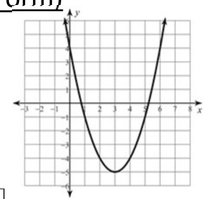
SM2 HANDOUT 5-5 (Convert to Vertex Form)

$y = x^2 - 6x + 4$ *Non-factorable*

The x-intercepts are *"ugly"*



What is the vertex form equation? $y =$ ____________

Does anyone remember the____________?

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

What is the purpose of the formula?

This version is easier to simplify

The ____ in the formula are the _______ of the *standard form equation.* $y = ax^2 + bx + c$

$y = ax^2 + bx + c$

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

a = 1 b = -6 c = 4

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

$$x = \frac{-(\ )}{2(\ )} \pm \frac{\sqrt{(\ )^2 - [4(\ )(\ )]}}{2(\ )}$$

$$x = \frac{-(-6)}{2(1)} \pm \frac{\sqrt{(-6)^2 - [4(1)(4)]}}{2(1)}$$

$$x = \frac{6}{2} \pm \frac{\sqrt{36 - 16}}{2}$$

$$x = 3 \pm \frac{\sqrt{20}}{2}$$

$$x = 3 \pm \frac{\sqrt{4}\sqrt{5}}{2}$$

$$x = 3 \pm \frac{2\sqrt{5}}{2}$$

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

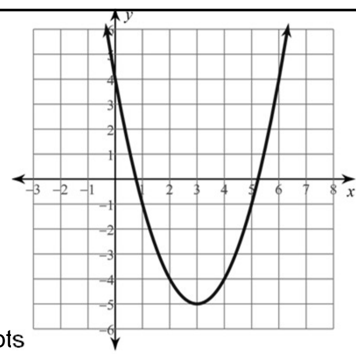
This formula often-times results in "*ugly*" calculations where students often make mistakes.

Standard Form Equation

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

Vertex Form Equation

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



The x-intercepts that came from the quadratic formula were:

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

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

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

Add 8 (left/right)

Divide by 4 (left/right)

$2 = (\_\_\_\_)^2$ What number, squared, equals 2?

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

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

The expression inside of the parentheses equals either _______ or _____

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

Find the X-intercepts from the Vertex Form Equations

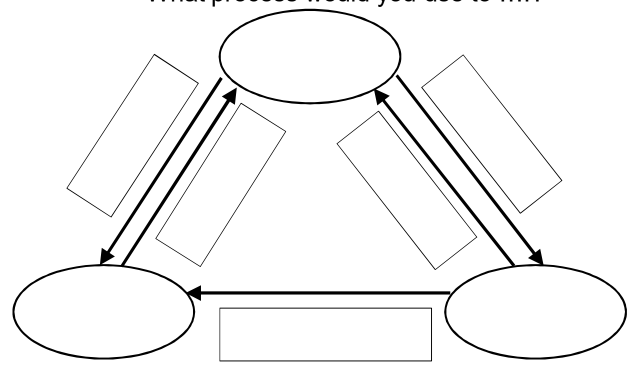
$y = (x-5)^2$

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

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

Write the <u>names</u> of the 3 forms of quadratic equation in the circles.

What process would you use to ….?



What have we learned?

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

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 <u>*vertex form equation*</u>, you can also find x-intercepts.

You have to know how to simplify square roots.

$$y = (x-2)^2 - 12$$
$$0 = (x-2)^2 - 12$$
$$12 = (x-2)^2$$
$$x = 2 \pm \sqrt{12}$$
$$x = 2 \pm \sqrt{4 * 3}$$
$$x = 2 \pm \sqrt{4}\sqrt{3}$$
$$x = 2 \pm 2\sqrt{3}$$

3. You can convert <u>*standard form quadratic equations*</u> into <u>*intercept form quadratic equations*</u> by: *factoring*

$\boxed{y = 2x^2 + 16x + 24}$ $\boxed{\rightarrow y = 2(x+6)(x+2)}$

3. You can convert <u>*intercept form quadratic equations*</u> into <u>*vertex form quadratic equations*</u> by:

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

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

$y = 2(2)(-2) = -8$ Vertex: $(-4, -8)$

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

VSF = 2, Vertex: $(-4, -8)$ $\boxed{y = 2(x+4)^2 - 8}$

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.

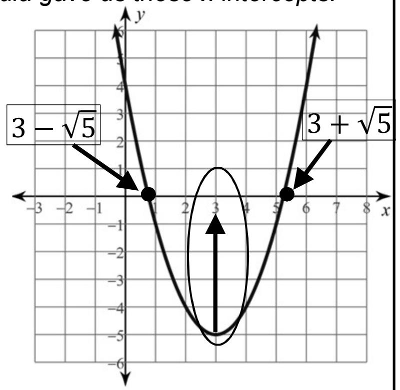
$y = x^2 - 6x + 4$

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

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

The x-coordinate of the vertex is 3.

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



What is the x-coordinate of the vertex?

$\boxed{y = 2x^2 + 16x + 24}$ $\boxed{\text{x-coord. of vertex} = \frac{-b}{2a}}$

a = 2 b = 16

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

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

What is the y-coordinate of the vertex?

$\boxed{f(-4) = 2(-4)^2 + 16(-4) + 24}$

$\boxed{f(-4) = -8}$ Vertex: $(-4, -8)$

What is the Vertex form equation?

$\text{VSF} = 2, \text{vertex} = (-4, -8)$ $\boxed{y = 2(x + 4)^2 - 8}$

What is the x-coordinate of the vertex?

$\boxed{y = x^2 - 6x + 13}$ $\boxed{\text{x-coord. of vertex} = \frac{-b}{2a}}$

a = 1 b = -6

What is the x-coordinate of the vertex?

$\boxed{y = 3x^2 + 6x - 12}$

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

$\boxed{y = 2x^2 + 16x + 24}$ → $\boxed{y = 2(x+4)^2 - 8}$

$\boxed{y = x^2 - 6x + 13}$ → $\boxed{y = (x-3)^2 + 4}$

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

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

$\boxed{y = x^2 - 2x - 12}$

$\boxed{y = x^2 + 20x + 99}$

$\boxed{y = x^2 - 14x + 50}$