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There Are Many Ways to Represent Functions

1.3

Recognizing Algebraic and Graphical Representations of Functions

LEARNING GOALS

In this lesson, you will:

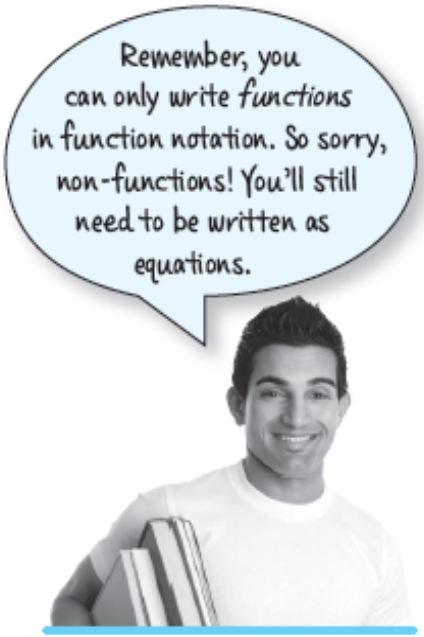
- Write equations using function notation.
- Recognize multiple representations of functions.
- Determine and recognize characteristics of functions.
- Determine and recognize characteristics of function families.

KEY TERMS

- function notation
- increasing function
- decreasing function
- constant function
- function family
- linear functions
- exponential functions
- absolute minimum
- absolute maximum
- quadratic functions
- linear absolute value functions
- linear piecewise functions

PROBLEM 1 A New Way to Write Something Familiar

Functions can be represented in a number of ways. An equation representing a function can be written using *function notation*. **Function notation** is a way of representing functions algebraically. This form allows you to more efficiently identify the independent and dependent quantities. The function $f(x)$ is read as "f of x" and indicates that x is the independent variable.



Let's look at the relationship between an equation and function notation.

Consider orders for a custom T-shirt shop. U.S. Shirts charges \$8 per shirt plus a one-time charge of \$15 to set a T-shirt design. The equation $y = 8x + 15$ can be written to model this situation. The independent variable x represents the number of shirts ordered, and the dependent variable y represents the total cost of the order, in dollars.

You know this is a function because for each number of shirts ordered (independent value) there is exactly one total cost (dependent value) associated with it.

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PROBLEM 2 Up, Down, or Neither?

In the previous lesson, you determined which of the given graphs represented functions. Gather all of the graphs from the previous lesson that you identified as functions.

A function is described as increasing when the dependent variable increases as the independent variable increases. If a function increases across the entire domain, then the function is called an **increasing function**.

A function is described as decreasing when the dependent variable decreases as the independent variable increases. If a function decreases across the entire domain, then the function is called a **decreasing function**.

If the dependent variable of a function does not change or remains constant over the entire domain, then the function is called a **constant function**.

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Definition

The family of **linear functions** includes functions of the form $f(x) = mx + b$, where m and b are real numbers.

m = slope
b = y-intercept

If $m = 0$, then $f(x) = b$, a constant function.

Graphical Behavior

Increasing / Decreasing / Constant:

Increasing or decreasing over the entire domain

Maximum / Minimum:

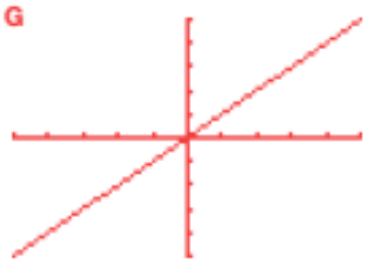
No maximum or minimum point

Curve / Line:

Straight lines

Linear Functions

Example



$f(x) = x$

Domain: all real numbers

Definition

The family of **exponential functions** includes functions of the form $f(x) = a \cdot b^x$, where a and b are real numbers, and b is greater than 0 but not equal to 1.

Graphical Behavior

Increasing / Decreasing / Constant:

Increasing or decreasing over the entire domain

Maximum / Minimum:

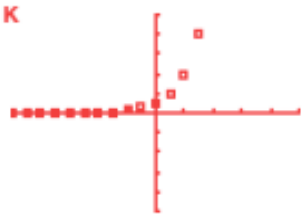
No maximum or minimum point

Curve / Line:

Smooth curves

Exponential Functions

Example



$f(x) = 2^x$,
where x is an integer
Domain: all integers

Quadratic Functions

Definition

The family of **quadratic functions** includes functions of the form, $f(x) = ax^2 + bx + c$ where a, b, and c are real numbers, and a is not equal to 0.

Graphical Behavior

Increasing / Decreasing / Constant:

Increase, then decrease OR decrease, then increase over the entire domain

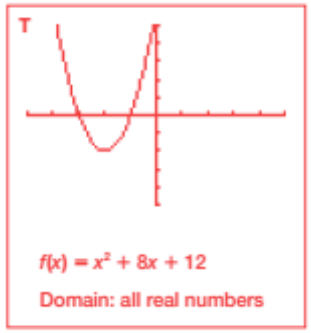
Maximum / Minimum:

Maximum OR minimum depending on the shape of the parabola

Curve / Line:

Smooth curves

Example



Linear Absolute Value Functions

Definition

The family of **linear absolute value functions** includes functions of the form $f(x) = a|x + b| + c$, where a, b, and c are real numbers, and a is not equal to 0.

Graphical Behavior

Increasing / Decreasing / Constant:

Increase, then decrease OR decrease, then increase over the entire domain

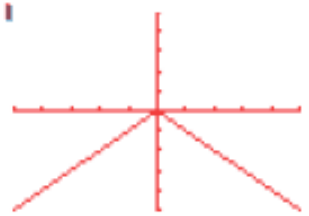
Maximum / Minimum:

Absolute maximum OR absolute minimum

Curve / Line:

Straight lines

Example



$f(x) = -|x|$

Domain: all real numbers

Linear Piecewise Functions

Definition

The family of **linear piecewise functions** includes functions that have equation changes for different parts, or pieces, of the domain.

Each piece represents a different function with its own domain.

Graphical Behavior

Increasing / Decreasing / Constant:

Pieces may be increasing, decreasing, and/or constant

Maximum / Minimum:

May OR may not have a maximum or minimum

Curve / Line:

Straight lines and line segments

Example