

Scope and Sequence Draft¹

Grades 9-12

The following are mathematical practices students develop as they explore the mathematical strands identified in the table below. Further reading on ways through which these practices are reinforced in mathematics courses can be found in the Common Core Standards for Mathematics (www.corestandards.org/the-standards/mathematics).

Mathematical Practices:

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

¹ Note: This document reflects the mathematical strands and ways of thinking in the Common Core State Standards for Mathematics, published by the Common Core State Standards Initiative.

MATHEMATICS STRAND	Algebra 1	Geometry	Algebra 2	Pre-calculus
Number and Quantity	<p>Use the properties of rational and irrational numbers</p> <p>Work flexibly with integers</p> <p>Understand relationships among operations (e.g. inverse operations)</p> <p>Develop and understanding of the properties of real numbers</p> <p>Use units as a way to understand problems and to guide the solution to multi-step problems</p> <p>Use dimensional analysis to perform unit conversions</p> <p>Choose and interpret scales of graphs and data displays</p> <p>Choose appropriate levels of accuracy for measuring and reporting quantities</p> <p>Estimate and judge reasonableness of numerical results</p> <p>Work with very large and very small numbers and represent them appropriately; understand relative size of numbers</p>	<p>Represent and model with vector quantities</p> <p>Find the components of a vector and use them to solve problems involving velocity and other quantities that have both magnitude and direction</p> <p>Perform operations on vectors (addition, subtraction, and multiplication by a scalar)</p>	<p>Extend the properties of exponents to rational exponents</p> <p>Perform arithmetic operations with complex numbers</p> <p>Use properties of complex numbers to perform operations, including finding the conjugate of a complex number</p> <p>Represent complex numbers on the complex plane; represent operations of complex numbers graphically</p> <p>Use complex numbers to solve quadratic equations</p> <p>Know and use the Fundamental Theorem of Algebra</p> <p>Use matrices to represent and manipulate data</p> <p>Perform operations with matrices</p> <p>Work with matrices as transformations of vectors</p>	

MATHEMATICS STRAND	Algebra 1	Geometry	Algebra 2	Pre-calculus
	<p>Recognize numerical patterns and extend numerical sequences</p> <p>Work with absolute value and understand that it represents distance a number lies from zero on the number line</p>			
Algebra	<p>Interpret mathematical expressions in terms of their context</p> <p>Use the structure of an expression to identify ways to rewrite it (e.g. factoring the difference of squares)</p> <p>Create equations and inequalities in one variable and use them to solve problems</p> <p>Create equations in two variables to represent relationships between quantities Rearrange formulas to highlight a quantity of interest (solve literal equations)</p> <p>Solve rational and radical equations in one variable</p> <p>Solve linear equations and inequalities in one variable</p>	<p>Use algebraic processes to find missing values in geometric figures</p> <p>Use coordinates to prove simple geometric theorems algebraically (e.g. prove or disprove that a figure defined by four given points in a coordinate plane is a rectangle)</p> <p>Prove the slope criteria for parallel and perpendicular lines and use these to solve geometric problems</p> <p>Use coordinates to compute perimeters of polygons and areas of triangles and rectangles (e.g. using the distance formula)</p>	<p>Choose and produce equivalent forms of expressions (e.g. factoring quadratics to find zeros; use properties of exponents to rewrite expressions)</p> <p>Perform arithmetic operations on polynomials</p> <p>Identify zeros of a polynomial</p> <p>Know and apply the binomial theorem</p> <p>Rewrite rational expressions in different forms</p> <p>Create equations in two or more variables to represent relationships between quantities</p> <p>Represent constraints by equations of inequalities and interpret solutions</p>	<p>Translate between the geometric description of conic sections and their equations</p> <p>Derive the equation of a circle of given center and radius using the Pythagorean Theorem</p> <p>Derive the equation of a parabola given a focus and directrix</p> <p>Derive the equations of ellipses and hyperbolas given foci and directrices</p>

MATHEMATICS STRAND	Algebra 1	Geometry	Algebra 2	Pre-calculus
	<p>Solve quadratic equations in one variable</p> <p>Understand that the graph of an equation in two variables is the set of all its solutions plotted on a coordinate plane (forming a curve)</p> <p>Work flexibly with function notation</p>		<p>Solve quadratic equations</p> <p>Solve systems of linear equations</p> <p>Solve a system of a linear equation and a quadratic equation algebraically and graphically</p> <p>Use matrices to represent and solve a system of linear equations</p> <p>Graph the solutions of a linear inequality in two variables</p> <p>Solve systems of inequalities in two variables</p> <p>Represent the solution of an inequality using interval notation</p>	
<p>Functions, transformations, and their representations</p>	<p>Understand the definition of a function as a map from one set to another set assigning to each element of the domain one element of the range</p> <p>Use function notation and evaluate functions from inputs in their domain</p> <p>Relate the domain of a function to its graph and to quantitative relations it describes</p>	<p>Experiment with transformation in the plane:</p> <p>Know precise definitions of angle, circle, perpendicular line, parallel line, line segment</p> <p>Represent transformations in the plane; describe transformations as functions that take points in the plane as inputs and give other points as outputs</p>	<p>Understand and apply direct and inverse variation; recognize that direct variation is represented by a linear function that passes through the origin</p> <p>Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers</p> <p>Interpret key features of a</p>	<p>Calculate and interpret the average rate of change of a function over a specified interval</p> <p>Estimate the rate of change of a function from its graph</p> <p>Graph square root, cube root, and piece-wise defined functions, including step functions and absolute value functions</p>

MATHEMATICS STRAND	Algebra 1	Geometry	Algebra 2	Pre-calculus
	<p>Write a function to describe a relationship between two quantities</p> <p>Find the inverse of a linear function</p> <p>Distinguish situations that can be modeled by linear functions and by non-linear functions</p>	<p>Given a regular polygon, describe rotations and reflections that map it to itself</p> <p>Develop definitions of rotations, reflections, and translations in terms of angles, perpendicular lines, parallel lines, and line segments</p> <p>Draw transformed figures (apply reflections, rotations, translations and dilations to a geometric figure)</p> <p>Specify a sequence of transformations that carry a give figure onto another</p> <p>Use the definition of congruence in terms of rigid transformations</p> <p>Show how to determine whether two given triangles are congruent</p> <p>Compare transformations that preserve distance and angle to those that do not (e.g. translations versus horizontal stretch)</p>	<p>graph of a function (e.g. intercepts; intervals where the function is increasing, decreasing, neither; minimum and maximum values; symmetry)</p> <p>Graph linear and quadratic functions and show intercepts, maxima, and minima</p> <p>Solve quadratic equations and interpret the solution geometrically</p> <p>Represent functions through tables, equations, verbal descriptions and move among these representations</p> <p>Write a function to describe a relationship between two quantities</p> <p>Compose and combine functions</p> <p>Identify the effect of various transformations of functions; use technology to experiment with cases and to illustrate the effects of transforming functions</p> <p>Find inverse functions (verify by composition that one</p>	<p>Graph rational functions identifying zeros and asymptotes when possible</p> <p>Graph exponential and logarithmic functions, showing intercepts and end behavior</p> <p>Understand arithmetic and geometric sequences as parallels of linear and exponential functions; derive the formula for the sum of a geometric series</p> <p>Graph trigonometric functions, showing period, amplitude, and shifts</p> <p>Understand the inverse relationship between exponential and logarithmic functions and use this relationship to solve problems</p> <p>Extend the domain of trigonometric functions using the unit circle (explain how the unit circle enables the extension of trigonometric functions to all real numbers)</p> <p>Understand radian measure of an angle as the length of an arc on the unit circle subtended by the angle</p>

MATHEMATICS STRAND	Algebra 1	Geometry	Algebra 2	Pre-calculus
			<p>function is the inverse of another)</p> <p>Prove that linear functions grow by equal differences over equal intervals and that exponential functions grow by equal factors over equal intervals</p> <p>Recognize when a function grows or decays by a constant percent rate over unit intervals</p> <p>Construct linear and exponential functions given a graph, a description of the relationship, or two input-output pairs</p> <p>Use special triangles to determine trigonometric function values</p>	<p>Use the unit circle to explain symmetry and periodicity of trigonometric functions</p> <p>Choose trigonometric functions to model periodic phenomena</p> <p>Understand how to restrict the domain of a trigonometric function to find inverse functions</p>
Modeling	<p>Represent data with plots on the real number line (dot plots, histograms, and box plots)</p>	<p>Use geometric shapes, their measures, and their properties to describe objects</p> <p>Apply geometric methods to solve design problems (designing an object of structure to satisfy physical constraints or minimize cost)</p>	<p>Fit a function to data; use functions fitted to data to solve problems in the context of the data (emphasis on linear and exponential models)</p> <p>Informally assess the fit of a function by plotting and analyzing residuals</p> <p>Fit a linear function to a scatter plot that suggests a</p>	<p>Fit a function to data; use functions fitted to data to solve problems in the context of the data (emphasis on linear and exponential models)</p> <p>Model real-world problems using linear, exponential, logarithmic, polynomial, and trigonometric functions</p>

MATHEMATICS STRAND	Algebra 1	Geometry	Algebra 2	Pre-calculus
			<p>linear association</p> <p>Interpret the slope (rate of change) and the intercept of a linear model in the context of the data</p> <p>Compute (using technology) the correlation coefficient of a linear fit</p> <p>Distinguish between correlation and causation</p>	
<p>Measurement and dimension</p>	<p>Represent measurements such as perimeter, area, and volume of geometric figures and objects using algebraic expressions</p>	<p>Make geometric constructions with a variety of tools and methods (e.g. copying a segment, an angle, bisecting a segment, and angle...)</p> <p>Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle</p> <p>Calculate perimeter, area, and other attributes of geometric objects</p> <p>Estimate areas of irregular shapes and volumes of irregular geometric objects</p> <p>Define trigonometric ratios and solve problems involving right triangles</p> <p>Understand that by similarity,</p>	<p>Define trigonometric ratios and solve problems involving right triangles</p> <p>Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to the definitions of trigonometric ratios for acute angles</p>	

MATHEMATICS STRAND	Algebra 1	Geometry	Algebra 2	Pre-calculus
		<p>side ratios in right triangles are properties of the angles in the triangle, leading to the definitions of trigonometric ratios for acute angles</p> <p>Apply trigonometry to general triangles</p> <p>Explain volume formulas and use them to solve problems</p> <p>Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems</p> <p>Visualize relationships between two- and three-dimensional objects: identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects</p>		
	<p>Explain each step of solving a simple equation</p>	<p>Prove theorems about lines and angles (e.g. vertical angles are congruent, alternate interior angles and corresponding angles congruent when a transversal crosses parallel lines)</p> <p>Prove theorems about triangles (e.g. measures of interior angles of a triangle</p>		<p>Prove the Pythagorean identities</p> <p>Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems</p> <p>Prove and use the half-angle and double-angle formulas for trigonometric functions</p>

MATHEMATICS STRAND	Algebra 1	Geometry	Algebra 2	Pre-calculus
Proof and Justification		<p>add up to 180 degrees, base angles of isosceles triangles are congruent, medians of a triangle meet at a point)</p> <p>Prove theorems about parallelograms (e.g. opposite sides are congruent, diagonals bisect each other)</p> <p>Verify experimentally the properties of dilations given by a center and a scale factor</p> <p>Prove theorems about triangles (e.g. a line parallel to one side of a triangle divides the other two proportionately; Pythagorean theorem proved using triangle similarity)</p> <p>Prove that all circles are similar</p> <p>Understand and apply theorems about circles</p>		<p>Derive the formula $A = (1/2)ab\sin(C)$ for the area of a triangle</p> <p>Prove the Law of Sines and the Law of Cosines and use them to solve problems (apply to find unknown measurements in right and non-right triangles)</p>
Statistics	<p>Represent data with plots on the real number line (dot plots, histograms, and box plots)</p> <p>Use statistics appropriate to the shape of the data distribution to compare center (mean and median) and spread (five number summary)</p>	<p>Describe events as subsets of a sample space (the set of outcomes) using characteristics of the outcomes, or as unions, intersections, or complements of other events* (probability)</p>	<p>Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data*</p> <p>Represent data on two quantitative variables on a scatter plot and describe how the variables are related*</p>	<p>Represent data on two quantitative variables on a scatter plot and describe how the variables are related</p> <p>Fit a function to data; use functions fitted to data to solve problems in the context of the data (emphasis on linear and exponential models)</p>

MATHEMATICS STRAND	Algebra 1	Geometry	Algebra 2	Pre-calculus
	<p>Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of outliers</p> <p>Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages</p> <p>Represent data on two quantitative variables on a scatter plot and describe how the variables are related</p> <p>Fit a function to the data; use functions fitted to data to solve problems in the context of the data</p>		<p>Fit a function to data; use functions fitted to data to solve problems in the context of the data (emphasis on linear and exponential models)*</p> <p>Compute (using technology) the correlation coefficient of a linear fit*</p> <p>Distinguish between correlation and causation*</p> <p>Use rules of probability to compute probabilities of compound events in a uniform probability model*</p> <p>Use probability to make decisions* (calculate expected values and use them to solve problems)</p> <p>Use probability to make fair decisions*; analyze decisions and strategies using probability concepts</p> <p>Understand that two events are independent if the probability of A and B occurring together is the product of their probabilities*, and use this characterization to determine if they are independent events</p>	<p>Understand statistics as a process for making inferences about population parameters based on a random sample from that population*</p> <p>Using simulation, decide if a specified model is consistent with results from a given data-generation process*</p> <p>Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each*</p> <p>Use data from a sample survey to estimate population mean or proportion; develop a margin of error through the use of simulation models for random sampling*</p>

MATHEMATICS STRAND	Algebra 1	Geometry	Algebra 2	Pre-calculus
			Understand conditional probability* Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations*	

Note: starred* items can be considered part of a new statistics course

MATHEMATICS STRAND	Calculus
Number and Quantity	Work with the concept of infinity, including limits at infinity and infinite limits
Algebra	Students extend their skills in symbolic manipulation by finding derivatives of polynomial functions, exponential functions, logarithmic functions and trigonometric functions; use the definition of the derivative to derive differentiation techniques
Functions and their representations	<p>Explore instantaneous rate of change using limiting values of average rate of change</p> <p>Relate the slope of a function at a particular point to instantaneous rate of change</p> <p>Describe and quantify motion (and understand the relationship between position, velocity, and acceleration)</p> <p>Work with the first, second...nth derivative of a function and interpret the meaning of these when possible</p> <p>Extend skills in symbolic manipulation by finding derivatives of polynomial functions, exponential functions, logarithmic functions and trigonometric functions; use the definition of the derivative to derive differentiation techniques</p> <p>Use implicit differentiation techniques to find the derivative of a function that cannot be written explicitly</p> <p>Solve problems using related rates</p> <p>Understand limits and continuity of functions</p> <p>Solve optimization problems using Calculus (find extreme values of a function)</p> <p>Find antiderivatives and interpret their meaning</p> <p>Understand and use the relationship between the derivative of a function and families of antiderivatives</p> <p>Learn to represent accumulation and relate it to areas under curves (application of limits)</p> <p>Model phenomena using Calculus concepts of instantaneous rate of change and accumulation, or area under a curve (the derivative and the integral)</p> <p>Understand and use the Fundamental Theorem of Calculus</p>
Modeling	<p>Solve problems using related rates</p> <p>Solve optimization problems using Calculus (find extreme values of a function)</p> <p>Learn to represent accumulation and relate it to areas under curves (application of limits)</p>
	<p>Use and apply the concept of successive approximation and lower and upper bounds in their study of integration</p> <p>Sketch curves using intercepts, infinite limits and limits at infinity (horizontal and vertical asymptotes), the first derivative (increasing or decreasing) and the second derivative (to</p>

MATHEMATICS STRAND	Calculus
Measurement and dimension	determine concavity); Use of technology for graphing complex curves Find the area under a curve and the area between curves using integration Find volumes of solids of revolution once they are sketched on the two-dimensional coordinate system

**MELROSE PUBLIC SCHOOLS
MATHEMATICS DEPARTMENT
COURSE SYLLABUS**

Course Title: Algebra I

Course Description

Algebra I **C.P. 1** **1 Credit**

This course consists of essential algebra topics such as linear equations, laws of exponents, operations with polynomials, and solving word problems. Emphasis is placed on preparing the students for the MCAS exam in tenth grade.

School Wide Learning Expectations

- Students will demonstrate the ability to use technology responsibly and effectively
- Students will demonstrate the ability to problem solve effectively

Course Specific Goals

Students will be able to:

- Utilize various methods to solve quadratic equations
- Graph lines using slopes and intercepts
- Perform all operations with polynomials
- Utilize algebra to set up and solve word problems
- Factor polynomials effectively

Essential Questions

- How are linear equations utilized in setting up and solving word problems?
- What laws of exponents are used when working with polynomials?
- How are slopes used in graphing lines?
- Why is the vertical line test utilized in determining functions on a graph?
- What geometrically are the solutions to linear systems?

Instructional Strategies

- Demonstrations
- Brainstorming
- Problem Solving
- Group Work
- Calculator Exercises
- Discovery Method

Learning Standards from Mass. Frameworks

Attached is an appendix from the Frameworks relevant to this course and referenced by number and strand in the course outline

Course Outline

A.1.N.2 Simplifying Algebraic Expressions
A.1.N.1 Evaluating Expressions Using Order of Operations
A.1.P.10 Solving Linear Equations
A.1.P.11 Solving Word Problems
A.1.P.7 Simplifying Monomials Using Laws of Exponents
10.P.3 Operations with Polynomial
10.P.2 Finding Slopes of Lines
A.1.P.6 Determining Equations of Lines
A.1.P.6 Graphing Linear Equations
A.1.P.3 Finding Domain and Range of Relations
A.1.P.1 Recognizing and Evaluating Functions
10.P.4 Factoring Polynomials
A.1.P.9 Solving Quadratic Equations with Factoring
A.1.P.9 Graphing vertical Parabolas
10.N.3 Simplifying Radicals
A.1.D2 Finding a Line of Best Fit for Data

Major Evaluation Strategies/Assessments

- Tests
- Homework
- Quizzes
- CORE Assignments
- Open Response Questions

Learning Standards for Algebra I

Note: The parentheses at the end of a learning standard contain the code number(s) for the corresponding standard(s) in the two-year grade spans.

Number Sense and Operations

[Understand numbers](#), ways of representing numbers, relationships among numbers, and number systems

[Understand meanings](#) of operations and how they relate to one another

[Compute fluently](#) and make reasonable estimates

Students engage in problem solving, communicating, reasoning, connecting, and representing as they:

- AI.N.1 Identify and use the properties of operations on real numbers, including the associative, commutative, and distributive properties; the existence of the identity and inverse elements for addition and multiplication; the existence of n^{th} roots of positive real numbers for any positive integer n ; the inverse relationship between taking the n^{th} root of and the n^{th} power of a positive real number; and the density of the set of rational numbers in the set of real numbers. (10.N.1)
- AI.N.2 Simplify numerical expressions, including those involving positive integer exponents or the absolute value, e.g., $3(2^4 - 1) = 45$, $4|3 - 5| + 6 = 14$; apply such simplifications in the solution of problems. (10.N.2)
- AI.N.3 Find the approximate value for solutions to problems involving square roots and cube roots without the use of a calculator, e.g., $\sqrt{3^2 - 1} \approx 2.8$. (10.N.3)
- AI.N.4 Use estimation to judge the reasonableness of results of computations and of solutions to problems involving real numbers. (10.N.4)

Patterns, Relations, and Algebra

[Understand patterns](#), relations, and functions

[Represent and analyze](#) mathematical situations and structures using algebraic symbols

[Use mathematical models](#) to represent and understand quantitative relationships

[Analyze change](#) in various contexts

Students engage in problem solving, communicating, reasoning, connecting, and representing as they:

- AI.P.1 Describe, complete, extend, analyze, generalize, and create a wide variety of patterns, including iterative, recursive (e.g., Fibonacci Numbers), linear, quadratic, and exponential functional relationships. (10.P.1)
- AI.P.2 Use properties of the real number system to judge the validity of equations and inequalities, to prove or disprove statements, and to justify every step in a sequential argument.
- AI.P.3 Demonstrate an understanding of relations and functions. Identify the domain, range, dependent, and independent variables of functions.
- AI.P.4 Translate between different representations of functions and relations: graphs, equations, point sets, and tabular.
- AI.P.5 Demonstrate an understanding of the relationship between various representations of a line. Determine a line's slope and x - and y -intercepts from its graph or from a linear equation that represents the line. Find a linear equation describing a line from a graph or a geometric description of the line, e.g., by using the "point-slope" or "slope y -intercept" formulas. Explain the significance of a positive, negative, zero, or undefined slope. (10.P.2)
- AI.P.6 Find linear equations that represent lines either perpendicular or parallel to a given line and through a point, e.g., by using the "point-slope" form of the equation. (10.G.8)
- AI.P.7 Add, subtract, and multiply polynomials. Divide polynomials by monomials. (10.P.3)

AI.P.8 Demonstrate facility in symbolic manipulation of polynomial and rational expressions by rearranging and collecting terms, factoring (e.g., $a^2 - b^2 = (a + b)(a - b)$, $x^2 + 10x + 21 = (x + 3)(x + 7)$, $5x^4 + 10x^3 - 5x^2 = 5x^2(x^2 + 2x - 1)$), identifying and canceling common factors in rational expressions, and applying the properties of positive integer exponents. (10.P.4)

AI.P.9 Find solutions to quadratic equations (with real roots) by factoring, completing the square, or using the quadratic formula. Demonstrate an understanding of the equivalence of the methods. (10.P.5)

AI.P.10 Solve equations and inequalities including those involving absolute value of linear expressions (e.g., $|x - 2| > 5$) and apply to the solution of problems. (10.P.6)

Patterns, Relations, and Algebra (continued)

AI.P.11 Solve everyday problems that can be modeled using linear, reciprocal, quadratic, or exponential functions. Apply appropriate tabular, graphical, or symbolic methods to the solution. Include compound interest, and direct and inverse variation problems. Use technology when appropriate. (10.P.7)

AI.P.12 Solve everyday problems that can be modeled using systems of linear equations or inequalities. Apply algebraic and graphical methods to the solution. Use technology when appropriate. Include mixture, rate, and work problems. (10.P.8)

Data Analysis, Statistics, and Probability

[Formulate questions](#) that can be addressed with data and collect, organize, and display relevant data to answer them

[Select and use](#) appropriate statistical methods to analyze data

[Develop and evaluate](#) inferences and predictions that are based on data

[Understand and apply](#) basic concepts of probability

Students engage in problem solving, communicating, reasoning, connecting, and representing as they:

AI.D.1 Select, create, and interpret an appropriate graphical representation (e.g., scatter plot, table, stem-and-leaf plots, circle graph, line graph, and line plot) for a set of data and use appropriate statistics (e.g., mean, median, range, and mode) to communicate information about the data. Use these notions to compare different sets of data. (10.D.1)

AI.D.2 Approximate a line of best fit (trend line) given a set of data (e.g., scatter plot). Use technology when appropriate. (10.D.2)

AI.D.3 Describe and explain how the relative sizes of a sample and the population affect the validity of predictions from a set of data. (10.D.3)

Learning Standards for Grades 9–10

Number Sense and Operations

[Understand numbers](#), ways of representing numbers, relationships among numbers, and number systems

[Understand meanings](#) of operations and how they relate to one another

[Compute fluently](#) and make reasonable estimates

Students engage in problem solving, communicating, reasoning, connecting, and representing as they:

- 10.N.1 Identify and use the properties of operations on real numbers, including the associative, commutative, and distributive properties; the existence of the identity and inverse elements for addition and multiplication; the existence of n^{th} roots of positive real numbers for any positive integer n ; and the inverse relationship between taking the n^{th} root of and the n^{th} power of a positive real number.
- 10.N.2 Simplify numerical expressions, including those involving positive integer exponents or the absolute value, e.g., $3(2^4 - 1) = 45$, $4|3 - 5| + 6 = 14$; apply such simplifications in the solution of problems.
- 10.N.3 Find the approximate value for solutions to problems involving square roots and cube roots without the use of a calculator, e.g., $\sqrt{3^2 - 1} \approx 2.8$.
- 10.N.4 Use estimation to judge the reasonableness of results of computations and of solutions to problems involving real numbers.

Patterns, Relations, and Algebra

[Understand patterns](#), relations, and functions

[Represent and analyze](#) mathematical situations and structures using algebraic symbols

[Use mathematical models](#) to represent and understand quantitative relationships

[Analyze change](#) in various contexts

Students engage in problem solving, communicating, reasoning, connecting, and representing as they:

- 10.P.1 Describe, complete, extend, analyze, generalize, and create a wide variety of patterns, including iterative, recursive (e.g., Fibonacci Numbers), linear, quadratic, and exponential functional relationships.
- 10.P.2 Demonstrate an understanding of the relationship between various representations of a line. Determine a line's slope and x - and y -intercepts from its graph or from a linear equation that represents the line. Find a linear equation describing a line from a graph or a geometric description of the line, e.g., by using the "point-slope" or "slope y -intercept" formulas. Explain the significance of a positive, negative, zero, or undefined slope.
- 10.P.3 Add, subtract, and multiply polynomials. Divide polynomials by monomials.
- 10.P.4 Demonstrate facility in symbolic manipulation of polynomial and rational expressions by rearranging and collecting terms; factoring (e.g., $a^2 - b^2 = (a + b)(a - b)$, $x^2 + 10x + 21 = (x + 3)(x + 7)$, $5x^4 + 10x^3 - 5x^2 = 5x^2(x^2 + 2x - 1)$); identifying and canceling common factors in rational expressions; and applying the properties of positive integer exponents.
- 10.P.5 Find solutions to quadratic equations (with real roots) by factoring, completing the square, or using the quadratic formula. Demonstrate an understanding of the equivalence of the methods.
- 10.P.6 Solve equations and inequalities including those involving absolute value of linear expressions (e.g., $|x - 2| > 5$) and apply to the solution of problems.
- 10.P.7 Solve everyday problems that can be modeled using linear, reciprocal, quadratic, or exponential functions. Apply appropriate tabular, graphical, or symbolic methods to the solution. Include compound interest, and direct and inverse variation problems. Use

technology when appropriate.

10.P.8 Solve everyday problems that can be modeled using systems of linear equations or inequalities. Apply algebraic and graphical methods to the solution. Use technology when appropriate. Include mixture, rate, and work problems.

Geometry

[Analyze characteristics](#) and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships
[Specify locations](#) and describe spatial relationships using coordinate geometry and other representational systems
[Apply transformations](#) and use symmetry to analyze mathematical situations
[Use visualization](#), spatial reasoning, and geometric modeling to solve problems

Students engage in problem solving, communicating, reasoning, connecting, and representing as they:

- 10.G.1 Identify figures using properties of sides, angles, and diagonals. Identify the figures' type(s) of symmetry.
- 10.G.2 Draw congruent and similar figures using a compass, straightedge, protractor, and other tools such as computer software. Make conjectures about methods of construction. Justify the conjectures by logical arguments.
- 10.G.3 Recognize and solve problems involving angles formed by transversals of coplanar lines. Identify and determine the measure of central and inscribed angles and their associated minor and major arcs. Recognize and solve problems associated with radii, chords, and arcs within or on the same circle.
- 10.G.4 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.
- 10.G.5 Solve simple triangle problems using the triangle angle sum property and/or the Pythagorean theorem.
- 10.G.6 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.
- 10.G.7 Using rectangular coordinates, calculate midpoints of segments, slopes of lines and segments, and distances between two points, and apply the results to the solutions of problems.
- 10.G.8 Find linear equations that represent lines either perpendicular or parallel to a given line and through a point, e.g., by using the "point-slope" form of the equation.
- 10.G.9 Draw the results, and interpret transformations on figures in the coordinate plane, e.g., translations, reflections, rotations, scale factors, and the results of successive transformations. Apply transformations to the solutions of problems.
- 10.G.10 Demonstrate the ability to visualize solid objects and recognize their projections and cross sections.
- 10.G.11 Use vertex-edge graphs to model and solve problems.

Measurement

[Understand measurable attributes](#) of objects and the units, systems, and processes of measurement
[Apply appropriate techniques, tools, and formulas](#) to determine measurements

Students engage in problem solving, communicating, reasoning, connecting, and representing as they:

- 10.M.1 Calculate perimeter, circumference, and area of common geometric figures such as parallelograms, trapezoids, circles, and triangles.
- 10.M.2 Given the formula, find the lateral area, surface area, and volume of prisms, pyramids, spheres, cylinders, and cones, e.g., find the volume of a sphere with a specified surface area.
- 10.M.3 Relate changes in the measurement of one attribute of an object to changes in other

attributes, e.g., how changing the radius or height of a cylinder affects its surface area or volume.

10.M.4 Describe the effects of approximate error in measurement and rounding on measurements and on computed values from measurements.

Data Analysis, Statistics, and Probability

[Formulate questions](#) that can be addressed with data and collect, organize, and display relevant data to answer them

[Select and use](#) appropriate statistical methods to analyze data

[Develop and evaluate](#) inferences and predictions that are based on data

[Understand and apply](#) basic concepts of probability

- Students engage in problem solving, communicating, reasoning, connecting, and representing as they:*
- 10.D.1 Select, create, and interpret an appropriate graphical representation (e.g., scatter plot, table, stem-and-leaf plots, box-and-whisker plots, circle graph, line graph, and line plot) for a set of data and use appropriate statistics (e.g., mean, median, range, and mode) to communicate information about the data. Use these notions to compare different sets of data.
- 10.D.2 Approximate a line of best fit (trend line) given a set of data (e.g., scatter plot). Use technology when appropriate.
- 10.D.3 Describe and explain how the relative sizes of a sample and the population affect the validity of predictions from a set of data.

MELROSE PUBLIC SCHOOLS MATHEMATICS DEPARTMENT COURSE SYLLABUS

Course Description

Algebra II

C.P. 1, C.P. 2, & H

1 Credit

This course expands on the topics covered in Algebra 1. New topics include simplifying radicals, operations with radicals, operations with imaginary and complex numbers, new methods of solving quadratic equations, and the graphs of the conic sections. The use of functions is explored. The honors level will cover derivations of formulas.

School Wide Learning Expectations

- Students will demonstrate the ability to use technology responsibly and effectively
- Students will demonstrate the ability to problem solve effectively

Course Specific Goals

Students will be able to:

- Utilize various methods to solve quadratic equations
- Simplify radical expressions
- Graph various functions, recognize why they are functions, and identify their domain and range
- Perform all operations with imaginary and complex numbers
- Solve word problems involving the utilization of quadratic equations

Essential Questions

- How are functions described and used in relationships between numbers?
- How is slope defined and used in writing the equations of lines?
- What methods are employed in solving systems of equations?
- What is the relationship between polynomial functions and their graphs?
- What methods are used to solve quadratic equations?

Instructional Strategies

- Demonstrations
- Brainstorming
- Problem Solving
- Group Work
- Calculator Exercises
- Discovery Method

Learning Standards from the Mass Frameworks

Attached is an appendix from the Frameworks relevant to this course and referenced by number and strand in the course outline

Course Outline

A.2.P.11 Solving Linear Equations
 A.2.P.11 Solving Linear Inequalities
 A.2.P.11 Absolute Value Functions
 A.2.P.10 Laws of Exponents
 10.P.3 Operations with Polynomials
 10.P.2 Slopes of Lines
 10.P.2 Graphing Lines
 10.P.2 Determining Equations of Lines
 10.P.2 Distance and Midpoint
 A.2.P.5 Relations and Functions
 A.2.P.5 Graphing Functions
 A.2.P.9 Solving Linear Systems
 A.2.P.9 Operations with Matrices
 10.P.4 Factoring Polynomials
 10.P.5 Solving Quadratic Equations
 10.P.5 Completing the Square
 A.2.P.4 Operations with Radicals
 A.2.N.1 Imaginary and Complex Numbers
 A.2.P.6 Conic Sections
 A.2.P.3 Binomial Expansion Using Pascal's Triangle
 A.2.G.1 Introduction to Trigonometric Ratios

Major Evaluation Strategies/Assessments

- Tests
- Homework

- Quizzes
- CORE Assignments
- Open Response Questions

Learning Standards for Algebra II

Note: The parentheses at the end of a learning standard contain the code number for the corresponding standard in the two-year grade spans.

Number Sense and Operations

[Understand numbers](#), ways of representing numbers, relationships among numbers, and number systems

[Understand meanings](#) of operations and how they relate to one another

[Compute fluently](#) and make reasonable estimates

Students engage in problem solving, communicating, reasoning, connecting, and representing as they:

- AII.N.1 Define complex numbers (e.g., $a + bi$) and operations on them, in particular, addition, subtraction, multiplication, and division. Relate the system of complex numbers to the systems of real and rational numbers. (12.N.1)
- AII.N.2 Simplify numerical expressions with powers and roots, including fractional and negative exponents. (12.N.2)

Patterns, Relations, and Algebra

[Understand patterns](#), relations, and functions

[Represent and analyze](#) mathematical situations and structures using algebraic symbols

[Use mathematical models](#) to represent and understand quantitative relationships

[Analyze change](#) in various contexts

Students engage in problem solving, communicating, reasoning, connecting, and representing as they:

- AII.P.1 Describe, complete, extend, analyze, generalize, and create a wide variety of patterns, including iterative and recursive patterns such as Pascal's Triangle. (12.P.1)
- AII.P.2 Identify arithmetic and geometric sequences and finite arithmetic and geometric series. Use the properties of such sequences and series to solve problems, including finding the formula for the general term and the sum, recursively and explicitly. (12.P.2)
- AII.P.3 Demonstrate an understanding of the binomial theorem and use it in the solution of problems. (12.P.3)
- AII.P.4 Demonstrate an understanding of the exponential and logarithmic functions.
- AII.P.5 Perform operations on functions, including composition. Find inverses of functions. (12.P.5)
- AII.P.6 Given algebraic, numeric and/or graphical representations recognize functions as polynomial, rational, logarithmic, or exponential. (12.P.6)
- AII.P.7 Find solutions to quadratic equations (with real coefficients and real or complex roots) and apply to the solutions of problems. (12.P.7)
- AII.P.8 Solve a variety of equations and inequalities using algebraic, graphical, and numerical methods, including the quadratic formula; use technology where appropriate. Include polynomial, exponential, and logarithmic functions; expressions involving the absolute values; and simple rational expressions. (12.P.8)
- AII.P.9 Use matrices to solve systems of linear equations. Apply to the solution of everyday problems. (12.P.9)

- AII.P.10 Use symbolic, numeric, and graphical methods to solve systems of equations and/or inequalities involving algebraic, exponential, and logarithmic expressions. Also use technology where appropriate. Describe the relationships among the methods. (12.P.10)
- AII.P.11 Solve everyday problems that can be modeled using polynomial, rational, exponential, logarithmic, and step functions, absolute values and square roots. Apply appropriate graphical, tabular, or symbolic methods to the solution. Include growth and decay; logistic growth; joint (e.g., $I = Prt$, $y = k(w_1 + w_2)$), and combined (F = $G(m_1m_2)/d^2$) variation. (12.P.11)
- AII.P.12 Identify maximum and minimum values of functions in simple situations. Apply to the solution of problems. (12.P.12)
- AII.P.13 Describe the translations and scale changes of a given function $f(x)$ resulting from substitutions for the various parameters a, b, c, and d in $y = af(b(x + c/b)) + d$. In particular, describe the effect of such changes on polynomial, rational, exponential, and logarithmic functions. (12.P.13)

Geometry

[Analyze characteristics](#) and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships
[Specify locations](#) and describe spatial relationships using coordinate geometry and other representational systems
[Apply transformations](#) and use symmetry to analyze mathematical situations
[Use visualization](#), spatial reasoning, and geometric modeling to solve problems

Students engage in problem solving, communicating, reasoning, connecting, and representing as they:

- AII.G.1 Define the sine, cosine, and tangent of an acute angle. Apply to the solution of problems. (12.G.1)
- AII.G.2 Derive and apply basic trigonometric identities (e.g., $\sin^2\theta + \cos^2\theta = 1$, $\tan^2\theta + 1 = \sec^2\theta$) and the laws of sines and cosines. (12.G.2)
- AII.G.3 Relate geometric and algebraic representations of lines, simple curves, and conic sections. (12.G.4)

Data Analysis, Statistics, and Probability

[Formulate questions](#) that can be addressed with data and collect, organize, and display relevant data to answer them
[Select and use](#) appropriate statistical methods to analyze data
[Develop and evaluate](#) inferences and predictions that are based on data
[Understand and apply](#) basic concepts of probability

Students engage in problem solving, communicating, reasoning, connecting, and representing as they:

- AII.D.1 Select an appropriate graphical representation for a set of data and use appropriate statistics (e.g., quartile or percentile distribution) to communicate information about the data. (12.D.2)
- AII.D.2 Use combinatorics (e.g., “fundamental counting principle,” permutations, and combinations) to solve problems, in particular, to compute probabilities of compound events. Use technology as appropriate. (12.D.6)

MELROSE PUBLIC SCHOOLS MATHEMATICS DEPARTMENT COURSE SYLLABUS

Course Title: Geometry

Course Description

Geometry C.P.1, C.P.2, H 1 Credit

This course explores the critical postulates governing angles, parallel lines, polygons, circles, congruency and similarity, areas of plane polygons and circles, as well as volumes and surface area of solids. Right triangles and their properties are emphasized.

School Wide Learning Expectations

- Students will demonstrate the ability to use technology responsibly and effectively
- Students will demonstrate the ability to problem solve effectively

Course Specific Goals

Students will be able to:

- Recognize points, lines, line segments, rays, angles and triangles
- Determine when figures are congruent or similar by identifying corresponding parts of figures
- Effectively work with ratios, recognize and work with proportions, apply the product and ratio theorems, and calculate geometric means
- Identify characteristics of circles and effectively work with chords, arcs, tangents, special angles in the circle and the relationship between these parts
- Determine the area of plane figures, volume and surface area of solid figures

Essential Questions

- What characteristics and properties of two and three dimensional geometric shapes can be utilized to develop mathematical arguments about relationships?
- How can geometry be utilized to specify locations and to describe spatial relationships?
- How can symmetry, congruency, and similarity be employed to analyze mathematical situations?
- What appropriate techniques, tools, and formulas can be used to determine measurements?
- How can visualization, special reasoning, and geometric modeling be utilized to solve problems?

Instructional Strategies

- Presentations
- Demonstrations
- Examples
- Problem solving
- Brainstorming
- Group Work
- Effective use of Smart-Board
- Calculator Exercises
- Discovery Method

Learning Standards from Mass. Frameworks

Attached is an appendix from the Frameworks relevant to this course and referenced by number and strand in the course outline

Course Outline

G.G.2	Deductive Reasoning
G.G.1	Points, Lines, and Planes
G.G.1	Angles and Segments
G.G.11	The Coordinate Plane
G.G.1	Types of angles and parallel lines
G.G.8	Properties of Triangles
G.G.1	Properties of Polygons
G.G.1	Properties of Quadrilaterals
G.G.8	Congruent and similar Polygons
G.G.2	Circles and their properties
G.G.15	Reflections, Translations, Rotations, and Dilations
G.M.1	Area and perimeter of polygons
G.M.1	The Pythagorean Theorem and its converse
10.G.1	Special Right Triangles
G.G.5	Proving Triangles Congruent
10.G.2	Similarity of Triangles
G.M.2	Volume and Surface Area of Solids
A.II.G.I	Finding Trigonometric Values

Major Evaluation Strategies/Assessments

- Tests
- Homework
- Quizzes
- CORE Assignments
- Open Response Questions
- Rubric used for Open Response and CORE Assignment

Learning Standards for Geometry

Note: The parentheses at the end of a learning standard contain the code number for the corresponding standard in the two-year grade spans.

Geometry

[Analyze characteristics](#) and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships
[Specify locations](#) and describe spatial relationships using coordinate geometry and other representational systems
[Apply transformations](#) and use symmetry to analyze mathematical situations
[Use visualization](#), spatial reasoning, and geometric modeling to solve problems

Students engage in problem solving, communicating, reasoning, connecting, and representing as they:

- G.G.1 Recognize special types of polygons (e.g., isosceles triangles, parallelograms, and rhombuses). Apply properties of sides, diagonals, and angles in special polygons; identify their parts and special segments (e.g., altitudes, midsegments); determine interior angles for regular polygons. Draw and label sets of points such as line segments, rays, and circles. Detect symmetries of geometric figures.
- G.G.2 Write simple proofs of theorems in geometric situations, such as theorems about congruent and similar figures, parallel or perpendicular lines. Distinguish between postulates and theorems. Use inductive and deductive reasoning, as well as proof by contradiction. Given a conditional statement, write its inverse, converse, and contra positive.
- G.G.3 Apply formulas for a rectangular coordinate system to prove theorems.
- G.G.4 Draw congruent and similar figures using a compass, straightedge, protractor, or computer software. Make conjectures about methods of construction. Justify the conjectures by logical arguments. (10.G.2)
- G.G.5 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. (10.G.4)
- G.G.6 Apply properties of angles, parallel lines, arcs, radii, chords, tangents, and secants to solve problems.
- G.G.7 Solve simple triangle problems using the triangle angle sum property, and/or the Pythagorean theorem. (10.G.5)
- G.G.8 Use the properties of special triangles (e.g., isosceles, equilateral, $30^\circ\text{--}60^\circ\text{--}90^\circ$, $45^\circ\text{--}45^\circ\text{--}90^\circ$) to solve problems. (10.G.6)
- G.G.9 Define the sine, cosine, and tangent of an acute angle. Apply to the solution of problems.
- G.G.10 Apply the triangle inequality and other inequalities associated with triangles (e.g., the longest side is opposite the greatest angle) to prove theorems and solve problems.
- G.G.11 Demonstrate an understanding of the relationship between various representations of a line. Determine a line's slope and x- and y-intercepts from its graph or from a linear equation that represents the line. Find a linear equation describing a line from a graph or a geometric description of the line, e.g., by using the "point-slope" or "slope y-intercept" formulas. Explain the significance of a positive, negative, zero, or undefined slope. (10.P.2)
- G.G.12 Using rectangular coordinates, calculate midpoints of segments, slopes of lines and segments, and distances between two points, and apply the results to the solutions of problems. (10.G.7)
- G.G.13 Find linear equations that represent lines either perpendicular or parallel to a given line and

- through a point, e.g., by using the “point-slope” form of the equation. (10.G.8)
- G.G.14 Demonstrate an understanding of the relationship between geometric and algebraic representations of circles.
- G.G.15 Draw the results, and interpret transformations on figures in the coordinate plane, e.g., translations, reflections, rotations, scale factors, and the results of successive transformations. Apply transformations to the solution of problems. (10.G.9)
- G.G.16 Demonstrate the ability to visualize solid objects and recognize their projections and cross sections. (10.G.10)
- G.G.17 Use vertex-edge graphs to model and solve problems. (10.G.11)
- G.G.18 Use the notion of vectors to solve problems. Describe addition of vectors and multiplication of a vector by a scalar, both symbolically and pictorially. Use vector methods to obtain geometric results. (12.G.3)

Learning Standards for Measurement

[Understand measurable attributes](#) of objects and the units, systems, and processes of measurement

[Apply appropriate techniques, tools, and formulas](#) to determine measurements

Students engage in problem solving, communicating, reasoning, connecting, and representing as they:

- G.M.1 Calculate perimeter, circumference, and area of common geometric figures such as parallelograms, trapezoids, circles, and triangles. (10.M.1)
- G.M.2 Given the formula, find the lateral area, surface area, and volume of prisms, pyramids, spheres, cylinders, and cones, e.g., find the volume of a sphere with a specified surface area. (10.M.2)
- G.M.3 Relate changes in the measurement of one attribute of an object to changes in other attributes, e.g., how changing the radius or height of a cylinder affects its surface area or volume. (10.M.3)
- G.M.4 Describe the effects of approximate error in measurement and rounding on measurements and on computed values from measurements. (10.M.4)
- G.M.5 Use dimensional analysis for unit conversion and to confirm that expressions and equations make sense. (12.M.2)

**MELROSE PUBLIC SCHOOLS
MATHEMATICS DEPARTMENT
COURSE SYLLABUS**

Course Title: Math Analysis

Course Description

Math Analysis C.P. 1 1 Credit

This course strengthens the concepts covered in Algebra II. New topics include complex numbers, conic sections, rational exponents, logarithms, conic sections polynomial functions, rational functions, and some different methods to solve quadratic equations.

School Wide Learning Expectations

- Students will demonstrate the ability to use technology responsibly and effectively
- Students will demonstrate the ability to problem solve effectively

Course Specific Goals

Students will be able to:

- Determine the relationship between polynomial functions, their graphs, and solutions
- Effectively solve quadratic equations utilizing various methods
- Effectively solve systems of equations and inequalities algebraically and geometrically
- Perform all operations with the set of complex numbers
- Effectively identify the key components of the conic sections and graph each conic

Essential Questions

- When does the need for imaginary numbers come into clear view in math?
- What essential components are necessary in order to graph polynomial functions?
- How is the process of completing the square utilized in deriving the quadratic formula?
- How do rational exponents connect to radicals?
- What are the key components of each of the 4 conic sections?

Instructional Strategies

- Presentations
- Demonstrations
- Examples
- Problem solving
- Brainstorming

- Group Work
- Effective use of Smart-Board
- Calculator Exercises
- Discovery Method

Learning Standards from Mass. Frameworks

Attached is an appendix from the Frameworks relevant to this course and referenced by number and strand in the course outline

Course Outline

12P8 Solving Linear Equations and Inequalities
 12P8 Graphing Lines and Determining Equations of Lines
 12N2 Laws of Exponents
 10P3 Operations with Polynomials
 12P11 Factoring Polynomials
 12P5 Composition of Functions
 12P11 Inverse Functions
 A1P8 The Conic Sections
 A1P10 Operations with Rational Expressions
 A1P10 Solving Equations with Rational Expressions
 12N1 Operations with Complex Numbers
 12P5 Graphing Polynomial Functions
 12P6 Graphing Rational Functions
 12P10 Simplifying Radicals
 12N2 Simplifying Expressions with Rational Exponents
 12P6 Simplifying Logarithmic Functions
 12P9 Linear Systems
 12P9 Binomial Expansion with Pascal's Triangle

Major Evaluation Strategies/Assessments

- Tests
- Homework
- Quizzes
- CORE Assignments
- Open Response Questions
- Rubric used for Open Response and CORE Assignment

Learning Standards for Grades 11–12

Number Sense and Operations

[Understand numbers](#), ways of representing numbers, relationships among numbers, and number systems

[Understand meanings](#) of operations and how they relate to one another

[Compute fluently](#) and make reasonable estimates

Students engage in problem solving, communicating, reasoning, connecting, and representing as they:

- 12.N.1 Define complex numbers (e.g., $a + bi$) and operations on them, in particular, addition, subtraction, multiplication, and division. Relate the system of complex numbers to the systems of real and rational numbers.
- 12.N.2 Simplify numerical expressions with powers and roots, including fractional and negative exponents.

Patterns, Relations, and Algebra

[Understand patterns](#), relations, and functions

[Represent and analyze](#) mathematical situations and structures using algebraic symbols

[Use mathematical models](#) to represent and understand quantitative relationships

[Analyze change](#) in various contexts

Students engage in problem solving, communicating, reasoning, connecting, and representing as they:

- 12.P.1 Describe, complete, extend, analyze, generalize, and create a wide variety of patterns, including iterative and recursive patterns such as Pascal's Triangle.
- 12.P.2 Identify arithmetic and geometric sequences and finite arithmetic and geometric series. Use the properties of such sequences and series to solve problems, including finding the general term and sum recursively and explicitly.
- 12.P.3 Demonstrate an understanding of the binomial theorem and use it in the solution of problems.
- 12.P.4 Demonstrate an understanding of the trigonometric, exponential, and logarithmic functions.
- 12.P.5 Perform operations on functions, including composition. Find inverses of functions.
- 12.P.6 Given algebraic, numeric and/or graphical representations recognize functions as polynomial, rational, logarithmic, exponential, or trigonometric.
- 12.P.7 Find solutions to quadratic equations (with real coefficients and real or complex roots) and apply to the solutions of problems.
- 12.P.8 Solve a variety of equations and inequalities using algebraic, graphical, and numerical methods, including the quadratic formula; use technology where appropriate. Include polynomial, exponential, logarithmic, and trigonometric functions; expressions involving absolute values; trigonometric relations; and simple rational expressions.
- 12.P.9 Use matrices to solve systems of linear equations. Apply to the solution of everyday problems.
- 12.P.10 Use symbolic, numeric, and graphical methods to solve systems of equations and/or inequalities involving algebraic, exponential, and logarithmic expressions. Also use technology where appropriate. Describe the relationships among the methods.
- 12.P.11 Solve everyday problems that can be modeled using polynomial, rational,

exponential, logarithmic, trigonometric, and step functions, absolute values, and square roots. Apply appropriate graphical, tabular, or symbolic methods to the solution. Include growth and decay; joint (e.g., $I = Prt$, $y = k(w_1 + w_2)$) and combined ($F = G(m_1m_2)/d^2$) variation, and periodic processes.

12.P.12 Relate the slope of a tangent line at a specific point on a curve to the instantaneous rate of change. Identify maximum and minimum values of functions in simple situations. Apply these concepts to the solution of problems.

12.P.13 Describe the translations and scale changes of a given function $f(x)$ resulting from substitutions for the various parameters a , b , c , and d in $y = af(b(x + c/b)) + d$. In particular, describe the effect of such changes on polynomial, rational, exponential, logarithmic, and trigonometric functions.

Geometry

[Analyze characteristics](#) and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships
[Specify locations](#) and describe spatial relationships using coordinate geometry and other representational systems
[Apply transformations](#) and use symmetry to analyze mathematical situations
[Use visualization](#), spatial reasoning, and geometric modeling to solve problems

Students engage in problem solving, communicating, reasoning, connecting, and representing as they:

- 12.G.1 Define the sine, cosine, and tangent of an acute angle. Apply to the solution of problems.
- 12.G.2 Derive and apply basic trigonometric identities (e.g., $\sin^2\theta + \cos^2\theta = 1$, $\tan^2\theta + 1 = \sec^2\theta$) and the laws of sines and cosines.
- 12.G.3 Use the notion of vectors to solve problems. Describe addition of vectors and multiplication of a vector by a scalar, both symbolically and geometrically. Use vector methods to obtain geometric results.
- 12.G.4 Relate geometric and algebraic representations of lines, simple curves, and conic sections.
- 12.G.5 Apply properties of angles, parallel lines, arcs, radii, chords, tangents, and secants to solve problems.

Measurement

[Understand measurable attributes](#) of objects and the units, systems, and processes of measurement
[Apply appropriate techniques, tools, and formulas](#) to determine measurements

Students engage in problem solving, communicating, reasoning, connecting, and representing as they:

- 12.M.1 Describe the relationship between degree and radian measures, and use radian measure in the solution of problems, in particular, problems involving angular velocity and acceleration.
- 12.M.2 Use dimensional analysis for unit conversion and to confirm that expressions and equations make sense.

Data Analysis, Statistics, and Probability

[Formulate questions](#) that can be addressed with data and collect, organize, and display relevant data to answer them
[Select and use](#) appropriate statistical methods to analyze data
[Develop and evaluate](#) inferences and predictions that are based on data
[Understand and apply](#) basic concepts of probability

Students engage in problem solving, communicating, reasoning, connecting, and representing as they:

- 12.D.1 Design surveys and apply random sampling techniques to avoid bias in the data collection.
- 12.D.2 Select an appropriate graphical representation for a set of data and use appropriate statistics (e.g., quartile or percentile distribution) to communicate information about the data.
- 12.D.3 Apply regression results and curve fitting to make predictions from data.
- 12.D.4 Apply uniform, normal, and binomial distributions to the solutions of problems.

- 12.D.5 Describe a set of frequency distribution data by spread (i.e., variance and standard deviation), skewness, symmetry, number of modes, or other characteristics. Use these concepts in everyday applications.
- 12.D.6 Use combinatorics (e.g., “fundamental counting principle,” permutations, and combinations) to solve problems, in particular, to compute probabilities of compound events. Use technology as appropriate.
- 12.D.7 Compare the results of simulations (e.g., random number tables, random functions, and area models) with predicted probabilities.

**MELROSE PUBLIC SCHOOLS
MATHEMATICS DEPARTMENT
COURSE SYLLABUS**

Course Title: Pre-Calculus

Course Description

Pre-Calculus

C.P. 1

1 Credit

This course covers the conic sections, exponential and logarithmic functions, analytical geometry, imaginary and complex numbers, the trigonometric functions, using trigonometry to solve problems, and binomial expansion. The honors level introduces limits and derivatives.

School Wide Learning Expectations

- Students will demonstrate the ability to use technology responsibly and effectively
- Students will demonstrate the ability to problem solve effectively

Course Specific Goals

Students will be able to:

- Effectively graph functions and relate their graphical representations to their algebraic ones
- Graph polynomial functions by examining end behavior, intercepts, and multiplicities
- Graph exponential and logarithmic functions
- Determine measure of angles and sides of triangles by utilizing trigonometry
- Solve problems by using the law of sines and the law of cosines

Essential Questions

- How are trigonometric functions related to their geometric definitions?
- How are polynomial functions of all degrees solved over complex and real fields?
- How are geometric and algebraic representations of curves translated between each other and applied to solutions of problems?
- How do transformations affect graphs of all types and how can the results be predicted and interpreted?
- How do the trigonometric identities connect to the Pythagorean Theorem and how are they used to solve problems?

Instructional Strategies

- Presentations
- Demonstrations
- Examples
- Problem solving
- Brainstorming
- Group Work
- Effective use of Smart-Board
- Calculator Exercises
- Discovery Method

Learning Standards from Mass. Frameworks

Attached is an appendix from the Frameworks relevant to this course and referenced by number and strand in the course outline

Course Outline

AIIN2	Radicals and Rational Exponents
AIPP6	Functions and Properties
AIPP5	Twelve Basic Functions
AIPP4	Exponential and Logarithmic Functions
PCP8	Conic Sections
PCN1	Imaginary and Complex Numbers
PCP2	Polynomial Functions and Their Graphs
AIPP4	Rational Functions
PCN1	Complex Zeros and Fundamental Theorem of Algebra
PCM1	Relationship Between Degree Measure and Radian Measure
PCP5	Angles and Measures
PCP3	Trigonometric Functions
PCP6	Graphs of Trigonometric Functions
PCP3	Inverse Trigonometric Functions
PCP4	Using Trigonometric Functions to Solve Right Triangles
PCP4	Trigonometric Identities
PCG1	Law of Sines and Cosines
PCG2	Discrete Math Topics
PCG2	Vectors
PCP9	Introduction to Limits

Major Evaluation Strategies/Assessments

- Tests
- Homework
- Quizzes
- CORE Assignments
- Open Response Questions

- Rubric used for Open Response and CORE Assignment

Learning Standards for Precalculus

Note: The parentheses at the end of a learning standard contain the code number for the corresponding standard in the two-year grade spans.

Learning Standards for Number Sense and Operations

[Understand numbers](#), ways of representing numbers, relationships among numbers, and number systems

[Understand meanings](#) of operations and how they relate to one another

[Compute fluently](#) and make reasonable estimates

Students engage in problem solving, communicating, reasoning, connecting, and representing as they:

PC.N.1 Plot complex numbers using both rectangular and polar coordinates systems. Represent complex numbers using polar coordinates, i.e., $a + bi = r(\cos\theta + isin\theta)$. Apply DeMoivre's theorem to multiply, take roots, and raise complex numbers to a power.

Patterns, Relations, and Algebra

[Understand patterns](#), relations, and functions

[Represent and analyze](#) mathematical situations and structures using algebraic symbols

[Use mathematical models](#) to represent and understand quantitative relationships

[Analyze change](#) in various contexts

Students engage in problem solving, communicating, reasoning, connecting, and representing as they:

PC.P.1 Use mathematical induction to prove theorems and verify summation formulas, e.g.,

$$\text{verify } \sum_{k=1}^n k^2 = \frac{n(n+1)(2n+1)}{6}.$$

PC.P.2 Relate the number of roots of a polynomial to its degree. Solve quadratic equations with complex coefficients.

PC.P.3 Demonstrate an understanding of the trigonometric functions (sine, cosine, tangent, cosecant, secant, and cotangent). Relate the functions to their geometric definitions.

PC.P.4 Explain the identity $\sin^2\theta + \cos^2\theta = 1$. Relate the identity to the Pythagorean theorem.

PC.P.5 Demonstrate an understanding of the formulas for the sine and cosine of the sum or the difference of two angles. Relate the formulas to DeMoivre's theorem and use them to prove other trigonometric identities. Apply to the solution of problems.

PC.P.6 Understand, predict, and interpret the effects of the parameters a , ω , b , and c on the graph of $y = a\sin(\omega(x - b)) + c$; similarly for the cosine and tangent. Use to model periodic processes. (12.P.13)

PC.P.7 Translate between geometric, algebraic, and parametric representations of curves. Apply to the solution of problems.

PC.P.8 Identify and discuss features of conic sections: axes, foci, asymptotes, and tangents. Convert between different algebraic representations of conic sections.

PC.P.9 Relate the slope of a tangent line at a specific point on a curve to the instantaneous rate of change. Explain the significance of a horizontal tangent line. Apply these concepts to the solution of problems.



Geometry

[Analyze characteristics](#) and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships
[Specify locations](#) and describe spatial relationships using coordinate geometry and other representational systems
[Apply transformations](#) and use symmetry to analyze mathematical situations
[Use visualization](#), spatial reasoning, and geometric modeling to solve problems

Students engage in problem solving, communicating, reasoning, connecting, and representing as they:

- PC.G.1 Demonstrate an understanding of the laws of sines and cosines. Use the laws to solve for the unknown sides or angles in triangles. Determine the area of a triangle given the length of two adjacent sides and the measure of the included angle. (12.G.2)
- PC.G.2 Use the notion of vectors to solve problems. Describe addition of vectors, multiplication of a vector by a scalar, and the dot product of two vectors, both symbolically and geometrically. Use vector methods to obtain geometric results. (12.G.3)
- PC.G.3 Apply properties of angles, parallel lines, arcs, radii, chords, tangents, and secants to solve problems. (12.G.5)

Measurement

[Understand measurable attributes](#) of objects and the units, systems, and processes of measurement
[Apply appropriate techniques, tools, and formulas](#) to determine measurements

Students engage in problem solving, communicating, reasoning, connecting, and representing as they:

- PC.M.1 Describe the relationship between degree and radian measures, and use radian measure in the solution of problems, in particular problems involving angular velocity and acceleration. (12.M.1)
- PC.M.2 Use dimensional analysis for unit conversion and to confirm that expressions and equations make sense. (12.M.2)

Data Analysis, Statistics, and Probability

[Formulate questions](#) that can be addressed with data and collect, organize, and display relevant data to answer them
[Select and use](#) appropriate statistical methods to analyze data
[Develop and evaluate](#) inferences and predictions that are based on data
[Understand and apply](#) basic concepts of probability

Students engage in problem solving, communicating, reasoning, connecting, and representing as they:

- PC.D.1 Design surveys and apply random sampling techniques to avoid bias in the data collection. (12.D.1)
- PC.D.2 Apply regression results and curve fitting to make predictions from data. (12.D.3)
- PC.D.3 Apply uniform, normal, and binomial distributions to the solutions of problems. (12.D.4)

- PC.D.4 Describe a set of frequency distribution data by spread (variance and standard deviation), skewness, symmetry, number of modes, or other characteristics. Use these concepts in everyday applications. (12.D.5)
- PC.D.5 Compare the results of simulations (e.g., random number tables, random functions, and area models) with predicted probabilities. (12.D.7)

- What is the related rate of change and how does one distinguish and how are related rates used in physical situations?
- What are some of the applications of calculus techniques to real world problems in engineering, physics, and other sciences?

Instructional Strategies

- Demonstrations
- Presentations
- Examples
- Problem Solving
- Group Work
- Effective Use of Smart-Board
- Calculator Exercises
- Discovery Method

Course Outline

Slope and Linear Equations
 Linear Transformations
 Solving Equations Graphically
 Inverse Functions
 Logarithmic and Exponential Functions
 Limits, Continuity and the Definition of the Derivative
 Graphical and Algebraic Approaches to Limits
 Derivatives and the Notion of Slope
 Differential Techniques
 Power, Sum, and Constant Rules
 Product and Quotient Rules
 Chain Rule and Implicit Derivatives
 Applications of Derivatives
 Extrema
 Related Rates
 Critical Points and Curve Sketching
 Integration
 The Fundamental Theorem of Calculus
 Approximating Area with Rectangles
 Definite and Indefinite Integrals
 Integrals by Substitution
 Integration by Parts
 Partial Fractions
 Applications of Definite Integrals
 Volumes and Solids of Revolution

Other Applications

Major Evaluation Strategies/Assessments

- Tests
- Homework
- Quizzes
- CORE Assignments
- Open Response Questions
- Rubric Used for Open Response questions and CORE Assignments

**MELROSE PUBLIC SCHOOLS
MATHEMATICS DEPARTMENT
COURSE SYLLABUS**

Course Title: Transition to College Algebra

Course Description

Transition to College Algebra CP 1 1 Credit

This course reviews difficult topics in previous algebra and geometry courses. Topics include trigonometry, complex numbers, advanced algebra and analytical geometry. Emphasis is placed on graphing techniques as well as the basic mathematical formulas. This course provides a solid foundation for students planning further study in the social sciences, education or other liberal arts disciplines.

School Wide Learning Expectations

- Students will demonstrate the ability to use technology responsibly and effectively
- Students will demonstrate the ability to problem solve effectively

Course Specific Goals

Students will be able to:

- Solve and graph linear and quadratic equations
- Solve linear systems and determine the points of intersection
- Determine the area and perimeter of simple and complex polygons
- Utilize trigonometry to solve both practical and theoretical problems
- Explore practical application problems involving the conic sections

Essential Questions

- How does the graph of vertical parabolas connect to quadratic equations?
- How is trigonometry used to solve missing angles and sides of right triangles?
- How do rational exponents connect to radicals?
- What number systems make up the complex number system?
- How is algebra utilized to solve word problems?

Instructional Strategies

- Demonstrations

- Presentations
- Examples
- Problem Solving
- Group Work
- Effective Use of Smart-Board
- Calculator Exercises
- Discovery Method

Learning Standards from Mass. Frameworks

Attached is an appendix from the Frameworks relevant to this course and referenced by number and strand in the course outline

Course Outline

12P8 Solving Linear Equations and Inequalities
 12P8 Laws of Exponents
 12P8 Operations with Polynomials
 12P8 Solving Polynomial Equations
 12P8 the Quadratic Formula
 12P8 Operations with Radicals
 12N2 Rational Exponents
 12P4 Logarithms
 12N1 Imaginary and Complex Numbers
 12P1 Binomial Expansion
 12P4 Functions
 12P6 Solving Exponential Functions
 12P10 Solving Linear Systems
 12P12 Determining Linear Equations and Graphing Lines
 12G1 Basic Trigonometric Functions
 12G2 Solving Right Triangles Using Trigonometry
 12M1 Converting Between radian Measure and Degree Measure
 12G4 The Conic Sections

Major Evaluation Strategies/Assessments

- Tests
- Homework
- Quizzes
- CORE Assignments
- Open Response Questions
- Rubric Used for Open Response questions and CORE Assignments

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Learning Standards for Grades 11–12

Number Sense and Operations

[Understand numbers](#), ways of representing numbers, relationships among numbers, and number systems
[Understand meanings](#) of operations and how they relate to one another
[Compute fluently](#) and make reasonable estimates

Students engage in problem solving, communicating, reasoning, connecting, and representing as they:

- 12.N.3 Define complex numbers (e.g., $a + bi$) and operations on them, in particular, addition, subtraction, multiplication, and division. Relate the system of complex numbers to the systems of real and rational numbers.
- 12.N.4 Simplify numerical expressions with powers and roots, including fractional and negative exponents.

Patterns, Relations, and Algebra

[Understand patterns](#), relations, and functions
[Represent and analyze](#) mathematical situations and structures using algebraic symbols
[Use mathematical models](#) to represent and understand quantitative relationships
[Analyze change](#) in various contexts

Students engage in problem solving, communicating, reasoning, connecting, and representing as they:

- 12.P.14 Describe, complete, extend, analyze, generalize, and create a wide variety of patterns, including iterative and recursive patterns such as Pascal's Triangle.
- 12.P.15 Identify arithmetic and geometric sequences and finite arithmetic and geometric series. Use the properties of such sequences and series to solve problems, including finding the general term and sum recursively and explicitly.
- 12.P.16 Demonstrate an understanding of the binomial theorem and use it in the solution of problems.
- 12.P.17 Demonstrate an understanding of the trigonometric, exponential, and logarithmic functions.
- 12.P.18 Perform operations on functions, including composition. Find inverses of functions.
- 12.P.19 Given algebraic, numeric and/or graphical representations recognize functions as polynomial, rational, logarithmic, exponential, or trigonometric.
- 12.P.20 Find solutions to quadratic equations (with real coefficients and real or complex roots) and apply to the solutions of problems.
- 12.P.21 Solve a variety of equations and inequalities using algebraic, graphical, and numerical methods, including the quadratic formula; use technology where appropriate. Include polynomial, exponential, logarithmic, and trigonometric functions; expressions involving absolute values; trigonometric relations; and simple rational expressions.
- 12.P.22 Use matrices to solve systems of linear equations. Apply to the solution of everyday problems.

- 12.P.23 Use symbolic, numeric, and graphical methods to solve systems of equations and/or inequalities involving algebraic, exponential, and logarithmic expressions. Also use technology where appropriate. Describe the relationships among the methods.
- 12.P.24 Solve everyday problems that can be modeled using polynomial, rational, exponential, logarithmic, trigonometric, and step functions, absolute values, and square roots. Apply appropriate graphical, tabular, or symbolic methods to the solution. Include growth and decay; joint (e.g., $I = Prt$, $y = k(w_1 + w_2)$) and combined ($F = G(m_1m_2)/d^2$) variation, and periodic processes.
- 12.P.25 Relate the slope of a tangent line at a specific point on a curve to the instantaneous rate of change. Identify maximum and minimum values of functions in simple situations. Apply these concepts to the solution of problems.
- 12.P.26 Describe the translations and scale changes of a given function $f(x)$ resulting from substitutions for the various parameters a , b , c , and d in $y = af(b(x + c/b)) + d$. In particular, describe the effect of such changes on polynomial, rational, exponential, logarithmic, and trigonometric functions.

Geometry

[Analyze characteristics](#) and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships
[Specify locations](#) and describe spatial relationships using coordinate geometry and other representational systems
[Apply transformations](#) and use symmetry to analyze mathematical situations
[Use visualization](#), spatial reasoning, and geometric modeling to solve problems

Students engage in problem solving, communicating, reasoning, connecting, and representing as they:

- 12.G.6 Define the sine, cosine, and tangent of an acute angle. Apply to the solution of problems.
- 12.G.7 Derive and apply basic trigonometric identities (e.g., $\sin^2\theta + \cos^2\theta = 1$, $\tan^2\theta + 1 = \sec^2\theta$) and the laws of sines and cosines.
- 12.G.8 Use the notion of vectors to solve problems. Describe addition of vectors and multiplication of a vector by a scalar, both symbolically and geometrically. Use vector methods to obtain geometric results.
- 12.G.9 Relate geometric and algebraic representations of lines, simple curves, and conic sections.
- 12.G.10 Apply properties of angles, parallel lines, arcs, radii, chords, tangents, and secants to solve problems.

Measurement

[Understand measurable attributes](#) of objects and the units, systems, and processes of measurement
[Apply appropriate techniques, tools, and formulas](#) to determine measurements

Students engage in problem solving, communicating, reasoning, connecting, and representing as they:

- 12.M.3 Describe the relationship between degree and radian measures, and use radian measure in the solution of problems, in particular, problems involving angular velocity and acceleration.
- 12.M.4 Use dimensional analysis for unit conversion and to confirm that expressions and equations make sense.

Data Analysis, Statistics, and Probability

[Formulate questions](#) that can be addressed with data and collect, organize, and display relevant data to answer them
[Select and use](#) appropriate statistical methods to analyze data
[Develop and evaluate](#) inferences and predictions that are based on data
[Understand and apply](#) basic concepts of probability

- Students engage in problem solving, communicating, reasoning, connecting, and representing as they:*
- 12.D.8 Design surveys and apply random sampling techniques to avoid bias in the data collection.
- 12.D.9 Select an appropriate graphical representation for a set of data and use appropriate statistics (e.g., quartile or

- percentile distribution) to communicate information about the data.
- 12.D.10 Apply regression results and curve fitting to make predictions from data.
- 12.D.11 Apply uniform, normal, and binomial distributions to the solutions of problems.
- 12.D.12 Describe a set of frequency distribution data by spread (i.e., variance and standard deviation), skewness, symmetry, number of modes, or other characteristics. Use these concepts in everyday applications.
- 12.D.13 Use combinatorics (e.g., “fundamental counting principle,” permutations, and combinations) to solve problems, in particular, to compute probabilities of compound events. Use technology as appropriate.
- 12.D.14 Compare the results of simulations (e.g., random number tables, random functions, and area models) with predicted probabilities.

**MELROSE PUBLIC SCHOOLS
MATHEMATICS DEPARTMENT
COURSE SYLLABUS**

Course Title: Consumer Math

Course Description

Consumer Math

CP2

1 Credit

This course prepares students to apply computing skills to solve everyday personal finances. Units covered include banking, checking accounts, credit cards, budgeting, job related finances, taxes, housing installment buying, household bills, insurance, financing a car, investing, and retirement.

School Wide Learning Expectations

- Students will demonstrate the ability to use technology responsibly and effectively
- Students will demonstrate the ability to problem solve effectively

Course Specific Goals

Students will be able to:

- Compute interest for all types of loans and read bank statements
- Create a working budget while maintaining this budget for an event
- Budget and calculate costs for food, housing, clothing, and home care
- Determine how the stock market can be utilized for investment purposes
- Determine individual income taxes by filling out necessary forms

Essential Questions

- What forms are necessary in order to file income taxes?
- How are monthly payments on a mortgage determined?
- How can credit cards affect a person's financial situation?
- What typical expenses make up a household budget?
- What type of investment opportunities are available for individuals?

Instructional Strategies

- Demonstrations
- Presentations
- Examples
- Problem Solving
- Group Work
- Effective Use of Smart-Board
- Calculator Exercises
- Discovery Method

Course Outline

Budgeting
 Personal Finance
 Banking
 Checking
 Buying a Car
 Obtaining a Mortgage
 Renting
 Types of Taxes
 Filing Income Taxes
 Job Benefits
 Preparing for Retirement
 Job Related Budgets
 Investing
 Insurance
 Everyday Math in Shopping

Major Evaluation Strategies/Assessments

- Tests
- Homework
- Quizzes
- CORE Assignments
- Open Response Questions

- Rubric Used for Open Response questions and CORE Assignments

