Remember transformations for absolute value functions?

\[ y = -2|x - 1| + 3 \]

- Opens down
- Slope = -2
- Right 1, Up 3

Graph showing a V-shape with a point at (1, 3)
Vertex: $(h, k)$

Axis of symmetry: $x = h$

Parabola:

- Positive $a$ opens up
- Negative $a$ opens down

- $|a| > 1$ narrows
- $|a| < 1$ widens
- $a$ is the "slope" from the vertex to the next point.

- $x-h$ right
- $x+h$ left
- $+k$ up
- $-k$ down

Use the same rules!
Example 1 Graph in vertex form.

Graph the function. Label the vertex and axis of symmetry.

\[ y = -(x + 1)^2 + 2 \]

- **Opens down**
- **Left 1**
- **Up 2**

Vertex: \((-1, 2)\)

Axis of symmetry: \(x = -1\)
On your whiteboard...

Graph the function. Label the vertex and axis of symmetry.

\[ y = 4(x - 2)^2 - 1 \]

- Opens up
- Narrows right 2
- Down 1

\[ a = \frac{4}{1} \]

Vertex: (2, -1)

Axis of Symmetry: \( x = 2 \)
Where did I go wrong?

This is the right answer.

$y = \frac{1}{3} (x + 3)^2 - 4$

Find the y-int instead since the slope is not helpful.

$y = \frac{1}{3} (0 + 3)^2 - 4$

$y = \frac{1}{3} (9)^2 - 4$

$y = 3 - 4 = -1 \ (0, -1)$
Graphing Quadratics

**Vertex Form**

\[ y = a(x - h)^2 + k \]

**Vertex:** \((h, k)\)

**Axis of Symmetry:** \(x = h\)

**y-intercept:** Substitute 0 for \(x\) and solve for \(y\).
Example 2  Identify the max or min.

A

\[ y = 4(x - 2)^2 - 7 \]

- \( a > 0 \) opens up
- Minimum of -7

B

\[ y = -2(x + 1)^2 + 5 \]

- \( a < 0 \) opens down
- Maximum of 5

(-1,5)
Homer tried two times to put this equation in standard form and still can't get the right answer. What is he doing wrong?

\[ y = 2(x+1)^2 \]
\[ y = (2x+2)^2 \]
\[ y = 4x^2+4 \]

Order of operations says to do exponents before multiplication.

\[ y = 2(x^2+1) \]
\[ y = 2x^2+2 \]

\[ 2(x+1)^2 \text{ is } 2(x+1)(x+1) \text{ then FOIL} \]
Example 3 Change from vertex form to standard form

\[ y = 2(x - 1)^2 + 1 \]

\[ y = 2(x-1)^2 + 1 \]
\[ = 2(x-1)(x-1) + 1 \]
\[ = 2(x^2 - x - x + 1) + 1 \]
\[ = 2(x^2 - 2x + 1) + 1 \]
\[ = 2x^2 - 4x + 2 + 1 \]
\[ y = 2x^2 - 4x + 3 \]

Foil first and then distribute!
On your whiteboard...

Change from vertex form to standard form

\[ y = -(x + 3)^2 + 5 \]

\[ y = -(x + 3)(x + 3) + 5 \]

\[ = -(x^2 + 3x + 3x + 9) + 5 \]

\[ = -(x^2 + 6x + 9) + 5 \]

\[ = -x^2 - 6x - 9 + 5 \]

\[ y = -x^2 - 6x - 4 \]