

1 quadratic functions and models

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Quadratic Functions and Models**

What is a Quadratic Function?

A quadratic function is a mathematical expression that represents a parabola, a U-shaped curve. It is defined by the general form: $f(x) = ax^2 + bx + c$, where a , b , and c are real numbers and $a \neq 0$.

Example of a Quadratic Model:

- $f(x) = x^2 + 2x - 3$ represents a parabola that opens upward.

Which Equations are Quadratic Functions?

Any equation that can be written in the form $f(x) = ax^2 + bx + c$, where $a \neq 0$, is a quadratic function.

Solving Quadratic Models

- **Factoring:** Solve for x by factoring the quadratic and setting the factors equal to zero.
- **Quadratic Formula:** Use the formula $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$.

Types of Quadratic Functions

Based on the value of the discriminant ($b^2 - 4ac$):

- **Opens Upward:** $a > 0$
- **Opens Downward:** $a < 0$

- **No Real Solutions:** $b^2 - 4ac < 0$

Functions as Models

Functions are used to represent relationships between variables. Quadratic functions can model various real-world phenomena, such as projectile motion and the area of a circle.

Identifying Quadratic Models

- Degree of 2 (x^2)
- U-shaped graph (parabola)

Real Example of a Quadratic Function

- The height of a projectile launched into the air is given by $f(t) = -16t^2 + 80t$, where t is the time in seconds.

Examples of Quadratic Equations

- $x^2 + 5x + 6 = 0$
- $(x - 2)^2 = 9$
- $2x^2 - 10x + 4 = 0$

Solving Quadratic Functions

Follow the appropriate method described in "Solving Quadratic Models."

Why "Quadratic"?

The term "quadratic" is derived from the Latin word "quadratus," meaning "square." The equation represents a second-degree polynomial, which involves the squaring of the variable x .

Can a Quadratic Function Be a Function?

Yes, a quadratic function is a type of function because it relates an input (x) to an output ($f(x)$).

Quadratic Models

Quadratic models are functions that express quadratic equations. They are used to model parabolic shapes and a variety of real-world phenomena.

Quadratic Function Modeling a Parabola

- $f(x) = a(x - h)^2 + k$
- Where: (h, k) is the vertex of the parabola

Writing a Quadratic Function for a Graph

- Identify the vertex (h, k) and the direction of opening (up/down).
- Use the formula $f(x) = a(x - h)^2 + k$, where $a = 1$ for parabolas with vertex at $(0, 0)$.

Characteristics of Quadratic Functions

- U-shaped graph
- Degree of 2
- Symmetric about the axis of symmetry
- Intercepts at $(0, c)$ and $(x\text{-intercepts})$

Model vs. Function

A model is a representation of a real-world situation, while a function is a mathematical relationship. A model can be a function, but not all functions are models.

Graph as a Mathematical Model

A graph can be a mathematical model if it represents the relationship between two or more variables.

Functional Model

A functional model expresses the relationship between two or more variables using a mathematical function.

Function as a Quadratic Function

Any function that satisfies the general form of a quadratic function ($f(x) = ax^2 + bx + c$) is a quadratic function.

Finding a Quadratic Function

To find a quadratic function:

- Plot points and draw the parabola.
- Determine the vertex (h, k) .
- Use the formula $f(x) = a(x - h)^2 + k$, where $a = 1$ for parabolas with a vertex at $(0, 0)$.

Rule for Quadratic Functions

The rule for a quadratic function is $f(x) = ax^2 + bx + c$.

Quadratic Function Teaching

Quadratic functions teach concepts such as:

- Modeling parabolic shapes
- Solving equations with no real solutions
- Graphing and analyzing functions

Quadratic Function Table

A quadratic function table shows the input-output pairs of a quadratic function.

Quadratic Programming Model

A quadratic programming model is an optimization problem that involves a quadratic function.

Quadratic System of Functions

A quadratic system of functions is a set of two or more quadratic functions that are related to each other.

Uses of Quadratic Models

Quadratic models are used to:

- Model projectile motion
- Determine the area of a circle
- Fit curves to data

Identifying Quadratic Models

Identify quadratic models by their:

- U-shaped graph
- Degree of 2
- General form ($f(x) = ax^2 + bx + c$)

Finding the Quadratic Model of a Function

- Use the vertex (h, k) and the formula $f(x) = a(x - h)^2 + k$.
- Solve a system of equations for a , b , and c .

Quadratic Functions in Real Life

- Projectile motion
- Area of a circle
- Profit functions in business

Meaning of Quadratic Function

A mathematical expression that represents a parabola, defined by the equation $f(x) = ax^2 + bx + c$.

Doing Quadratic Functions

Solving or analyzing quadratic functions using various methods.

Status of Quadratic Functions as Functions

Yes, all quadratic functions are functions.

Quadratic Function Model

A mathematical representation of a quadratic function in the general form $f(x) = ax^2 + bx + c$.

Uses of Quadratic Functions

Modeling parabolic phenomena and solving various real-world problems.

Analysis of Quadratic Functions

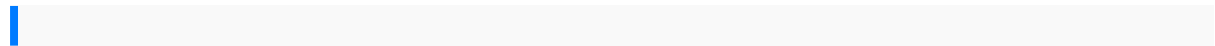
Examining the properties, characteristics, and behavior of quadratic functions.

Types of Problems Modeled with Quadratic Functions

Projectile motion, profit functions, and fitting curves to data.

Etymology of "Quadratic"

Derived from Latin "quadratus," meaning "square," referring to the squaring of the variable x .



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