

# *Belmont High School*

*Michael M. Harvey*  
*Principal*



*Daniel E. Richards*  
*Layne W. Millington*  
*Assistant Principals*

*221 Concord Avenue*  
*Belmont, Massachusetts 02478-3047*  
*(617) 993-5900*  
*FAX (617) 993-5909*

## **Mathematics Department Courses**

- Advanced Algebra and Trigonometry
- Advanced Placement Calculus AB
- Advanced Placement Calculus BC
- Algebra 1
- Algebra 2 - 412
- Algebra 2 - 414
- Algebra 2 Honors
- Calculus
- Financial and Business Applications of Mathematics
- Geometry - 410
- Geometry Honors
- Mathematics Skills Development - 475
- Mathematics Skills Development - 476
- Pre-Calculus - 426
- Pre-Calculus Honors
- Topics in Mathematics

*\* Learn      \* Think      \* Create      \* Serve*

## Belmont High School Course Outline

**Course Title:** Advanced Algebra and Trigonometry

**Course Number:** 421

**Credits:** 5

**Course Type:** Year

**Department:** Mathematics

### **Course Description:**

This course covers many of the same topics as Pre-Calculus - 426, but proceeds at a more deliberate pace. Students receive more one-on-one instruction and teachers adapt materials and assessment. Students taking this course should have successfully completed Algebra 2. This course extends the topics covered in Algebra 2 with a strong focus on graphing and interpreting graphs and is designed to deepen understanding of linear, polynomial, and rational functions, trigonometry, exponential and logarithmic functions, and other non-linear functions. Graphing calculators are required.

### **Resources:**

There is no official textbook. The course is taught using materials developed by teachers over the last 5 years.

### **Topics:**

Semester 1: Linear Functions, Systems of Equations and Inequalities, Families of Functions, Polynomial and Rational Functions, Exponential and Logarithmic Functions.  
Semester 2: Right Triangle Trigonometry, Law of Cosines and Law of Sines, Angle Measurement, Introduction to Trigonometric Identities and Equations

### **Assessments:**

There are frequent quizzes and unit tests as well as final exam. Homework is graded regularly. (CT,CS)

Students will be able to recognize and use formulas successfully. (CT)

Students will be able to support their understanding through use of the graphing calculator. (CS)

Students will be able to communicate the material effectively verbally and on paper. (CS)

Students will be able to collaborate with classmates to enhance understanding. (CS, CT)

Students will demonstrate ability to solve more complex problems. (CT)

*Learn \* Think \* Create \* Serve*

# Belmont High School

## Course Outline

**Course Title:** Advanced Placement Calculus AB

**Course Number:** 432

**Credits:** 5

**Course Type:** Year

**Department:** Mathematics

### Course Description:

Students should have a strong background in Honors Pre-Calculus entering this course. Calculus AB is the equivalent of a college-level course in calculus. Topics include derivatives of algebraic functions and applications of differential calculus, integration and applications of the definite integral, methods of integration, and slope fields. Graphing calculators are used throughout this course. This course culminates in students taking the AP exam.

### Resources:

**Primary Textbook:** Calculus Concepts and Contexts, James Stewart, 1998

### Topics:

**Review:** Review of functions, graphing, exponentials, logarithms, composition of functions, inverses, domain, range, and use of the graphing calculator.

**Limits:** Tangent lines, Velocity, Limit of a function, One-Sided Limits, Calculation of Limits (Using Algebra and Tables on the graphing calculator), The Squeeze Theorem, Definition of Continuity, Intermediate Value Theorem, Limits Involving Infinity

**The Derivative:** Definition of the Derivative, The Derivative as a Rate of Change, The Derivative as a Function, Differentiability of a Function (Differentiability implies Continuity), The Second Derivative, The Third Derivative, Linear Approximation, What does the derivative tell us about the function?, Graphing functions from the derivatives, Graphing derivative of functions

**Differentiation Rules:** Derivatives of Polynomials and Exponential Function, The Power Rule, The Product Rule and Quotient Rule, Applications to Physics (distance, velocity, acceleration, Limits involving Trigonometric Functions, Derivatives of the Trigonometric Functions, The Chain Rule, Implicit Differentiation, Derivatives of Inverse Functions, Derivatives of the Inverse Trigonometric Functions, Derivative of Logarithmic Functions, Logarithmic Differentiation

**Application of the Derivatives:** Related Rates Problems, Maximum and Minimum Values, Critical Points, Increasing/Decreasing Functions (Review), Local and Absolute Extrema, The Extreme Value Theorem, Fermat's Theorem, Derivatives and the Shapes of Curves, Mean Value Theorem, Increasing and Decreasing Test, First Derivative Test, Concavity Test, Second Derivative Test, Optimization Problems

**Integrals:** Approximating Area under a Curve using Rectangles, The Distance problem, The Definite Integral, Riemann Sums, Evaluating Riemann sums, Midpoint Rule, Properties of the Definite Integral, Evaluating Definite Integral, Evaluation Theorem, Total Change Theorem (Total Distance versus Displacement), Indefinite Integrals, The Fundamental Theorem of Calculus, The Definite Integral as an Area Accumulator Function, Methods of Integration, Guess and Check, Substitution, Approximate Integration, Midpoint, Trapezoidal Rule

**Applications of Integration:** Area between curves, Volumes of Revolution, Volumes by Disks, Volumes by Cylinders, Volumes with Known Cross Sections, Average Value of a Function

**Differential Equations:** Slope Fields, Modeling with Differential Equations, Separable Differential Equations, Applications of the Differential Equations, Newton's Law of Cooling, Exponential Growth and Decay, Population Growth

**(After the AP Exam):** L'Hospital's Rule, Integration by Parts, Integration by Partial Fractions

### Assessments:

Weekly mini-quizzes are given to check student progress. (CT) Each quarter take-home problem sets are assigned. (CS,CT) Students are encouraged to work with each other to develop solutions to these free-response type questions. (CS) These activities help students to learn to communicate mathematical ideas and to verify and explain solutions. Both written and oral communication is major a goal of this course. Individual students are regularly assigned problems to present to the class. (CS,CT,RS) These activities allow me to track individual achievement and allow students to practice their verbal and written communication of mathematical ideas. Unit tests are given at the end of each chapter.(CS,CT,) They consist of multiple choice questions as well as a set of free-response questions. (The

use of a calculator is restricted on certain problems.)

*Learn \* Think \* Create \* Serve*

# Belmont High School

## Course Outline

**Course Title:** Advanced Placement Calculus BC

**Course Number:** 434

**Credits:** 5

**Course Type:** Year

**Department:** Mathematics

### Course Description:

Students should have a strong background in Honors Pre-Calculus entering this course. BC Calculus is the equivalent of a fast-paced college course in calculus. Topics include parametric equations, vector theory, sequences and series, polar derivatives, derivatives of algebraic functions and applications of differential calculus, integration and applications of the definite integral, transcendental functions, methods of integration, infinite series, and Euler's method. Graphing calculators are used throughout this course. This course culminates in students taking the AP exam, which requires the use of a graphing calculator.

### Resources:

**Textbook:** Primary Text: Stewart, James, Calculus-Concepts and Contexts  
(full edition), Brooks/Cole Publishing 1998

### Topics:

**INTRODUCTORY UNIT FUNCTIONS AND MODELS ( Review from Honors Pre-Calculus):**

Review: Review of Functions, graphing, exponentials, logarithms, composition, inverses, domain, range, use of graphing calculator (CT)

**LIMITS:** Tangent lines, velocity, limit of a function, one-sided limits, calculation of limits, The Squeeze Theorem, Definition of Continuity, Intermediate Value Theorem, Infinite Limits, Limits at Infinity.(CT)

**THE DERIVATIVE:** Definition of the Derivative, the Derivative as a rate of change, the Derivative as a function, differentiability, differentiability implies continuity, higher order derivatives, linear approximation and the differential, what do the first and the second derivative tell us about the function? Increasing/decreasing functions, concavity, inflection points. Graphing functions and their derivatives. Graphing a function from its derivative.(CT)

**DIFFERENTIATION RULES:** Derivatives of polynomial and exponential functions, the Power Rule, The Product and Quotient Rules, applications to Physics (distance, velocity, acceleration), limits involving trigonometric functions, derivatives of trigonometric functions, The Chain Rule, implicit differentiation, derivatives of parametric functions including the second derivative, derivatives of composite functions, derivatives of inverse functions.(CT)

**APPLICATIONS OF THE DERIVATIVE:** Related Rate Problems, Maximum and Minimum Values, critical points, increasing/decreasing functions (review), local and absolute extrema, The Extreme Value Theorem, Fermat's Theorem, derivatives and the shapes of curves, The Mean Value Theorem, increasing and decreasing test, the first derivative test, concavity test, The Second Derivative Test, optimization problems, indeterminate forms and L'Hospital's Rule. Newton's Method for finding roots of an equation.(CT, RS, CS)

**INTEGRALS:** Approximating area under a curve using rectangles, the distance problem. The Definite Integral, Riemann Sums, evaluating Riemann Sums, Midpoint Rule, properties of the definite integral, evaluating the definite integral, Evaluation Theorem, Total Change Theorem (total distance versus displacement), Indefinite Integrals, The Fundamental Theorem of Calculus, the definite integral as area accumulator function, methods of integration (including guess and check, and substitution), integration by parts, partial fractions, approximate integration, The Midpoint and The Trapezoidal Rule, Improper Integrals.  
(CT)

**APPLICATIONS OF INTEGRATION:** Area between curves, volumes of fixed cross sections, volumes of revolution, volumes by washer, disks, average value of a function, arc length (three forms)(CT, RS, CS)

**DIFFERENTIAL EQUATIONS:** slope fields, modeling with differential equations, separable differential equations, Euler's method for solving a differential equations with slope fields, orthogonal trajectories, the logistic equation, applications of differential equations including Newton's Law of Cooling, Exponential Growth and Decay, Population Growth (logistic and exponential)(CT, RS, CS, CS)

**POLAR CURVES:** Review of polar coordinates with graphing, area enclosed by a polar curve, intersection of two polar curves, area between two polar curves (CT)

**VECTORS:** definition of a vector and a scalar (review), operations on vectors (adding and multiplying), dot and cross product, absolute value of a vector, derivatives of a vector (displacement, velocity, and acceleration), relation of vectors to parametric curves.(CT, RS)

**INFINITE SERIES:** Infinite sequences, a series as a limit of a Partial Sum, infinite series both convergent and divergent (definition and examples) including telescoping series, geometric series, and the Harmonic Series, The Test for Divergence, The Integral and Comparison Tests, Alternating Series Test. Alternating Series Estimation Theorem, Absolute Convergence, The Ratio Test(CT)

**POWER SERIES:** definition of Power Series Centered at "a", tests for convergence of a power series, radius and interval of convergence, representation of

functions as power series, differentiation and integration of power series (term by term), Taylor Series, Maclaurin Series, Power Series for functions  $\sin x$ ,  $\cos x$ , the exponential function, and  $a/(1-x)$ , nth degree Taylor Polynomial of a function at "a", Taylor's Inequality, formal manipulation of a Power Series multiplication and division of a power series, Lagrange Error Bounds(CT)

### **Assessments:**

Students will be assessed on their ability to communicate their reasoned solutions to Calculus problems using the following four techniques:

- a. analytical
- b. graphical
- c. numerical
- d. verbal

There are weekly mini quizzes(CT) , take home problem(CS, CT) sets, group work (CS, CT, RS, CZ) and tests (CT), verbal peer explanations(CS, CT, RS) and unit tests (CT, CS) at the end of each chapter. The latter consist of both multiple choice and free response questions, both with and without a calculator, to mimic the AP exam that they will take. The course is informal and meant to be both rigorous and an adventure for students.

*Learn \* Think \* Create \* Serve*

## Belmont High School Course Outline

**Course Title:** Algebra 1

**Course Number:** 402

**Credits:** 5

**Course Type:** Year

**Department:** Mathematics

### Course Description:

Students learn algebraic skills in the area of basic operations with polynomials, factoring of polynomials, and operations with algebraic fractions and irrational numbers. The study of word problems and other applications aids students in developing good problem solving techniques. The study of data sets may include linear regression and measures of central tendency. Other topics studied include inequalities, exponents and graphs of linear equations.

Successful completion of this course should prepare the student for Geometry – 410

### Resources:

Algebra: Concepts and Applications, Glencoe-McGraw Hill publishing, 2001

### Topics:

The Language of Algebra  
Integer Operations  
Solving Linear Algebraic Equations and Linear Inequalities  
Algebraic Applications of Ratios, Proportions and Percentages  
Relations, Functions and Variations  
Writing and Graphing Linear Functions  
Rules of Exponents, Square Roots  
Classifying Polynomials, Operations involving Polynomials  
Factoring: Greatest Common Factor, Quadratic Trinomial and Difference of Squares Factoring  
Solving Quadratic Equations using Factoring and Quadratic Formula.  
Solving Systems of Linear Equations

### Assessments:

The students will be assessed based on their ability to demonstrate competency of the following math standards .(CS)  
Students will identify and use the properties of operations on real numbers.(CT)  
Students will identify and use the existence of the identity and inverse elements for addition and multiplication. (CT)  
Students will solve equations and inequalities of linear expressions.(CT)  
Students will simplify numerical expressions including those involving positive integers, exponents, absolute values or square roots. (CT)  
Students will use estimation to judge the reasonableness of results of computation. Students will demonstrate an understanding of relations and functions. (CT) Students will be able to translate between different representations of functions and relations: graphs, equations, point sets, and tables.(CT)  
Students will determine a line's slope  $x$  and  $y$  intercept's from its graph and from its equation. (CT)  
Students will find the linear equation to describe a graph or a geometric description using slope  $y$  intercept formulas.(CT)  
Students will add, subtract, multiply and classify polynomials.  
Students will demonstrate facility in symbolic manipulation by rearranging and collecting terms, identifying and canceling common factors and applying properties of integer exponents. (CT)  
Students will solve quadratic equations using factoring and quadratic formula(CT)

Students will solve everyday problems that can be modeled using linear functions. (CT)  
Applying appropriate tabular, graphical, or symbolic methods to the solution.(CT)  
Students will apply algebraic and graphical methods to solve systems of linear equations.(CT)  
Students will solve everyday problems that can be modeled using systems of linear equations.  
(CT)

*Learn \* Think \* Create \* Serve*



## Belmont High School Course Outline

**Course Title:** Algebra 2

**Course Number:** 412

**Credits:** 5

**Course Type:** Year

**Department:** Mathematics

### Course Description:

This course covers many of the same topics as Algebra 2 - 414, but proceeds at a more deliberate pace. Students receive more one-on-one instruction and teachers adapt materials and assessment. Students electing this course should have successfully completed Algebra 1 and Geometry. A major goal of Algebra 2 is problem solving. Some of the topics included are: rational expressions, radicals, exponents, quadratic equations, complex numbers, linear systems, functions and graphing. Scientific calculators will be used.

### Resources:

Intermediate Algebra with Applications  
6th Edition by Richard N. Aufmann, Vernon C. Barker, and Joanne S. Lockwood

### Topics:

1. Review of Real Numbers
2. First-Degree Equations & Inequalities
3. Linear Functions & Inequalities in Two Variables
4. Systems of Equations and Inequalities
5. Polynomials & Exponents
6. Rational Expressions
7. Rational Exponents and Radicals
8. Quadratic Equations and Inequalities

### Assessments:

Students will be assessed on their ability to:

1. Demonstrate a variety of equation solving techniques(CT)
2. Create and analyze graphs of linear and quadratic functions(CT)
3. Communicate algebra concepts both in writing and orally (CS)
4. Communicate mathematical ideas and verify and explain solutions using proper vocabulary and notation (CS)
5. Recognize the roles of algebra in real life applications(CT)
6. Solve problems using mathematical formula(CT)
7. Ability to apply previously learned concepts to new applications(CT)

*Learn \* Think \* Create \* Serve*

## Belmont High School Course Outline

**Course Title:** Algebra 2

**Course Number:** 414

**Credits:** 5

**Course Type:** Year

**Department:** Mathematics

### Course Description:

Students who elect this course should have a strong background in Algebra 1 and Geometry. This second year algebra course emphasizes the solution of equations and applications to problem situations. The course is comprehensive through quadratics and may include such topics as exponential and logarithmic functions, and the analytic geometry of conic sections. Graphing calculators may be used, but are not required.

Successful completion of this course should prepare the student for Pre-Calculus - 426.

### Resources:

Algebra 2 (Glencoe/McGraw-Hill)  
Scientific Calculator

### Topics:

Solving Equations and Inequalities  
Linear Relations and Functions  
Systems of Equations and Inequalities  
Polynomials  
Radical Equations  
Quadratic Equations and Functions  
Conic Sections  
Rational Expressions and Equations  
Exponential and Logarithmic Equations

### Assessments:

Students will be able to:

Define complex numbers and operations on them. (CT,CS)

Relate the system of complex numbers to the systems of real and rational numbers. (CT,CS)

Simplify numerical expressions with powers and roots, including fractional and negative exponents. (CT)

Demonstrate an understanding of the exponential and logarithmic functions. (CT,CS)

Perform operations on functions, including composition. (CT)

Find inverses of functions. (CT)

Solve quadratic equations and apply to the solutions of problems. (CT)

Solve a variety of equations and inequalities using algebraic, graphical, and numerical methods, including the quadratic formula. (CT)

Solve polynomial, exponential, rational and logarithmic functions. (CT)

Solve systems of equations and/or inequalities. (CT)

Solve everyday problems that can be modeled using polynomial, rational, exponential, logarithmic, absolute values and square roots. (CT)

Solve problems including growth and decay and variation. (CT)

Identify maximum and minimum values of functions in simple situations. (CT,CS)

Describe the translations and scale changes of quadratic functions.(CT, CS)

Relate geometric and algebraic representations of lines, simple curves, and conic sections. (CT, CS)

*Learn \* Think \* Create \* Serve*

## Belmont High School Course Outline

**Course Title:** Algebra 2 Honors

**Course Number:** 416

**Credits:** 5

**Course Type:** Year

**Department:** Mathematics

### Course Description:

This course stresses both the structure and computations necessary to solve problems in algebra and trigonometry. The course involves an intensive study of equations, inequalities, functions, polynomials, conic sections, logarithms, exponents, and linear programming. The pace of the course is demanding and students electing this course should have a strong background in algebra and geometry. While graphing calculators will be used occasionally, maintenance of numeric skills is stressed.

Successful completion of this course should prepare the student for Pre-Calculus Honors – 428.

### Resources:

Textbook: Algebra and Trigonometry, Structure and Method Book 2 (Brown, Dolciani, et. al)  
Scientific Calculator

### Topics:

Students will be introduced to a variety of functions, including linear, quadratic, exponential and logarithmic. They will learn to manipulate and solve equations using these functions. Accuracy and orderly procedures will be stressed.

Outline: Students will demonstrate knowledge, ability, and manipulation in the following topics.

1. Basic Concepts of Algebra-order of operations, word problems, using field properties, algebraic proof, literal equations
2. Solving Inequalities - in one variable, word problems involving inequalities, absolute value inequalities
3. Linear Equations and Functions - solving and graphing linear equations in 2 variables, slope of a line, solving systems of linear equations in 2 variables, problem solving using system of equations, graphing linear inequalities, graphing systems of linear inequalities, functions and relations (their graphs, values and equations)
4. Products and Factors of Polynomials - simplifying, adding, subtracting, laws of exponents, multiplying polynomials, finding GCF's and LCM's, factoring, solving polynomial equations and inequalities
5. Rational Expressions - extending the laws of exponents to quotients, simplifying, multiplying, dividing, adding and subtracting rational expressions, simplifying complex fractions, solving fractional equations and inequalities
6. Irrational and Complex Numbers - finding roots of real numbers, simplifying radicals, simplifying sums, products and quotients of binomials containing radicals, solving equations containing radicals, decimal representation of real numbers, introducing the imaginary unit  $i$  and complex numbers; adding, subtracting, multiplying and dividing complex numbers
7. Quadratic Equations and Functions - solving quadratics by completing the square and the quadratic formula, determining the nature of the roots, solving equations in quadratic form, graphing quadratic functions using both the vertex and quadratic forms, writing a quadratic equation from given information about the roots
8. Variation - direct, indirect and joint variation
9. Analytic Geometry and Conic Sections - distance and midpoint formulas, circles, parabolas (focus-directrix form), ellipses, hyperbolas, identifying conics, shifting conics from center at the origin, intersecting conics, estimating, graphing and finding solutions

of these systems

10. Exponential and Logarithmic Functions - extending the laws of exponents to include rational numbers, relation between logarithmic functions and exponentials, laws of logarithms, defining common and natural logarithms, solving growth and decay problems with exponential and logarithmic functions, solving equations involving exponents and logarithms (\*\*graphing calculators may be used in some demonstrations, although graphing calculators are not required for students)
11. Triangle Trigonometry - using degrees for angle measure, defining trigonometric functions of acute and general angles, using calculators and tables to find values of trig functions, finding the sides and angles of a right triangle
12. \*\* If time permits - - Laws of Sines and Cosines, solving any given triangle, using area formulas to find area of triangles

**Assessments:**

Students will be assessed on their ability to:

- a. use a variety of techniques to simplify expressions and solve equations (CT)
- b. create and analyze graphs of linear and quadratic, exponential, and logarithmic functions (CT, CS)
- c. communicate algebraic concepts both in written and oral form(CT, CS)
- d. communicate mathematical ideas and verify and explain solutions using proper vocabulary and notation (CT,CS)
- e. recognize the roles of algebra in real life problems and applications (RS, CT, CZ)
- f. solve problems using mathematical formulas(CT)
- g. apply previously learned concepts to new applications (CT)

*Learn \* Think \* Create \* Serve*

## Belmont High School Course Outline

**Course Title:** Calculus

**Course Number:** 430

**Credits:** 5

**Course Type:** Year

**Department:** Mathematics

### Course Description:

This course introduces the student to Calculus and Analytic Geometry, stressing an intuitive approach as well as problem solving techniques. A small number of theoretical proofs are demonstrated only to familiarize the student with notations that will be used later in college. Major topics include limits, derivatives and integrals of algebraic and trigonometric functions, and applications. Emphasis is placed on being able to solve problems with and without a graphing calculator. Students may choose to take the Calculus AB exam with additional study and review. Students are required to complete a summer packet prior to the beginning of this course.

### Resources:

The textbook is Calculus: Graphical, Numerical Algebraic by Finney, Demana, Waits, Kennedy. We also use a TI-83 or TI-84 calculator in class daily.

### Topics:

Applying the concept of limit, we study the two major ideas of Calculus, the derivative and the integral. We approach these in three different ways: intuitively/graphically, through Algebra, and using the graphing calculator. We also explore the most significant applications of these techniques to business, science and other areas of Mathematics. Some of the major ideas studied are: limits, continuous and discontinuous functions, the intermediate value theorem, average rates of change and instantaneous rates of change, related rates, logarithmic differentiation, curve sketching and analysis, the mean value theorem, area under a curve, the average value theorem, techniques of integration and volumes of rotation.

### Assessments:

Students will be asked to:

- 1) Explain the graph of a function, mentioning maximum, minimum, asymptotes, points of discontinuity, intervals of increase/decrease and concavity, domain and range. (CT, CS)
- 2) Apply derivatives to rate of change problems, both practical and theoretical. (CT)
- 3) Apply differentiation to maximum and minimum verbal problems. (CT, CS)
- 4) Understand both the functional and geometric relationship between the derivative and the integral. (CT)
- 5) Find limits, derivatives and integrals from graphs, using algebra, and using the graphing calculator. (CT)
- 6) Apply integration to area and volume of rotation problems. (CT)
- 7) Demonstrate preparedness for college calculus courses. (CZ, RS)

*Learn \* Think \* Create \* Serve*

## Belmont High School Course Outline

**Course Title:** Financial and Business Applications of Mathematics

**Course Number:** 422

**Credits:** 5

**Course Type:** Year

**Department:** Mathematics

### Course Description:

This course is designed for students interested in managing personal finances. Included is a mix of financial background and theory, as well as mathematical applications. Topics include career choices, personal banking, credit, investing, taxes, and topics of special interest. Students will be expected to complete a number of projects and will become proficient in a variety of technology applications including Microsoft Word, Excel and Power Point. Students should have successfully completed Algebra 2.

### Resources:

Mathematics of Money with Algebra (Clayton) Southwestern Publishing  
TI 83 or 84 Graphing Calculator

### Topics:

Careers  
Checking Accounts  
Savings Accounts  
Small Business  
Loans and Amortization  
Credit Cards  
Stocks, bonds and mutual funds  
Income Taxes

### Assessments:

Students will be able to:  
Compare and contrast careers including payment options, benefits and deductions, and decision making based on break-even analysis. (RS, CS)  
Analyze checking account options and their costs. (CT, CS)  
Fill out checks, deposit tickets, make endorsements, complete checkbook register and reconciliation. (CS)  
Understand the Federal Reserve System and its purpose. (CS, RS)  
Understand and compute compound interest and calculate the result of long-term savings. (CT)  
Analyze, interpret and develop cost, revenue and profit functions for a small business. (RS, CT)  
Calculate break-even points for small business units. (CT)  
Understand the cost of borrowing money, credit overload, and importance of credit rating. (CT, RS)  
Compute an amortization schedule for a loan and understand the effect of changing the terms of the loan. (CT)  
Understand the personal responsibility of owning a credit card and the effects of different APRs, late fees, over limit fees, etc. (RS, CT)  
Calculate average daily balance on a credit card. (CT)  
Understand the difference between types of investments as they relate to liquidity, risk and reward. (CT, CS)  
Understand the volatility of stock market prices and make predictions for prices and inflation. (CT, RS)  
Fill out a personal income tax form. (CT, CS)

*Learn \* Think \* Create \* Serve*

## Belmont High School Course Outline

**Course Title:** Geometry

**Course Number:** 410

**Credits:** 5

**Course Type:** Year

**Department:** Mathematics

### Course Description:

Students who elect Geometry - 410 will benefit from a strong background in Algebra 1. The course blends a contemporary treatment of plane geometry with some exposure to solid geometry. A primary aim of this course will be the development of logical inquiry through proofs. Students will focus on the study of triangles, parallel lines, quadrilaterals, circles and solids. Areas of plane figures and surface areas and volumes of solids are included. Transformations, tessellations and symmetry will be investigated. Right triangle trigonometry will be studied along with applications.

Successful completion of this course should prepare the student for Algebra 2 - 414.

### Resources:

Geometry for Enjoyment and Challenge (McDougall/Littell)  
Scientific Calculator

### Topics:

Measurement of Segments and Angles  
Two-Column Proofs  
Congruent Triangles  
Parallel/Perpendicular Lines  
Relation of Lines and Planes  
Polygons  
Similarity  
Right Triangles  
Circles  
Area and Volume

### Assessments:

Students will be able to:

Use deduction to establish the validity of geometric conjectures and to prove theorems in Euclidean geometry. (CT and CS)

Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships. (CT)

Use visualization, spatial reasoning, and geometric modeling to solve problems. (CT)

Identify figures using properties of sides, angles, and diagonals. (CT and CS)

Recognize and solve problems involving angles formed by transversals of coplanar lines. (CT)

Identify and determine the measure of central and inscribed angles and their associated minor and major arcs. (CT)

Recognize and solve problems associated with radii, chords, and arcs. (CT)

Apply congruence and similarity correspondences (e.g.,  $\triangle ABC \cong \triangle XYZ$ ) and properties of the figures to find missing parts of geometric figures, and provide logical justification. (CT and CS)

Solve simple triangle problems using the triangle angle sum property and/or the Pythagorean theorem. (CT)

Use the properties of special triangles (e.g., isosceles, equilateral,  $30^\circ$ - $60^\circ$ - $90^\circ$ ,  $45^\circ$ - $45^\circ$ - $90^\circ$ ) to solve problems. (CT)

Draw the results, and interpret transformations on figures in the coordinate plane. (CT and CS)

Apply properties of chords, tangents, and secants to solve problems.(CT)

Find area and volume of two- and three-dimensional figures.(CT)



*Learn \* Think \* Create \* Serve*

## Belmont High School Course Outline

**Course Title:** Geometry Honors

**Course Number:** 406

**Credits:** 5

**Course Type:** Year

**Department:** Mathematics

### Course Description:

A comprehensive modern course in Geometry is the study of a logical system of ideas that enables us to perceive and derive new ones. This course requires a strong background in algebra since algebraic concepts are integrated throughout the course. Major subject areas include lines, angles, polygons, trigonometry, planes, congruence, similarity, circles, areas, volumes, constructions, probability, coordinate proofs and applications. A primary aim of the course will be the development of logical inquiry through geometric proofs. Proofs will focus on triangles, parallel lines, transformations, and symmetry. Applications of geometry to art, architecture, and science are also included in this course.

Successful completion of this course should prepare the student for Algebra 2 Honors – 416.

### Resources:

The textbook is Geometry for Enjoyment and Challenge by Rhoad, Milauskas and Whipple. We also use scientific (not graphing) calculators for square roots and sine, cosine and tangent functions.

### Topics:

This is an honors plane geometry course with a heavy emphasis on problem solving and proof. Students are presented with the lexicon of geometry, introductory logic and set theory. Topics of algebra and probability are reviewed and are integrated into problem-solving methods whenever possible.

The main themes of the course are: congruence, similarity, right-triangle relationships, area and volume, properties of polygons with an emphasis on quadrilaterals, and circles.

### Assessments:

Students completing the course are able to:

- 1) Interpret and create diagrams. CT,CS
- 2) Express geometric ideas with correct notation. CS
- 3) Understand the structure and development of geometry as an example of the structure and development of mathematics in general. CT
- 4) Write logical arguments and proofs including two-column, paragraph, algebraic, coordinate and indirect proofs and proving a statement false using a counterexample. CT,CS
- 5) Use algebra to solve problems originating in geometric situations, including: area, volume, slope, midpoint, distance, proportions, Pythagorean equations, and trigonometry. CT,CS
- 6) Students understand the application of probability to the infinite sets of points of geometry. CT
- 7) Students are prepared for Algebra 2 and have particularly reviewed quadratic equations, systems of linear equations, radicals and proportions. CT
- 8) Present a cogent, well-organized solution to a problem which might include diagrams, graphs, logic, set theory, algebra, probability, trigonometry, proof and be able to explain the solution to their peers. CT,CS,CZ

9) Complete projects which will require some/all of the following: organization of information, research, writing, building models, geometric constructions, etc. CT, CS, CZ, RS

Assessment strategies include quizzes, tests, homework, mid-year and final exams, projects, discussions and presentations. CT,CS,RS

*Learn \* Think \* Create \* Serve*

## Belmont High School Course Outline

**Course Title:** Mathematics Skills Development

**Course Number:** 475

**Credits:** 2

**Course Type:** Year

**Department:** Mathematics

### **Course Description:**

Sophomores who scored 238 or lower on the Grade 8 MCAS Mathematics will register in this course. Juniors and seniors who scored below 240 on the Grade 10 MCAS Mathematics test, and must retake and pass this test to be eligible for graduation, will also be expected to take this course. It will focus on all of the strands in the mathematics curriculum of the Belmont Public Schools. All instruction will be based on diagnostic assessment of students' needs. Topic sequence and emphasis will be consistent with the Massachusetts Frameworks and the mathematics curriculum of the Belmont Public Schools. Students may take this course more than once for credit.

### **Resources:**

Massachusetts Department of Education database of previous MCAS exams  
MCAS Test preparation workbooks  
individual student test results from previous MCAS exams

### **Topics:**

Number Sense  
Data Analysis and Probability  
Measurement  
Geometry  
Patterns, Relations and Algebra

### **Assessments:**

Students will:

1. gain increased understanding of test taking strategies(CT,CS)
2. understand the complex vocabulary and proper notation used in the MCAS exam(CT,CS)
3. improve skills in the 5 strands of the Massachusetts curriculum frameworks(CT,CS)
4. build confidence in their mathematical skills and abilities(CT,CS)

*Learn \* Think \* Create \* Serve*

## Belmont High School Course Outline

**Course Title:** Mathematics Skills Development

**Course Number:** 476

**Credits:** 2

**Course Type:** Year

**Department:** Mathematics

### **Course Description:**

Freshmen scored 238 or lower on the Grade 8 MCAS Mathematics will register in this course. This course will focus on all of the strands in the mathematics curriculum of the Belmont Public Schools. All instruction will be based on diagnostic assessment of students' needs. Topic sequence and emphasis will be consistent with the Massachusetts Frameworks and the mathematics curriculum of the Belmont Public Schools.

### **Resources:**

Massachusetts Department of Education database of previous MCAS exams  
MCAS Test preparation workbooks  
individual student test results from previous MCAS exams

### **Topics:**

Number Sense  
Data Analysis and Probability  
Measurement  
Geometry  
Patterns, Relations and Algebra

### **Assessments:**

Students will:

1. gain increased understanding of test taking strategies(CT)
2. understand the complex vocabulary and proper notation used in the MCAS exam(CT,CS)
3. improve skills in the 5 strands of the Massachusetts curriculum frameworks(CT,CS)
4. build confidence in their mathematical skills and abilities(CT,CS)

*Learn \* Think \* Create \* Serve*

## Belmont High School Course Outline

**Course Title:** Pre-Calculus

**Course Number:** 426

**Credits:** 5

**Course Type:** Year

**Department:** Mathematics

### Course Description:

Students choosing this course should enjoy mathematical challenges and have a solid background in Algebra 2 and Geometry. Pre-Calculus presents and develops the topics usually included in an introductory analysis course. It includes a study of linear and quadratic equations and continues with an intensive study of polynomials, inequalities, functions, exponents, logarithms, conic sections, and trigonometry. Students are required to complete a summer packet prior to the beginning of this course.

### Resources:

Text: Advanced Mathematics, PreCalculus with Discrete Math and Data Analysis. By Richard Brown. Students are required to use a graphic calculator like the TI-83+, or TI-84.

### Topics:

- + Linear and quadratic functions are reviewed as the year begins.
- + Analysis of higher degree polynomials consists of finding roots, minima and maxima & graphing.
- + Inequalities of Absolute value and polynomial functions, culminating in Linear programming.
- + Unit on functions covers: characteristics, operations, symmetry & transformations
- + Exponents and logarithms, applications and natural logs
- + Conic sections: circles, ellipses & hyperbolas, including systems
- + Trigonometry: review of pertinent geometry, all six trig functions and their inverses, graphing
- + Triangle trigonometry, area formulas and Sine Law and Cosine Law

### Assessments:

- + Students will be able to completely analyze polynomial functions. (CT, CS)
- + Students will successfully create and solve linear systems with multiple constraints. (CT, CS)
- + When analyzing functions, students will predict their behavior during transformations. (CT, CS)
- + Students will understand the inverse relationship between exponents and logs and successfully apply them to growth and decay problems (CT, CS)
- + Students of trigonometry will be able to clearly distinguish between the different functions, their inverses and their reciprocals. They will be able to solve triangles of all kinds including real-world applications. (CT, CS)
- + Quizzes, tests and final exams as well as home work and class work contribute to the students' grades. (CT, CS)

*Learn \* Think \* Create \* Serve*

## Belmont High School Course Outline

**Course Title:** Pre-Calculus Honors

**Course Number:** 428

**Credits:** 5

**Course Type:** Year

**Department:** Mathematics

### Course Description:

This course requires a very strong background in Algebra 2 and Geometry. This course covers the properties of polynomial, logarithmic, exponential and trigonometric functions. An extensive introduction to calculus is included through the study of limit theory, curve sketching, sequences and series, trigonometry and vectors. Graphing calculators will be used extensively and are necessary, but maintenance of numeracy skills is essential.

Successful completion of this course should prepare the student for a course in AP Calculus.

### Resources:

Textbook: Contemporary Precalculus; A Graphing Approach by Thomas W. Hungerford

### Topics:

Review and Technology Preview  
Functions and Graphs  
Linear and Quadratic Equations  
Polynomial and Rational Functions  
Exponential and Logarithmic Functions  
Trigonometric Functions  
Triangle Trigonometry  
Trigonometric Identities and Equations  
Applications of Trigonometry  
Analytic Geometry  
Systems of Equations  
Discrete Algebra  
Limits and Continuity

### Assessments:

Students will be assessed on their ability to:

1. Formulate and analyze graphs and functions (CT)
2. Communicate precalculus concepts both in writing and orally (CS)
3. Communicate mathematical ideas and verify and explain solutions using proper vocabulary and notation (CS)
4. Recognize the roles of mathematics and functions in real life applications (CT)
5. Solve problems using mathematical formula (CT)
6. Ability to apply previously learned concepts to new applications (CT)

*Learn \* Think \* Create \* Serve*

## Belmont High School Course Outline

**Course Title:** Topics in Mathematics

**Course Number:** 418

**Credits:** 5

**Course Type:** Year

**Department:** Mathematics

### **Course Description:**

This course is designed to appeal to a wide variety of students who prefer to study mathematics applied to Humanities and Social Sciences. Technological applications of the graphing calculator, computer, and Internet (as time allows) are emphasized. Project-based assignments are used in assessment as well as tests. Topics in this curriculum include probability, statistics, surveys, matrices, HTML and web page design, Internet search skills, and coding. Game theory, graph/network theory, and spreadsheets may be included at the discretion of the teacher. Mathematics skills will be reinforced throughout the course. Students beginning this course should have successfully completed Algebra 2. The graphing calculator is used extensively in this course.

### **Resources:**

Materials are supplied by instructors in the form of unit packets.

TI-83 or 84 Graphing Calculator needed daily.

### **Topics:**

Probability Unit including counting, expected value, independent events, fair games, leading to game theory.

Matrix Mathematics Unit including matrix operations, systems of equations, expected value, determinants, matrix inverses, leading to game theory, coding and graph theory.

Statistics Unit including survey design, sampling, measures of center and spread, confidence intervals and graphs, leading to a survey of sample size 100.

### **Assessments:**

Students will be able to:

Probability Unit: Calculate probabilities, design tree and Venn Diagrams, use permutations and combinations when appropriate, evaluate games, write simple BASIC programs for the TI graphing calculator, create and analyze their own student-developed game. CT,CS,CZ,RS

Matrix Unit: Complete matrix calculations, solve matrix equations and systems of linear equations using matrix inverses and Cramer's rule, apply matrices to games, networks and graphs, fair division problems, and coding, creating and using their own matrix-encrypted code.  
CT,CS,CZ,RS

Statistics Unit: Identify good elements of survey design and sampling procedures, calculate statistics and their associated graphs, interpret graphs, understand bias and sampling error, and the relationship between sample size and confidence intervals, leading to a student-designed and administered survey which is then analyzed using Fathom software and presented in professional format. CT,CS,CZ,RS

Assessments include: homework, quizzes, classroom activities, projects, presentations, calculator programs in TI BASIC, surveys, spreadsheet assignments, etc.  
CT,CS,CZ,RS



*Learn \* Think \* Create \* Serve*