Algebra 1  
Unit 7Lesson 16CC BY NC 2024 Illustrative Mathematics®

Unit 7, Lesson 16

# Graphing from the Vertex Form

* Let’s graph equations in vertex form.

Algebra 1  
Unit 7Lesson 16CC BY NC 2024 Illustrative Mathematics®

## 16.1Which Form to Use?

Expressions in different forms can be used to define the same function. Here are three ways to define a function, .

standard form

factored form

vertex form

Which form would you use if you want to find the following features of the graph of ? Be prepared to explain your reasoning.

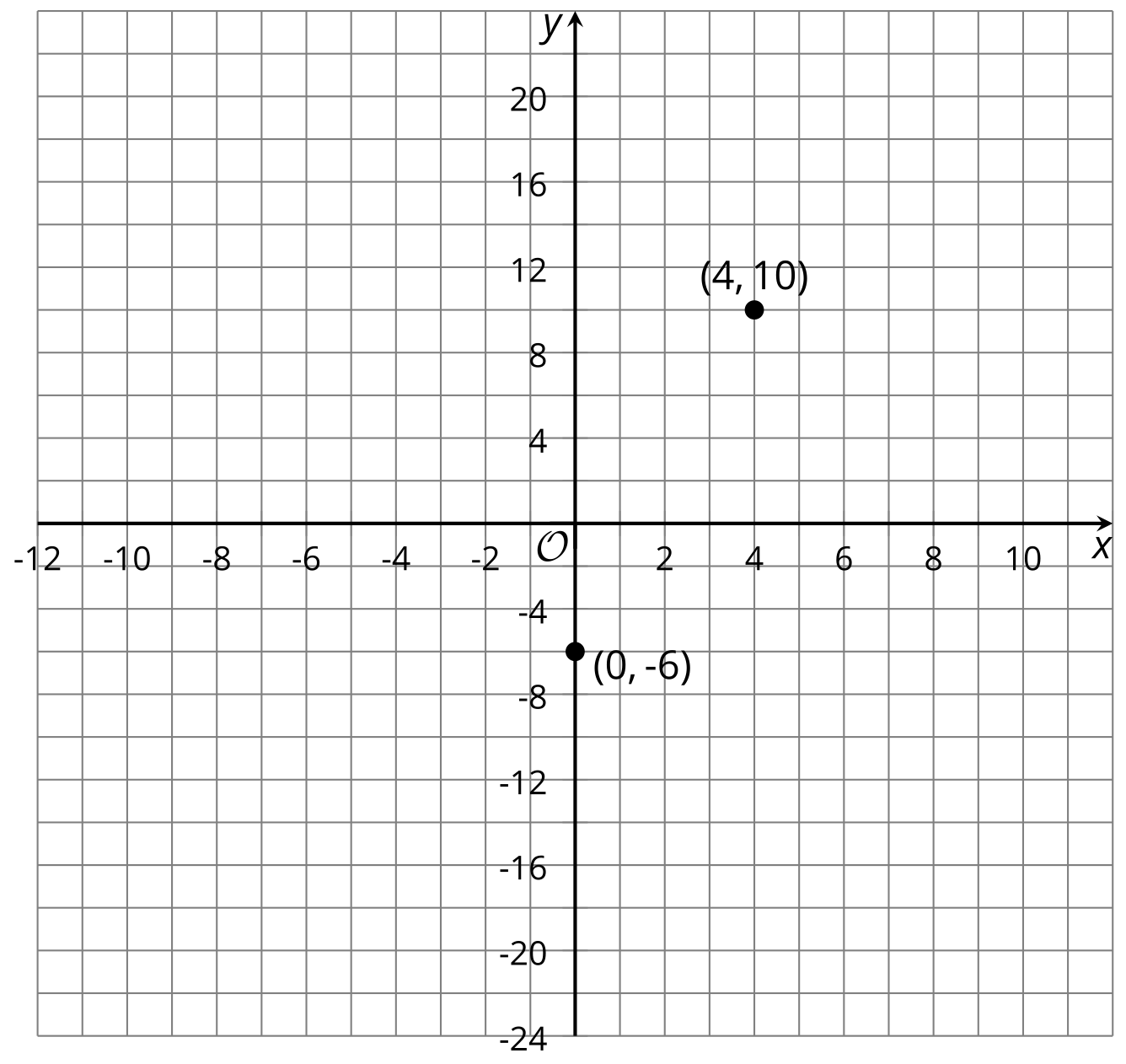
1. the -intercepts
2. the vertex
3. the -intercept

Algebra 1  
Unit 7Lesson 16CC BY NC 2024 Illustrative Mathematics®

## 16.2Sharing a Vertex

Here are two equations that define quadratic functions.

1. The graph of passes through and , as shown on the coordinate plane.

* Find the coordinates of another point on the graph of . Explain or show your reasoning. Then use the points to sketch and label the graph.
* 

1. On the same coordinate plane, identify the vertex and two other points that are on the graph of . Explain or show your reasoning. Sketch and label the graph of .
2. Priya says, "Once I know that the vertex is , I can find out, without graphing, whether the vertex is the maximum or the minimum of function . I can just compare the coordinates of the vertex with the coordinates of a point on either side of it."

* Complete the table, and then explain how Priya might have reasoned about whether the vertex is the minimum or maximum.

|  |  |  |  |
| --- | --- | --- | --- |
|  | * 3 | * 4 | * 5 |
|  |  | * 10 |  |

### Are you ready for more?

1. Write a the equation for a quadratic function whose graph has the vertex at and contains the point .
2. Sketch a graph of your function.

Algebra 1  
Unit 7Lesson 16CC BY NC 2024 Illustrative Mathematics®

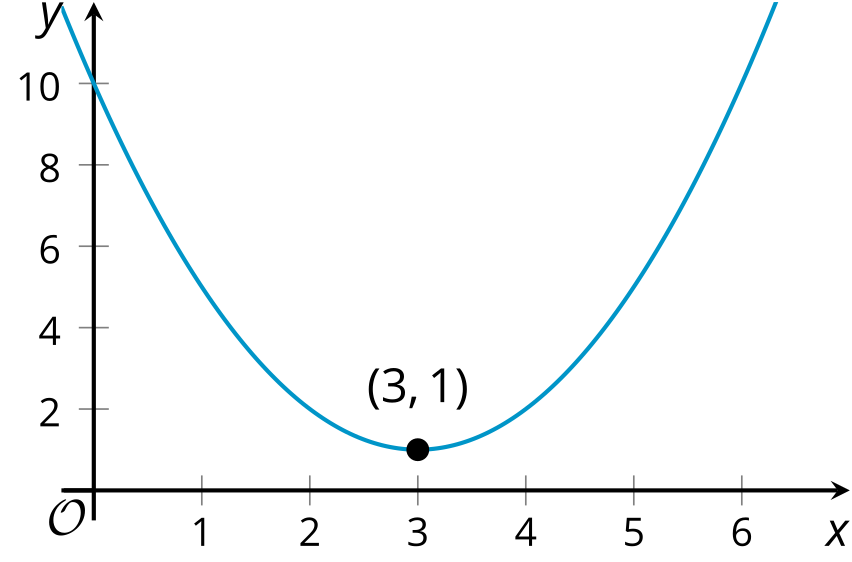
## 16.3Card Sort: Matching Equations with Graphs

Your teacher will give you a set of cards containing an equation or a graph that represents a quadratic function. Take turns matching each equation to a graph that represents the same function. Record your matches, and be prepared to explain your reasoning.

## Lesson 16 Summary

Not surprisingly, vertex form is especially helpful for finding the vertex of a graph of a quadratic function. For example, we can tell that the function, , given by has a vertex at .

We also noticed that, when the squared expression has a positive coefficient, the graph opens upward. This means that the vertex, , represents the minimum function value, .



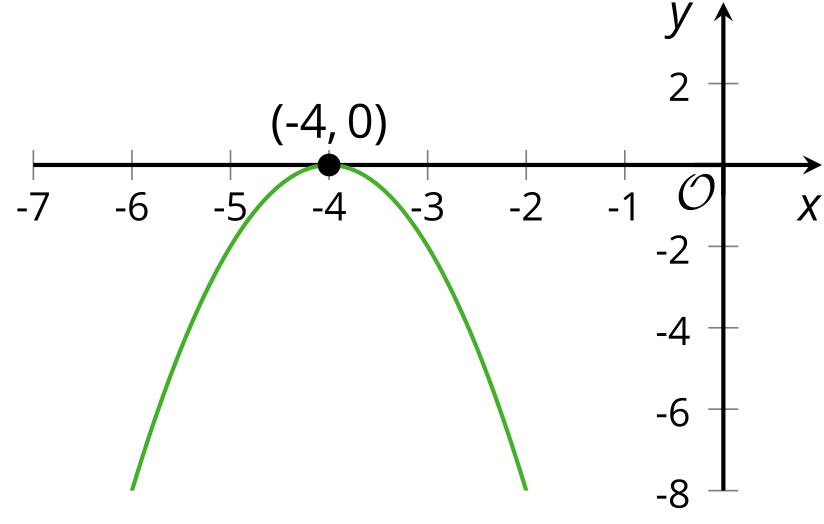
But why does function take on its minimum value when is 3?

Here is one way to explain it: When , the squared term equals 0, because . When is any other value besides 3, the squared term  is a positive number greater than 0. (Squaring any number results in a positive number.) This means that the output when will always be greater than the output when , so function  has a minimum value at .

This table shows some values of the function for some values of . Notice that the output is the least when , and it increases both as increases and as it decreases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|  | 10 | 5 | 2 | 1 | 2 | 5 | 10 |

The squared term sometimes has a negative coefficient, for instance in . The value that makes equal 0 is -4, because . Any other value makes greater than 0. But when is multiplied by a negative number like -2, the resulting expression, , ends up being negative. This means that the output when will always be less than the output when , so function  has its maximum value when .



Remember that we can find the -intercept of the graph representing any function that we have seen. The -coordinate of the -intercept is the value of the function when . If is defined by , then the -intercept is because . Its vertex is at . Another point on the graph with the same -coordinate is located the same horizontal distance from the vertex but on the other side.

