Standard (Vertex) Form

What is standard (vertex) form of a quadratic function?

- Vertex form is a way to rewrite a quadratic function in a way that the vertex can be identified easily.

- The standard (vertex) form is as follows: \( f(x) = a(x-h)^2 + k \), where \((h, k)\) is the vertex of the function and \(a\) is the quadratic coefficient.

How can a quadratic function be rewritten in vertex form?

- A quadratic function can be rewritten in vertex form by completing the square.

- The following is an example:

\[
\begin{align*}
\text{f(x) } & = x^2 - 2x - 8 \\
\text{f(x) } & = (x^2 - 2x) - 8 \\
\text{f(x) } & = (x^2 - 2x + 1) - 8 - 1 \\
\text{f(x) } & = (x - 1)(x - 1) - 9 \\
\text{f(x) } & = (x - 1)^2 - 9
\end{align*}
\]

The vertex is \((1, -9)\).

- Here is another example that is a bit more complicated:
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\[ f(x) = -2x^2 - 8x + 13 \]

The given function is in the form \( f(x) = ax^2 + bx + c \) form.

\[ f(x) = (-2x^2 - 8x) + 13 \]

First, group the \( x^2 \) and \( x \) terms.

\[ f(x) = -2(x^2 + 4x) + 13 \]

Factor out any common numbers.

\[ f(x) = -2(x^2 + 4x + 4) + 13 - 4(-2) \]

Then, add \( \frac{b}{2} \) inside the parentheses and subtract the same value on the outside. This time, when subtracting by \( \frac{b}{2} \) on the outside, multiply it by the number that was factored out.

\[ f(x) = -2(x+2)(x+2) + 13 + 8 \]

Next, factor the expression in the parentheses and multiply.

\[ f(x) = -2(x+2)^2 + 21 \]

Finally, simplify. The vertex is \((-2, 21)\).

You Try!

- Try rewriting the following functions in standard (vertex) form:

\[ f(x) = 3x^2 - 12x - 3 \]

\[ f(x) = -6x^2 + 18x - 9 \]

The following works were referred to during the creation of this handout: Wolfram Alpha.