

Algebra IB

(Available in English and Spanish)

SCOPE OF COURSE

This course is divided into two semesters of study (A & B) comprised of five units each. The second semester (B) is a study of linear functions; inequalities, absolute value, and radicals; quadratic functions, circles, modeling exponential growth and decay; systems of equations and inequalities; and probability and statistics.

SEQUENCE OF SKILLS

UNIT 1 – Linear Functions

Functions and Relations

- learn about relations and functions
- learn about ordered pairs
- learn about domain and range

Functional Notation

- learn functional notation
- learn the difference between a dependent and an independent variable
- learn to evaluate functions

Graphing

- introduce the Cartesian coordinate system
- name points
- plot points
- use a table

Linear Functions

- learn what a linear function is
- verify whether or not a given point lies on a line
- graph equations of the form $y = mx + b$ and $ax + by = c$ by plotting points
- use the vertical line test

Slope of a Line

- define slope
- find slopes using a graph or data
- find slopes using equations in the form $y = mx + b$ and $ax + by = c$

Intercepts

- define intercepts
- find intercepts using a graph or data
- find intercepts using equations in the form $y = mx + b$ and $ax + by = c$

Applications of Slopes and Intercepts

- look at slope as a rate
- interpret slope and intercepts in applied situations
- look at graphs in terms of direct variation

Effects of Change of Slope and Intercepts: look at equations in the form $y = mx + b$ and determine

- what happens to the graph if m changes
- what happens to the graph if b changes

Parallel and Perpendicular Lines

- learn the characteristics of lines that are parallel and lines that are perpendicular

Writing Linear Equations: write the equation of a line

- given the slope and the y-intercept
- given the graph of the line
- given a slope and a point on a line
- given the y-intercept and a point on the line

More on Writing Linear Equations: write the equation of a line

- given any two points on the line
- given a point on the line and the line is parallel to another given line
- given a point on the line and the line is perpendicular to another given line
- in real-world applications

Horizontal and Vertical Lines: learn to recognize the graphs of equations in the form

- $y = c$ and $x = c$

Other Special Linear Equations: learn to recognize and use equations of the form

- $y = x$ and $y = -x$

Applications: study some applications of linear functions such as

- scatter plots and lines of best fit
- matching graphs with data

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UNIT 2 – Inequalities, Absolute Value, and Radicals

Graphing and Writing Inequalities

- learn to graph inequalities on a number line
- learn to write inequalities to represent real-world solutions
- learn to write inequalities given a number line graph
- learn to graph and recognize inequalities of the form $x \leq a$ or $x \leq b$
- write and graph the corresponding real-world examples
- recognize valid and invalid inequality strings

The Algebra of Inequalities

- learn how to find solutions to algebraic inequalities

Linear Inequalities in Two Variables

- learn why it is necessary to use the Cartesian plane instead of using a number line to graph the solution to some inequalities
- learn to determine whether or not an ordered pair is a solution to an inequality in two variables
- learn to graph the solution of linear inequalities in two variables

Writing Linear Equations in Two Variables

- learn to write inequalities associated with graphs
- learn to write inequalities corresponding to word problems

Absolute Value Equations: learn to solve and graph absolute value equations

- involving one variable-graph results on a number line
- involving two variables-graph results on the Cartesian plane

Absolute Value Inequalities with One Variable

- learn to simplify and graph absolute value inequalities with one variable
- learn to write absolute value inequalities represented by graphs
- learn to write absolute value inequalities corresponding to word problems

Absolute Value Inequalities in Two Variables

- learn to graph absolute value inequalities in two variables
- learn to write absolute value inequalities in two variables given their graph

Simplifying Radicals with Variables

- learn to simplify radicals that contain variables

Multiplying and Dividing Radical Expressions with Variables

- learn to multiply and divide radical expressions with variables

Addition and Subtraction of Radicals with Variables

- learn to recognize like radical terms
- learn to add and subtract radical expressions with variables

Rational Expressions with Radical Monomial Denominators: learn to rationalize fractions with a

- square root for a denominator
- cube root for a denominator

Rational Expressions with Radical Binomial Denominators

- learn to find the conjugate of a binomial containing a square root
- learn to rationalize the denominators of fractions that are binomials with square roots

Gears, Pulleys, and the Wheel and Axle

- learn how gears and pulleys use the number of teeth or radius of circles to gain speed or to gain mechanical advantage

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UNIT 3 – Quadratic Functions, Circles, and Modeling Exponential Growth and Decay

Conic Sections

- recognize which second-degree equations, in general form, are equations of parabolas, circles, or neither
- recognize solutions to quadratic equations
- graph circles and parabolas by plotting points

The Basics About Quadratic Functions

- recognize when a parabola is a quadratic function
- find the vertex of a quadratic function by observation
- write the equation of the line of symmetry
- determine whether a vertex is a maximum or a minimum
- find the points of reflection of points on a parabola

Solving Quadratic Equations-Using Square Roots

- learn the relationship between the graph of a quadratic function and the solutions to a quadratic equation
- learn when quadratic equations may be solved algebraically using square roots and how to do it

Solving Quadratic Equations-By Factoring

- learn the zero-product property
- learn to solve equations by factoring

Completing the Square

- learn to solve quadratic equations by completing the square

The Quadratic Formula

- learn how to solve quadratic equations by using the quadratic formula

The Discriminant and the Nature of Roots: learn how to use the discriminant to determine

- the number of roots a given quadratic equation will have
- the kind of roots to expect from a given quadratic equation

The Vertex of a Parabola

- learn to find the vertex of a quadratic function written in the general form $y = ax^2 - bx + c$
- learn to find the vertex of a quadratic function written in the standard form $y - k = a(x - h)^2$
- learn to change from standard form to general form by expanding
- learn to change from general form to standard form by completing the square

Graphing Quadratic Functions

- study the effects of changing the a in $y = ax^2$
- study the effects of changing the c in $y = x^2 + c$
- graph a quadratic function written in standard form and written in general form

Writing the Equations of Quadratic Functions: learn to write the equation of a quadratic function given

- a graph
- practical problems

Maximum and Minimum Problems

- learn to find the maximum and minimum value of a quadratic function on an interval $[a, b]$
- use the information learned about quadratic functions to solve practical problems

The Distance Formula and a Circle

- learn how to find the distance between two points in a plane
- learn how to write the equation of a circle in standard form
- learn how to find the center and radius of a circle when it is written in standard form
- learn how to change the equation of a circle in standard form to one in general form

The Midpoint Formula and the Circle

- learn how to find the midpoint of a line segment
- learn more on writing equations of circles
- learn how to find the center and radius of a circle when it is written in general form

Mathematical Modeling-Exponential Growth and Decay

- learn to model an exponential growth and decay
- learn to solve problems involving exponential growth and decay

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UNIT 4 – Systems of Equations and Inequalities

Systems of Two Linear Equations-Graphing

- determine the possible number of solutions to a system of two linear equations
- find the solution to the system by graphing

Systems of Two Linear Equations-Substitution

- learn to solve a system of linear equations by substitution
- learn how to recognize systems with no solutions or an infinite number of solutions when solving the system by substitution

Systems of Two Linear Equations-Addition or Elimination Method

- learn how to find the solution to a system of equations by the addition or elimination method

Writing Systems of Equations

- learn what is necessary for a problem involving two variables, to have a unique solution
- learn how to write systems of equations in order to solve practical situations

Systems of Equations with More than Two Variables

- examine systems with more than two variables visually
- determine the number of possible solutions to these systems
- solve a system with more than two variables by substitution

Solving Systems of Equations in Three Variables by Elimination

- learn to use elimination to solve systems of equations in three variables

Applications of Systems of Equations with Three Variables

- learn to recognize systems of equations that do not have unique solutions
- learn to write and solve practical problems involving three variables

Simultaneous Solutions-A Linear Equation and a Quadratic Function

- determine the number of possible solutions to a system of equations
- find the solution to systems of equations (with a linear equation and a quadratic function) algebraically and by graphing

Simultaneous Solutions-A Linear Equation and a Absolute Value Function or a Circle

- compare quadratic functions and absolute value functions
- find simultaneous solutions to systems with a linear function and an absolute value function
- find simultaneous solutions to systems with a linear function and a circle

Matrices-Introduction

- learn what a matrix is and how it is named
- learn what the elements and dimensions of a matrix are
- learn some arithmetic operations with matrices

Solving Systems of Equations with Matrices

- learn to write systems of equations in matrix form
- learn the row operations for matrices
- learn to solve systems of equations with matrices

Determinants and Cramer's Rule

- learn what a determinant of a square matrix is and how to find its value
- learn how to use determinants to solve systems of linear equations in two variables
- learn to use determinants to determine if a system of linear equations in two variables is dependent, independent, or inconsistent

System of Linear Inequalities

- learn to find the solution to a system of linear inequalities by graphing
- learn to recognize whether or not specific points are part of the solution by observation
- learn to solve application problems involving linear inequalities

Linear Programming

- learn how to solve systems of inequalities using linear programming

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UNIT 5 – Probability and Statistics

Theoretical Probability

- develop an understanding of the number associated with a probability
- find sample spaces and events
- determine theoretical probabilities

Mutually Exclusive and Complementary Events

- learn how to recognize mutually exclusive events and complementary events
- learn to use Venn Diagrams with probability
- learn properties of probability for complementary and mutually exclusive events

Tree Diagrams and Multistage Experiments

- find probabilities of a multistage experiment with the help of tree diagrams
- understand the difference between dependent and independent events
- learn to use the counting principle to check that the number of outcomes is correct

Geometric Probability and Expected Value

- learn to use an area model and geometric shapes to find probabilities
- learn to use expected value to make wise decisions

Experimental Probability and Simulations

- learn how to model experiments using random numbers
- learn how to find probabilities using simulations

Permutations

- learn how to use permutations for counting
- learn about factorials and how to evaluate them
- solve problems using permutations

Combinations

- understand the difference between permutations and combinations
- evaluate combinations
- solve problems with combinations

Organizing Data

- show how to organize statistical data using line plots and stem and leaf plots
- use data to draw conclusions

Bar Graphs

- learn to create bar graphs
- learn to create histograms
- learn to create double bar graphs
- learn to analyze data

Line Graphs and Pictographs

- learn to analyze data
- learn to create line graphs
- learn to create pictographs

Circle Graphs

- learn to analyze data
- learn to create circle graphs

Mean and Median

- learn to calculate mean and median measures of central tendency
- learn to analyze data using central tendency

Frequency Distributions

- learn to calculate the mean and median of a frequency distribution
- learn to find the mode of a set of data
- learn to analyze data using central tendency

Box and Whisker Plots

- study range and outliers
- learn about quartiles and interquartile range (IQR)
- learn to make and interpret box and whisker plots