

TRUMBULL PUBLIC SCHOOLS

TRUMBULL, CONNECTICUT

MATHEMATICS CURRICULUM

Precalculus 400

Spring 1993

Writing Team:

Nial Neger

Frank Eastwood

Joyce Hamilton

Mary Quinlan

Edward C. Lovely

Supervisor of Curriculum Development

TABLE OF CONTENTS
Algebra II and Trigonometry 400

	Page
Philosophy	1
Goals and Prerequisites.....	2
Scope and Sequence	3
Objectives	4 - 10
Evaluation Methods	11
Time Allotments	12
Text	13

The Trumbull Board of Education as a matter of policy, prohibits discrimination on the grounds of age, creed, religion, sex, race, color, handicap, political affiliation, marital status or national origin.

Philosophy Precalculus 400

Precalculus 400, an honors level course, is designed for the advanced math student. It differs from Precalculus 300 by its content, and the difficulty of the problems presented.

While many of the topics in this course and its 300 level counterpart may look the same, the typical exercise done in this course is more difficult than that in the 300 level course. Topics are also done faster than in the 300 level course because more areas are covered in the 400 level course than in the other course. There will be a great deal of emphasis placed on problem solving and applications to the real-world.

The demands of the course are such because it is designed for students who have a strong mathematical background and ability and who wish to continue in the advanced mathematics sequence. These students are most likely planning to apply to very competitive universities and they will need this type of background to be admitted to these schools. This course will provide them with the content knowledge expected of them, and also will help them adjust to the work load they will be expected to carry and the competition they will get from other students. Needless to say, students enrolled in this course should be highly self-motivated and have strong mathematical ability. Students electing this course should be prepared to spend a lot of time outside of class studying and preparing work for this course.

Goals Precalculus 400

1. Students will advance and refine their ability to do algebraic manipulations.
2. Students will expand their knowledge of algebraic topics by studying areas new to them.
3. Students will further develop their ability to reason mathematically and solve mathematical problems.
4. Students will strengthen their ability to express themselves algebraically in written and oral work.
5. Students will be prepared to take the A.P. Calculus 400 course, which usually is elected after completion of Precalculus 400.

Prerequisites

A student enrolling in Precalculus 400 should have previously obtained a grade of "B" or better in Algebra II 400. Or, a student who took Algebra II 300 may enroll in Precalculus II 400 if they received a grade of "A" or better and have the recommendation of their Algebra II 300 teacher.

Scope and Sequence
Precalculus 400

- I. Linear and Quadratic Functions
- II. Polynomial Functions
- III. Inequalities
- IV. Function Theory
- V. Exponents and Logarithms
- VI. Analytic Geometry
- VII. Trigonometric Functions
- VIII. Trigonometric Equations
- IX. Triangle Trigonometry
- X. Trigonometric Formulas
- XI. Polar Coordinates and Complex Numbers
- XII. Sequences and Series
- XIII. Combinatorics

OBJECTIVES
Precalculus 400

I. Linear and Quadratic Functions

Students will:

- A. Find the intersection of two lines.
- B. Find the distance between two points.
- C. Find the coordinates of the midpoint of a line segment.
- D. Find the slope of a line.
- E. Determine if two lines are parallel, perpendicular, or oblique.
- F. Find the equation of a line from given conditions.
- G. Model real-world situations using linear functions.
- H. Perform arithmetic operations on complex numbers.
- I. Solve quadratic equations using different methods.
- J. Find the equation of a quadratic function from given conditions.
- K. Graph quadratic equations.

II. Polynomial Functions

Students will:

- A. Evaluate a polynomial function using synthetic division.
- B. Determine the zeros of a polynomial function.
- C. Apply the factor and remainder theorems.

- D. Determine the equation of a polynomial function from given conditions.
- E. Graph polynomial functions.
- F. Solve polynomial equations by factoring.
- G. Solve polynomial functions by the rational root theorem.
- H. Apply the fundamental theorem of algebra.
- I. Apply the complex conjugate theorem.
- J. Apply the radical root theorem.
- K. Apply the sum and product of roots theorem.

III. Inequalities

Students will:

- A. Solve and graph linear inequalities in one variable.
- B. Solve and graph polynomial inequalities in one variable.
- C. Graph polynomial inequalities in two variables.
- D. Graph the solution set of a system of inequalities.

IV. Function Theory

Students will:

- A. Identify functions.
- B. Determine the domain, range, and zeros of functions.
- C. Graph functions.

- D. Perform operations on functions and determine the domains of the resulting functions.
- E. Reflect the graphs of functions and use symmetry to sketch the graphs of functions.
- F. Determine periodicity and amplitude from graphs of functions.
- G. Stretch and shrink graphs horizontally and vertically and translate graphs.
- H. Find the inverse of a function.
- I. Form functions of one variable from verbal descriptions.

V. Exponents and Logarithms

Students will:

- A. Use integral exponents to simplify expressions.
- B. Use rational exponents to simplify expressions.
- C. Define and apply exponential functions.
- D. Define and apply the number e .
- E. Define and apply logarithmic function.
- F. Prove and apply the laws of exponents.
- G. Solve exponential and logarithmic equations.

VI. Analytic Geometry

Students will:

- A. Prove geometric theorems using coordinate geometry.
- B. Determine the equations of circles and graph them.

- C. Find the intersection of circles and lines.
- D. Determine the equations of ellipses and graph them.
- E. Determine the equations of hyperbolas and graph them.
- F. Determine the equations of parabolas and graph them.
- G. Solve systems of second degree equations.

VII. Trigonometric Functions

Students will:

- A. Work with angle measure in degrees and radians.
- B. Determine coterminal angles.
- C. Find the arc length and area of a sector of a circle.
- D. Solve problems involving apparent size.
- E. Find the values of the sine and cosine from their definition.
- F. Solve simple trigonometric equations.
- G. Use reference angles to find values of the sine and cosine function.
- H. Graph the sine and cosine functions.
- I. Find values of the tangent, cotangent, cosecant, and secant functions.
- J. Graph the tangent, cotangent, cosecant, and secant functions.
- K. Define and find values of the inverse trig functions.

VIII. Trigonometric Equations

Students will:

- A. Solve simple trigonometric equations.
- B. Determine the equations of modified sine and cosine curves.
- C. Use trigonometric functions to model periodic behavior.
- D. Simplify trigonometric expressions using identities.
- E. Solve complicated trigonometric equations.

IX. Triangle Trigonometry

Students will:

- A. Use trigonometry to find the unknown sides or angles of a right triangle.
- B. Find the area of a triangle given two sides and the measure of the included angle.
- C. Use the law of sines to find unknown parts of a triangle.
- D. Use the law of cosines to find the unknown parts of a triangle.

X. Trigonometric Formulas

Students will:

- A. Apply formulas for $\cos(A \pm B)$ and $\sin(A \pm B)$.
- B. Rewrite a sum or difference as a product.
- C. Apply the formulas for $\tan(A \pm B)$.
- D. Apply the double and half-angle formulas.
- E. Use identities to solve trig equations.

XI. Polar Coordinates and Complex Numbers

Students will:

- A. Graph polar equations.
- B. Write complex numbers in polar form.
- C. Find products of complex numbers in polar form.
- D. Find powers of complex numbers in polar form.
- E. Find roots of complex numbers in polar form.

XII. Sequences and Series

Students will:

- A. Identify arithmetic or geometric sequences and find a formula for their n th term.
- B. Use recursive sequences to solve problems.
- C. Find the sum of the first n terms of an arithmetic or geometric sequence.
- D. Find or estimate the limit of an infinite sequence, or show it does not exist.
- E. Find the sum of an infinite geometric sequence.
- F. Represent series using sigma notation.
- G. Understand and apply the concept of mathematical induction.

XIII. Combinatorics

Students will:

- A. Use Venn diagrams to illustrate the intersection and union of sets.

- B. Use the inclusion-exclusion principle to solve counting problems involving the union and intersection of sets.
- C. Use the multiplication, addition, and complement principles to solve counting problems.
- D. Solve problems involving permutations and combinations.
- E. Solve counting problems that involve permutations with repetitions and circular permutations.
- F. Apply the binomial theorem and Pascal's triangle.

Evaluation Methods
Precalculus 400

1. Student participation in class.
2. Homework
3. Quizzes
4. Teacher and publisher made unit tests.
5. Teacher and publisher made cumulative tests.
6. Projects or papers.
7. Mid-year and final exams based on curriculum objectives.

Suggested Time Allotment Per Unit
Precalculus 400

Unit	Marking Period
I. Linear and Quadratic Functions	1
II. Polynomial Functions	1
III. Inequalities	1
IV. Function Theory	1
V. Exponents and Logarithms	2
VI. Analytic Geometry	2
VII. Trigonometric Functions	2
VIII. Trigonometric Equations	3
IX. Triangle Trigonometry	3
X. Trigonometric Formulas	3
XI. Polar Coordinates and Complex Numbers	4
XII. Sequences and Series	4
XIII. Combinatorics	4

Textbook
Advanced Mathematics
Precalculus with Discrete Mathematics and Data Analysis
Richard G. Brown, Houghton Mifflin Company, 1994

Mathematical Modeling Project
Precalculus
Performance Rubric

Score	Criteria
5	<ul style="list-style-type: none"> ✓ Novel or unique idea, ✓ Clear statement of hypothesis, ✓ Data set of 8 or more points w/ source cited or collection method clearly defined, ✓ Correctly calculated regression equation, and ✓ Insightful commentary and sound analysis of relationship with respect to regression equation and other factors.
4	<ul style="list-style-type: none"> ✓ Clear statement of hypothesis, ✓ Data set of 8 or more points w/ source cited or collection method clearly defined, ✓ Correctly calculated regression equation, and ✓ Insightful commentary and sound analysis of relationship with respect to regression equation and other factors.
3	<ul style="list-style-type: none"> ✓ Statement of hypothesis, ✓ Data set provided w/ source cited or collection method clearly defined, ✓ Correctly calculated regression equation, and ✓ Some commentary and analysis of relationship.
2	<ul style="list-style-type: none"> ✓ Data set w/ source cited or collection method clearly defined, ✓ Incorrectly calculated regression equation, and ✓ Some commentary and analysis of relationship.
1	<ul style="list-style-type: none"> ✓ Data source not cited or collection method not clearly defined, ✓ Incorrectly calculated regression equation, and ✓ Limited commentary and analysis of relationship.
0	<ul style="list-style-type: none"> ✓ Data source not cited or collection method not clearly defined, ✓ Incorrectly calculated regression equation, and ✓ No commentary or analysis of relationship.

Name: _____

Regression Task

You are to analyze the relationship between any two parameters. The data you use may be self-generated or researched. You may work individually or cooperatively in groups of two or three.

You are to submit, as a group, a word-processed report, which includes:

- ✓ a title,
- ✓ a clear statement of hypothesis being investigated (i.e.- “We are examining the effects A has on B.”),
- ✓ the data you collected (at least 8 data points),
- ✓ cite source of data (if self-generated, explain collection process),
- ✓ a mathematical model for the relationship (i.e.- an equation/formula),
- ✓ an analysis of the relationship, and
- ✓ any conclusions, predictions, or commentary.

Possible Topics

- Year vs. postage cost
- TV size vs. Cost
- Age vs. Capitals named in 30 seconds
- Distance vs. Toll
- Distance vs. Airfare
- Ulna length vs. Height
- Age vs. Hours of TV
- Latitude vs. temperature
- Record vs. Attendance (sports)
- Other: Be creative, yet appropriate

Piecewise Relations

Performance Task and Rubric

Your task is to create a “picture” or drawing on your calculator using equations of functions and defining their respective domains as needed. You will be assessed via the rubric below. Be creative!

Score	Criteria
3	<ul style="list-style-type: none">✓ Novel or unique idea.✓ Looks “real”; one can clearly discern what it is.✓ Highly intricate or sophisticated drawing consisting a varied domains.✓ At least 10 separate equations and two different function types (e.g. – linear, quadratic, square root, ...).
2	<ul style="list-style-type: none">✓ Looks “real”; one can clearly discern what it is.✓ Somewhat intricate or sophisticated drawing consisting of varied domains,✓ At least 10 separate equations.
1	<ul style="list-style-type: none">✓ Looks “somewhat real”; one can kind of discern what it is.✓ Somewhat intricate or sophisticated drawing.✓ At least 6 separate equations.
0	<ul style="list-style-type: none">✓ Basic or simplistic drawing.✓ Five or fewer equations.