

MATHEMATICS

Advanced Mathematics

Curriculum

Grade 11/12

Vineland Public Schools
Vineland, New Jersey

2004-2005

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Vineland Public Schools Mission Statement

We believe that all Vineland Public School students can learn. We recognize that learning is the result of a strong partnership of parents, teachers, and the community, as students are challenged to become active participants in the quest for excellence. Our goal is to ensure a safe, creative, stimulating and caring environment, which promotes self-esteem, sound character, responsibility and respect for diversity. This will enable students to become knowledgeable, skillful, life-long learners who are contributing citizens in our changing society. We expect the best from our students and will give no less of ourselves.

Course Description

The Advanced Mathematics course is a precalculus course for students who are planning to pursue a college education which will require Calculus for non-scientific or non-math majors. A thorough study of linear relations, functions, and circular functions and their inverses will be included. Additional topics will include exponential, logarithms, conic sections, complex numbers, nature of graphs, and how it applies to polynomial functions. This course provides the student with in-depth learning of mathematical skills and concepts mandated by the New Jersey Core Curriculum Content Standards. This course builds upon the NJ CCS skills obtained in the fourth and eighth grade core objectives.

Instruction will be in a combination of teacher presentations, discussions, activities, classroom exercises, and student led discovery. Recommended time lines are included with each topic allowing sufficient classroom time for the completion of supplemental activities, exercises, and projects, as well as instruction.

Course Goals

In accordance with New Jersey Core Curriculum Content Standards for Mathematics, this course will provide successful completion of all relevant Standards in section 4. All students will use mathematical applications to gather and organize information and to solve problems. All students will develop an understanding of the nature and impact of mathematical concepts as they relate to the individual, society, and the environment.

These goals are to promote:

1. Exposure to a variety of learning environments that will be conducive to our multicultural society.
2. An increase in student self-esteem and confidence in his/her mathematical ability.
3. The value of mathematics and make student aware of its use in various careers.
4. Communication of mathematical thinking to peers and teachers both orally and in writing.(NJCC4.5B1)
5. The use of reasoning to support their mathematical conclusions and problem solutions.(NJCC4.5D2)
6. Learning of Advanced Mathematics through problem solving, inquiry, and discovery.(NJCC4.5A1)
7. Understanding how mathematical ideas interconnect and build on one another to produce a coherent whole.(NJCC4.5C6)
8. Apply Advanced Mathematics in practical situations and in other disciplines. (NJCC4.5C4)
9. Use of technology as a problem solving tool and investigate properties of functions and their graphs. (NJCC4.5F3, F4)
10. Use of various graphing methods to solve and graph higher degree equations.
11. Use of variety of trigonometric methodology to solve triangles. (NJCC4.2E1)
12. Use of models and algebraic formulas to represent conic sections.
13. Use of logarithmic and exponential functions to model real world phenomena and solve problems that involve varying quantities. (NJCC4.3C1)
14. A variety of problem solving techniques and strategies to solve problems.(NJCC4.5A3)
15. Use of Polar representation of numbers as an alternative method to understanding the complex numbers.
16. Use of Combinatorics and Probability to model situations and solve problems using these models. (NJCC4.4B3, C1)

NJ Core Content Curriculum Standards for Mathematics

Standard 4.1 Number and Numerical Operations-All students will develop number sense and will perform standard numerical operations and estimations on all types of numbers in a variety of ways.

4.1 Number and Numerical Operations

- A. Number Sense
- B. Numerical Operations
- C. Estimation

Standard 4.2 Geometry and Measurement- All students will develop spatial sense and the ability to use geometric properties, relationships, and measurement to model, describe, and analyze phenomena.

4.2 Geometry and Measurement

- A. Geometric Properties
- B. Transforming Shapes
- C. Coordinate Geometry
- D. Units of Measurement
- E. Measuring Geometric Objects

Standard 4.3 Patterns and Algebra-All students will represent and analyze relationships among variable quantities and solve problems involving patterns, functions, algebraic concepts and processes.

4.3 Patterns and Algebra

- A. Patterns and Relationships

- B. Functions
- C. Modeling
- D. Procedures

Standard 4.4 Data Analysis, Probability, and Discrete Mathematics-All students will develop an understanding of the concepts and techniques of data analysis, probability, and discrete mathematics, and will use them to model situations, solve problems, and analyze and draw appropriate inferences from data.

4.4 Data Analysis, Probability, and Discrete Mathematics

- A. Data Analysis (Statistics)
- B. Probability
- C. Discrete Mathematics-Systemic Listing and Counting
- D. Discrete Mathematics-Vertex-Edge Graph and Algorithms

Standard 4.5 Mathematical Processes-All students will use mathematical processes of problem solving, communication, connections, reasoning, representations, and technology to solve problems and communicate mathematical ideas.

4.5 Mathematical Processes

- A. Problem Solving
- B. Communication
- C. Connections
- D. Reasoning
- E. Representations
- F. Technology

COURSE CONTENTS

I. Linear Relations and Functions

- 1.1 Relations and Functions
- 1.2 Composition of Functions
- 1.3 Graphing Linear Equations
- 1.4 Writing Linear Equations
- 1.5 Writing Equations of Parallel and Perpendicular Lines
- 1.6 Modeling Real world Data with Linear Functions
- 1.7 Piecewise Functions
- 1.8 Graphing Linear Inequalities

II. Systems of Linear Equations and Inequalities

- 2.1 Solving Systems of Equations in Two Variables
- 2.2 Solving Systems of Equations in Three Variables
- 2.3 Modeling Real World Data with Matrices
- 2.4 Modeling Motion with Matrices
- 2.5 Determinants and Multiplicative Inverses of Matrices
- 2.6 Solving Systems of Linear Inequalities
- 2.7 Linear Programming

III. The Nature of Graphs

- 3.1 Symmetry and Coordinate Graphs
- 3.2 Families of Graphs
- 3.3 Graphs of Nonlinear Inequalities
- 3.4 Inverse Functions and Relations
- 3.5 Continuity and End Behavior
- 3.6 Critical Points and Extrema
- 3.7 Graphs of Rational Functions
- 3.8 Direct, Inverse, and Joint Variation

IV. Polynomial and Rational Functions

- 4.1 Polynomial Functions

- 4.2 Quadratic Equations
- 4.3 The Remainder and Factor Theorems
- 4.4 The Rational Root Theorem
- 4.5 Locating Zeros of a Polynomial Function
- 4.6 Rational Equations and Partial Fractions
- 4.7 Radical Equations and Inequalities
- 4.8 Modeling Real World with Polynomial Functions

V. The Trigonometric Functions

- 5.1 Angles and Degree Measure
- 5.2 Trigonometric Ratios in Right Triangles
- 5.3 Trigonometric Functions on the Unit Circle
- 5.4 Applying Trigonometric Functions
- 5.5 Solving Right Triangles
- 5.6 The Law of Sines
- 5.7 The Ambiguous Case for the Law of Sines
- 5.8 The Law of Cosines

VI. Graphs of Trigonometric Functions

- 6.1 Angles and Radian Measure
- 6.2 Linear and Angular Velocity
- 6.3 Graphing Sine and Cosine Functions
- 6.4 Amplitude and Period of Sine and Cosine Functions
- 6.5 Translations of Sine and Cosine Functions
- 6.6 Modeling Real World Data with Sinusoidal Functions
- 6.7 Graphing Other Trigonometric Functions
- 6.8 Trigonometric Inverses and Their Graphs

VII. Trigonometric Identities and Equations

- 7.1 Basic Trigonometric Identities
- 7.2 Verifying Trigonometric Identities
- 7.3 Sum and Difference Identities
- 7.4 Double-Angle and Half-Angle Identities
- 7.5 Solving Trigonometric Equations
- 7.6 Normal Form of a Linear Equation
- 7.7 Distance from a Point to a Line

VIII. Polar Coordinates and Complex Numbers

- 9.1 Polar Coordinates
- 9.2 Graphs of Polar Coordinates
- 9.3 Polar and Rectangular Coordinates
- 9.4 Polar Form of a Linear Equation
- 9.5 Simplifying Complex Numbers
- 9.6 The Complex Plane and Polar Form of Complex Numbers
- 9.7 Products and Quotients of Complex Numbers in Polar Form
- 9.8 Powers and Roots of Complex Numbers

IX. Conics

- 10.1 Introductions to Analytic Geometry
- 10.2 Circles
- 10.3 Ellipses
- 10.4 Hyperbolas
- 10.5 Parabolas
- 10.7 Transformations of Conics
- 10.8 Systems of Second-Degree Equations and Inequalities

X. Exponential and Logarithmic Functions

- 11.1 Real Exponents
- 11.2 Exponential Functions
- 11.3 The Number e
- 11.4 Logarithmic functions
- 11.5 Common Logarithms
- 11.6 Natural Logarithms

XI. Combinatorics and Probability

- 13.1 Permutations and Combinations
- 13.2 Permutations with Repetitions and Circular Permutations
- 13.3 Probability and Odds

COURSE OBJECTIVES

I. Linear Relations and Functions (4.3 B-C)

1.1 Determine whether a given relation is a function and perform operations with functions.

1.2 Evaluate and find zeros of linear functions using functional notation.

1.3 Graph and write functions and inequalities.

1.4 Write equations of parallel and perpendicular lines.

1.5 Model data using scatter plots and write prediction equations.

II. Systems of Linear Equations and Inequalities (4.1 B3, 4.3 B)

2.1 Solve systems of equations and inequalities.

2.2 Define matrices.

2.3 Add, subtract, and multiply matrices.

2.4 Use matrices to model transformations.

2.5 Find determinants and inverses of matrices.

2.6 Use linear programming to solve problems.

III. The Nature of Graphs (4.3 B – D)

3.1 Graph functions, relations, inverses, and inequalities.

3.2 Analyze families of graphs.

3.3 Investigate symmetry, continuity, end behavior, and transformations of graphs.

3.4 Find asymptotes and extrema of functions.

3.5 Solve problems involving direct, inverse, and joint variation.

IV. Polynomial and Rational Functions (4.1B, D1-2)

4.1 Determine roots of polynomial equations.

4.2 Solve quadratic, rational, and radical equations and rational and radical inequalities.

4.3 Find the factors of polynomials.

4.4 Approximate real zeros of polynomial functions.

4.5 Write and interpret polynomial functions that model real world data.

V. The Trigonometric Functions (4.3B, 4.2A)

5.1 Convert decimal degree measures to degrees, minutes, and seconds and vice versa.

5.2 Identify angles that are coterminal with a given angle.

5.3 Solve triangles.

5.4 Find the values of trigonometric functions.

5.5 Find the area of triangles.

VI. Graphs of Trigonometric Functions (4.2 E)

6.1 Change from radian measure to degree measure, and vice versa.

6.2 Find linear and angular velocity.

6.3 Use and draw graphs of trigonometric functions and their inverses.

6.4 Find the amplitude, the period, the phase shift, and the vertical shift for trigonometric functions.

6.5 Write trigonometric equations to model a given situation.

VII. Trigonometric Identities and Equations (4.2 A & C, 4.3 B)

7.1 Use reciprocal, quotient, Pythagorean, symmetry, and opposite-angle identities.

7.2 Verify trigonometric identities.

7.3 Use the sum, difference, double-angle, and half-angle identities.

7.4. Solve trigonometric equations and inequalities.

7.6 Find the distance from a point to a line.

VIII. Polar Coordinates and Complex Numbers (4.2 C)

9.1 Add, subtract, and multiply vectors.

9.2 Convert between polar and rectangular coordinates.

9.3 Add, subtract, multiply, and divide complex numbers in rectangular and polar forms.

9.4 Convert between rectangular and polar forms of complex numbers.

9.5 Find the powers and roots of complex numbers.

IX. Conics (4.2)

10.1 Use analytic methods to prove geometric relationships.

10.2 Use the standard and general forms of the equations of circles, parabolas, ellipses, and hyperbolas.

10.3 Graph circles, parabolas, ellipses, and hyperbolas.

10.4 Find the eccentricity of conic sections.

10.5 Recognize conic sections by their equations.

10.6 Graph and solve systems of second degree equations and inequalities.

X. Exponential and Logarithmic Functions (4.3 B)

11.1 Simplify and evaluate expressions containing rational and irrational exponents.

11.2 Use and graph exponential functions and inequalities.

11.3 Evaluate expressions and graph and solve equations involving logarithms.

11.4 Model real world situations and solve problems using common and natural logarithms.

XI. Combinatorics and Probability (4.4 B-C)

13.1 Solve problems involving combinations and permutations.

13.2 Distinguish between independent and dependent events and between mutually exclusive and mutually inclusive events.

13.3 Find probabilities.

13.4 Find odds for the success and failure of an event.

Proficiency

Satisfactory student achievement in each of the proficiencies listed in this curriculum shall be determined by student attainment of the 70% district passing-standard. Such proficiency shall be measured by a multiplicity of evaluation techniques and activities that include, but are not restricted to the following:

1. Teacher-made tests/quizzes
2. Class participation
3. Homework assignments
4. Reports and Projects
5. Oral reports and presentations: includes PowerPoint Presentation
6. Notebook/Journal
7. Cooperative group projects/activities
8. Standardized tests

Instructional Resources

Holliday, Berchie; Cuevas, Gilbert; McClure, Melissa; Carter, John; Marks, Daniel;
Advanced Mathematical Concepts, Glencoe/McGraw-Hill, 2001

TI-83 Plus Graphing Calculator, Texas Instrument Inc.

Advanced Mathematics

A Pacing Chart is a Teaching Time Frame Guide

First Marking Period 10 weeks	Chapter 1 3 weeks	Chapter 2 3 weeks	Chapter 3 4 weeks	
Second Marking Period 10 weeks	Chapter 4 3 weeks	Chapter 10 4 weeks	Chapter 11 3 weeks	Midterm
Third Marking Period 10 weeks	Chapter 5 5 weeks	Chapter 6 5 weeks		
Fourth Marking Period 10 weeks	Chapter 7 4 weeks	Chapter 9 4 weeks	Chapter 13 2 Weeks	Final Assessment

Number of actual instructional days will vary due to school activities, school closings, etc.