2-2 Properties of Quadratic Functions in Standard Form

Vocabulary

axis of symmetry-

standard form-

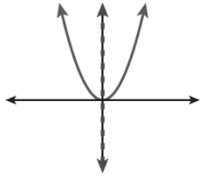
minimum value-

maximum value-

2-2 Properties of Quadratic Functions in Standard Form

When you transformed quadratic functions in the previous lesson, you saw that reflecting the parent function across the *y*-axis results in the same function.

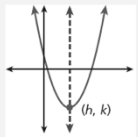
$f(x) = x^2$
$g(x) = (-x)^2 = x^2$



2-2 Properties of Quadratic Functions in Standard Form

This shows that parabolas are symmetric curves. The **axis of symmetry** is the line through the vertex of a parabola that divides the parabola into two congruent halves.

Axis of Symmetry Quadratic Functions

WORDS	ALGEBRA	GRAPH
The axis of symmetry is a vertical line through the vertex of the function's graph.	The quadratic function $f(x) = a(x - h)^2 + k$ has the axis of symmetry $x = h$.	

2-2 Properties of Quadratic Functions in Standard Form

Example 1: Identifying the Axis of Symmetry

Identify the axis of symmetry for the graph of $f(x) = -\frac{1}{2}(x+5)^2 - 8$ **.**

Rewrite the function to find the value of *h.*

** f(x)=

Because *h*=___, the axis of symmetry is the vertical line _____ .

2-2 Properties of Quadratic Functions in Standard Form

Check It Out! Example1

Identify the axis of symmetry for the graph of

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

Rewrite the function to find the value of *h.*

**f(x)=

Because *h* =___, the axis of symmetry is the vertical line _____ .

2-2 Properties of Quadratic Functions in Standard Form

Another useful form of writing quadratic functions is the *standard form*. The **standard form** of a quadratic function is $f(x) = ax^2 + bx + c$, where $a \neq 0$.

The coefficients *a*, *b*, and *c* can show properties of the graph of the function. You can determine these properties by expanding the vertex form.

$f(x) = a(x - h)^2 + k$

2-2 Properties of Quadratic Functions in Standard Form

$a = a \quad -2ah = b \quad ah^2 + k = c$

$f(x) = ax^2 + bx + c$

a = *a* { *a* in standard form is the same as in vertex form. It indicates whether a reflection and/or vertical stretch or compression has been applied.

2-2 Properties of Quadratic Functions in Standard Form

$a = a \quad -2ah = b \quad ah^2 + k = c$

$f(x) = ax^2 + bx + c$

b = –2*ah* { Solving for *h* gives _____ . Therefore, the axis of symmetry, *x* = *h*, for a quadratic function in standard form is_____ .

2-2 Properties of Quadratic Functions in Standard Form

$a = a \quad -2ah = b \quad ah^2 + k = c$

$$f(x) = ax^2 + bx + c$$

$c = ah^2 + k$ { Notice that the value of c is the same value given by the vertex form of f when $x = 0$: $f(0) = a(0 - h)^2 + k = ah^2 + k$. So c is _____.

2-2 Properties of Quadratic Functions in Standard Form

These properties can be generalized to help you graph quadratic functions.

Properties of a Parabola

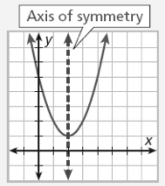
For $f(x) = ax^2 + bx + c$, where a, b, and c are real numbers and $a \neq 0$, the parabola has these properties:

The parabola opens upward if $a > 0$ and downward if $a < 0$.

The axis of symmetry is the vertical line $x = -\frac{b}{2a}$.

The vertex is the point $\left(-\frac{b}{2a}, f\left(-\frac{b}{2a}\right)\right)$.

The y-intercept is c.



2-2 Properties of Quadratic Functions in Standard Form

Example 2A: Graphing Quadratic Functions in Standard Form

Consider the function $f(x) = 2x^2 - 4x + 5$.

a. Determine whether the graph opens upward or downward. **It opens _____ .**

b. Find the axis of symmetry.

The axis of symmetry is _____ .

2-2 Properties of Quadratic Functions in Standard Form

Example 2A: Graphing Quadratic Functions in Standard Form (continued)

Consider the function $f(x) = 2x^2 - 4x + 5$.

c. Find the vertex.

The vertex is_____ .

d. Find the *y*-intercept.

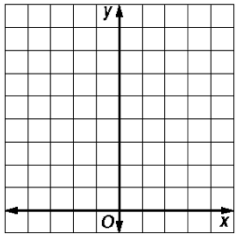
The y intercept is_____ .

2-2 Properties of Quadratic Functions in Standard Form

Example 2A: Graphing Quadratic Functions in Standard Form

Consider the function $f(x) = 2x^2 - 4x + 5$.

e. Graph the function.



2-2 Properties of Quadratic Functions in Standard Form

Example 2B: Graphing Quadratic Functions in Standard Form

Consider the function $f(x) = -x^2 - 2x + 3$.

a. Determine whether the graph opens upward or downward. It opens _____ .

b. Find the axis of symmetry.

The axis of symmetry is _____ .

2-2 Properties of Quadratic Functions in Standard Form

Example 2B: Graphing Quadratic Functions in Standard Form

Consider the function $f(x) = -x^2 - 2x + 3$.

c. Find the vertex.

The vertex is _____ .

d. Find the *y*-intercept.

The *y*-intercept is _____.

2-2 Properties of Quadratic Functions in Standard Form

Example 2B: Graphing Quadratic Functions in Standard Form

Consider the function $f(x) = -x^2 - 2x + 3$.

e. Graph the function.