{2(2)} = -4$$

What is the y-coordinate of the vertex?

$$f(-4) = 2(-4)^2 + 16(-4) + 24$$

$$f(-4) = -8$$

Vertex:  $(-4, -8)$

What is the Vertex form equation?

$VSF = 2, \text{ vertex} = (-4, -8)$

$$y = 2(x + 4)^2 - 8$$

What is the vertex form equation?

$$y = x^2 - 6x + 13$$

$$a = 1$$

$$b = -6$$

Vertex:  $(3, f(3))$

$$\text{x-coord. of vertex} = \frac{-b}{2a}$$

$$\frac{-b}{2a} = \frac{-(-6)}{2(1)} = 3$$

What is the y-coordinate of the vertex?

$$f(3) = (3)^2 - 6(3) + 13$$

$$f(3) = 4$$

Vertex:  $(3, 4)$

What is the Vertex form equation?

VSF = 1, vertex =  $(3, 5)$

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

What is the vertex form equation?

$$y = 3x^2 + 6x - 12$$

$$a = 3$$

$$b = -4$$

Vertex:  $(-1, f(-1))$

$$\text{x-coord. of vertex} = \frac{-b}{2a}$$

$$\frac{-b}{2a} = \frac{-(6)}{2(3)} = -1$$

What is the y-coordinate of the vertex?

$$f(-1) = 3(-1)^2 + 6(-1) - 12$$

$$f(-1) = -15$$

Vertex:  $(-1, -15)$

What is the Vertex form equation?

$$\text{VSF} = 3, \text{ vertex} = (-1, -15) \quad y = 3(x + 1)^2 - 15$$

We converted these standard form equations into vertex form.  
What are the x-intercepts of the following equations?

$$y = 2x^2 + 16x + 24 \rightarrow y = 2(x + 4)^2 - 8$$

$$y = x^2 - 6x + 13 \rightarrow y = (x - 3)^2 + 4$$

$$y = 3x^2 - 6x - 12 \rightarrow y = 3(x + 1)^2 - 15$$

Convert the following non-factorable standard form equations into vertex form. Find the x-intercepts.

$$y = x^2 - 2x - 12$$

$$y = x^2 + 20x + 99$$

$$y = x^2 - 14x + 50$$