Module 3: Exploring Functions

TOPIC 3: INTRODUCTION TO QUADRATIC FUNCTIONS

In this topic, students begin by exploring 4 scenarios which can be represented with quadratic functions. In the following lesson, students represent each situation with an equation, a graph, and a table of values and explore the characteristics of the functions represented by each situation and different forms of a quadratic function. Students then use what they have learned about function transformations and apply this knowledge to transforming quadratic functions. Finally, students summarize the key characteristics and attributes of the different forms of quadratic functions.

Where have we been?

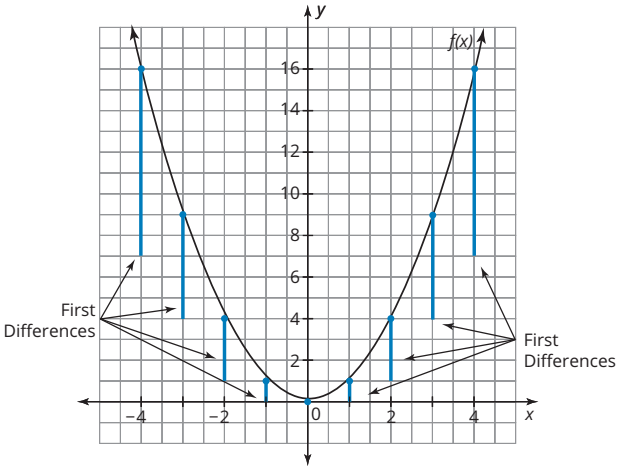
Students build on their understanding of nonlinear functions as they explore the key characteristics of quadratic functions and compare them to linear functions.

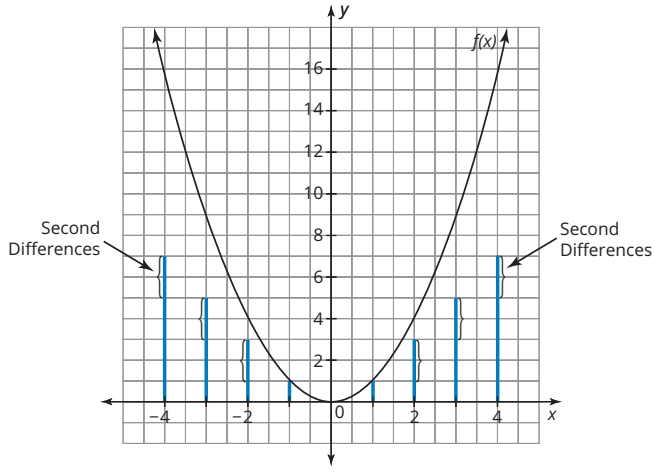
Where are we going?

In future courses, students will explore higher-order polynomials. Understanding the structure of a degree 2 polynomial, both in terms of graphs and equations, prepares students to understand the structure of cubics, quartics, and beyond. In their extensive study of polynomials, students will come back to their knowledge of key characteristics of quadratics, particularly their understanding of zeros, roots, and intercepts.

Second Differences

Linear functions have a constant rate of change, so their first differences are constant: for each increase or decrease of 1 in the *x*-value, the *y*-value of a linear function goes up or down the same amount. But quadratic functions are different.





The first differences of a quadratic function are not constant. But the second differences—the differences between the first differences—are constant.

Punkin' Chunkin'

Every year the county of Sussex, Delaware, holds a competition called the Punkin' Chunkin' World Championships, which is a pumpkin-throwing competition. Participants build machines that hurl pumpkins great distances. The winner is the person whose machine hurls the pumpkin the farthest.

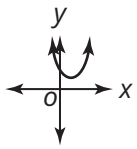
Talking Points

It can be helpful to understand quadratic functions for college admissions tests.

Here is an example of a sample question:

Given that $f(x) = ax^2 + bx + c$, which is the graph of f if $a < 0$ and $c > 0$?

(A)



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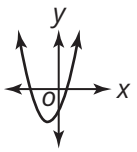

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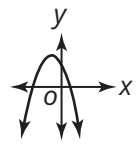

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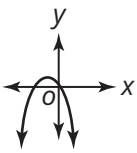

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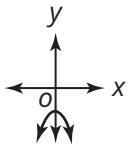

To solve this problem, you should know about transformations of quadratic functions.

If $a < 0$, then you know that the parabola is an upside-down u shape. The variable c represents the y-intercept. Since $c > 0$, the y-intercept is above the x-axis.

So, Choice C is correct.

Key Terms

parabola

The shape that a quadratic function forms when graphed is called a parabola.

roots

The roots of an equation indicate where the graph of the equation crosses the x-axis.

vertex form

The vertex form of a quadratic function is $f(x) = a(x - h)^2 + k$, where $a \neq 0$.

general form

A quadratic function written in the form $f(x) = ax^2 + bx + c$, where $a \neq 0$, is in general form, or standard form.

factored form

A quadratic function written in the form $f(x) = a(x_1 - r)(x_2 - r)$, where $a \neq 0$, is in factored form.