Module 1: Exploring Patterns in Linear and Quadratic Relationships

TOPIC 3: APPLICATIONS OF QUADRATICS

This topic provides students with an opportunity to review what they have learned in Algebra 1 and build upon that foundation as they model and solve problems for situations involving quadratics. Students start with a real-world problem that can be modeled by a quadratic inequality. From there, students are given a scenario that can be modeled by a system of a quadratic function and a linear function. They use technology to graph the system and determine the solutions. Students are presented with a real-world situation and use familiar strategies to complete a quadratic regression to determine the curve of best fit. Students determine the inverses of linear and quadratic equations. Finally, students explore parabolas as a conic section and write the general and standard equations.

Where have we been?

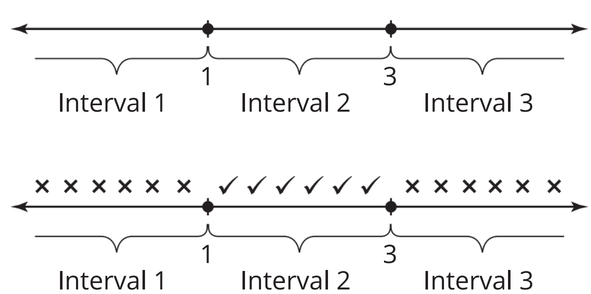
Students have graphed and solved linear inequalities in one variable and in two variables, as well as systems of linear inequalities. They use these skills to graph and solve quadratic inequalities, interpreting the solution set in the same way. Students know that a graph represents the solutions to the function it models and that the intersection point(s) of two graphs represent the solution(s) shared by both functions.

Where are we going?

This topic provides students with an opportunity to bring together the techniques that they have learned in Algebra 1 and build upon this foundation throughout this course. Students' knowledge of first- and second-degree polynomials will be used and expanded upon as they encounter cubics, quartics, rational functions, and logarithmic functions. Modeling advanced scenarios will be heavily used by students who continue on to calculus and post-secondary mathematics.

Quadratic Inequalities

To solve a quadratic inequality, such as $x^2 - 4x + 3 < 0$, you can first solve the corresponding quadratic equation: $x^2 - 4x + 3 = 0$, which will give you the roots $x = 1$ or $x = 3$. Plot the roots to create intervals on the x-axis.



Try $x = 0$	Try $x = 2$	Try $x = 4$
$0^2 - 4(0) + 3 < 0$	$2^2 - 4(2) + 3 < 0$	$4^2 - 4(4) + 3 < 0$
$3 < 0$ ×	$4 - 8 + 3 < 0$	$16 - 16 + 3 < 0$
	$-1 < 0$ ✓	$3 < 0$ ×

Interval 2 satisfies the original inequality, so the solution includes all numbers between 1 and 3.

Systems

Your body is an amazing collection of different systems. Your cardiovascular system pumps blood throughout your body, your skeletal system provides shape and support, and your nervous system controls communication between your senses and your brain. Your skin, including your hair and fingernails, is a system all by itself—the integumentary system—and it protects all of your body's other systems. You also have a digestive system, endocrine system, excretory system, immune system, muscular system, reproductive system, and respiratory system.

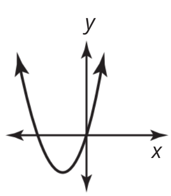
Why do we call these systems "systems"? What do you think makes up a system?

Talking Points

Quadratic functions is an important topic to know about for college admissions tests.

Here is a sample question:

If $p = 0$ and $q < 0$, then which shows the graph of $f(x) = (x - p)(x - q)$?

A.


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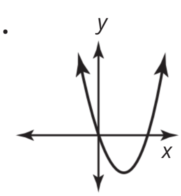

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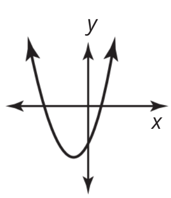

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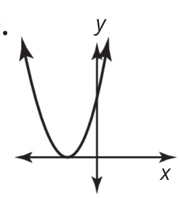

The function is given in factored form, so it has zeros at p and q, which means that the function crosses the x-axis at p and q. Since $p = 0$ and q is negative, the function crosses the x-axis at $x = 0$ and at some negative x-value. Choice A, then, is the correct graph.

Key Terms

restrict the domain
To restrict the domain of a function means to define a new domain for the function that is a subset of the original domain.

one-to-one function
A relation is a one-to-one function if both the relation and its inverse are functions.

parabola
A parabola is the set of all points in a plane that are equidistant from a focus and a directrix.

general form of a parabola
A general form of a parabola is an equation of the form $Ax_2 + Dy = 0$ or $By_2 + Cx = 0$.