Module 1: Extending Linear Relationships

TOPIC 1: EXTENDING LINEAR RELATIONSHIPS

Students begin this topic by reviewing what they know about systems of linear equations. They apply this knowledge to solve systems involving a linear and a quadratic equation and systems of three linear equations in three variables. Students also use systems of linear inequalities and linear programming to model optimal solutions to real-world situations. They use matrices to solve systems of linear equations in three variables.

Next, they calculate the absolute value of given values before considering the linear absolute value function. Students first graph the function $f(x) = x$, and then graph $f(x) = |x|$ and $f(x) = |-x|$, discussing how each graph changed. Students explore transformations of the function before moving on to solve and graph linear absolute value equations and inequalities based on real-world situations.

Where have we been?

Students enter this topic with a wide range of experiences with linear functions. Students have set up and solved systems of equations since late middle school and early high school. They have investigated properties of real numbers, including the multiplicative identity and multiplicative inverse. In this topic, students will extend these properties to a new object—a matrix.

Where are we going?

Although derived from linear relationships, linear absolute value functions are more complex than the linear functions students have dealt with previously. They share enough characteristics with linear functions to be familiar to students, but they also serve as a bridge to the nonlinear functions they will study during the remainder of this course: quadratic functions, polynomial functions, and radical and rational functions.

Linear Absolute Value Function

The coordinate plane shows the graph of the linear absolute value function $f(x) = -2|x - 1| + 4$.

The graph increases to a vertex and then decreases and is symmetric across a vertical line through the vertex.
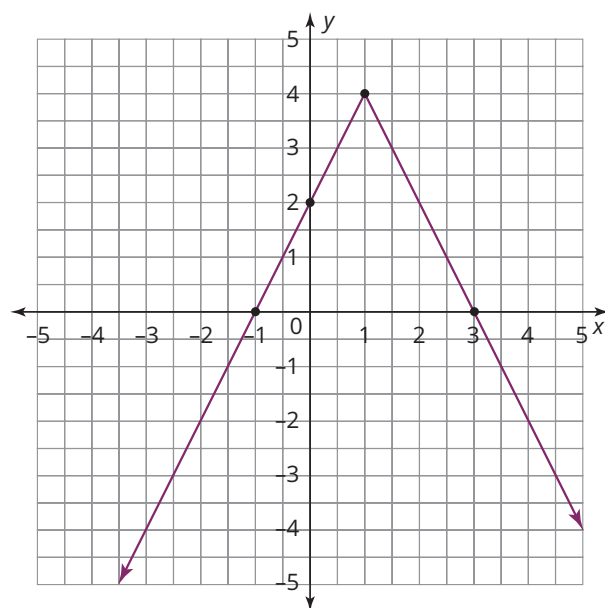
Systems

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 fi ngernails, 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.

Talking Points

Absolute value is an important topic to know about for college admissions tests.

Here is an example of a sample question:

What are the values of *n* and *p* so that $-n|2p - 6| > 0$?

For the product to be greater than 0, the factors must be either both greater than 0 or both less than 0.

Since one of the factors is an absolute value, the factors cannot be both less than 0, so they are both greater than 0.

This means that *n* must be less than 0, and *p* cannot be equal to 3.

The solution is all values such that $n < 0$ and $p \neq 3$.

Key Terms

linear programming
Linear programming is a branch of mathematics that determines the maximum and minimum value of linear expressions on a region produced by a system of linear inequalities.

matrix
A matrix (plural matrices) is an array of numbers composed of rows and columns.

absolute value
The absolute value of a number is its distance from zero on the number line.

line of reflection
A line of reflection is the line that the graph is reflected across.

linear absolute value equation
An equation in the form $|x + a| = c$ is a linear absolute value equation.