MARYLAND STATE DEPARTMENT OF EDUCATION
Achievement Matters Most

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Maryland's Voluntary State Curriculum - High School Mathematics

All high school students in the 21st century need to be mathematically competent and confident problem solvers if they are going to be able to be successful after graduation. The goal of the Maryland Voluntary State Curriculum (VSC) for High School Mathematics for College and Workplace Readiness is to provide high school students access to a curriculum that will achieve this goal by preparing graduating seniors for the first credit-bearing mathematics course in college and/or preparing them for employment in high-performance, high-growth jobs.

The Algebra/Data Analysis and Geometry Voluntary State Curricula are divided into three columns:

- Identified prerequisites from the Voluntary State Curriculum for Mathematics 3-8(VSC 3-8)
- Algebra/Data Analysis or Geometry Core Learning Goals (CLG)
- Additional Topics

The first column, devoted to the VSC 3-8 curriculum, includes the prerequisite knowledge for students prior to their studying the Algebra/Data Analysis or Geometry curriculum. The second column contains the Core Learning Goals (CLG). All students must successfully complete an Algebra/Data Analysis course and a Geometry course in which the CLG are a part of the curriculum. The Algebra/Data Analysis CLG are assessed on the High School Assessment, a requirement for a high school diploma. The Algebra/Data Analysis High School Assessment also provides the data used to produce a school's Adequate Yearly Progress required by the No Child Left Behind Act. The third column includes additional topics for this course. The format of three columns is designed to assist teachers in seeing the connections between the VSC 3-8, CLG, and additional topics. Information concerning instruction and assessment of the curriculum in the Algebra/Data Analysis and Geometry Core Learning Goals can be found at http://www.mdk12.org/instruction/curriculum/mathematics

The Algebra II Voluntary State Curriculum (VSC AII) is divided into two columns:

- Algebra II Core Content
- Additional topics

The first column is comprised of an edited version of the Bridge Goals that was prepared during 1996-2000 by a group of Maryland's high school and college mathematics teachers. The edited version also includes content contained in the American Diploma Project Algebra II curriculum. The goal of the VSC AII is for students to be prepared to enter successfully into a credit-bearing college mathematics course.

As an integral part of the learning and assessment of mathematics in Maryland, students are expected to be able to communicate mathematically by explaining how they arrive at a solution to a given problem, and to justify the correctness of their solution. Where appropriate, justifications may be given in the form of an algebraic or geometric proof. In addition, the processes of problem solving and reasoning should be integral to the mathematics curriculum. Formative and summative assessments should reflect the instruction while addressing the various levels of cognitive demand in mathematics. Real-world applications and connections to other disciplines are critical to all mathematics, and should be included throughout the mathematics curriculum. Note that specific applications are not included in these documents. This is a deliberate decision to avoid an unintentional narrowing of the instruction. Examples of applications may be found in public release items at http://www.mdk12.org/intruction/curriculum/mathematics/clg_toolkit.html

Technology – in the form of graphing calculators, computers and appropriate software-- is vital to the study of mathematics, and should be used to enhance students' understanding of various mathematics subject matter. Technology should be employed when it can enhance students' understanding without diminishing mental mathematics and estimation skills.

Maryland's Voluntary State Curriculum for High School Mathematics will help teachers provide instruction in mathematics that enables students to view mathematics as an understandable, useful, and enjoyable subject.

Voluntary State Curriculum – Algebra II

Algebra II Voluntary State Curriculum (VSC)	
Algebra II Goal 1: Integration into Broader Knowledge **The student will develop, analyze, communicate, and apply models to real-world situations using the language of mathematics and appropriate technology.**	**Additional Topics Would Include**
1.1 The student will model and interpret real-world situations, using the language of mathematics and appropriate technology. **1.1.1 The student will determine and interpret a linear function when given a graph, table of values, essential characteristics of the function, or a verbal description of a real-world situation.** **Assessment Limits** ➢ The majority of these items should be in context. ➢ Essential characteristics are any points on the line, x- and y-intercepts*, and slope*. **Skill Statement** Given one or more of the following: • a verbal description • a graph • a table of values* • an equation* • two or more essential characteristics • an absolute value equation the student will be able to do each of the following: • write and/or solve an equation or an inequality that models the situation • graph the function • find and/or interpret the meaning of any essential characteristics in the context of the problem. *Students should be able to perform these skills with and without the use of a graphing calculator.	

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1.1 The student will model and interpret real-world situations, using the language of mathematics and appropriate technology. **1.1.2 The student will determine and interpret a quadratic function when given a graph, table of values, essential characteristics of the function, or a verbal description of a real-world situation.** **Assessment Limits** ➢ The majority of the items should be in context. ➢ Essential characteristics are zeros, vertex (maximum or minimum), y-intercept, increasing and decreasing behavior. ➢ A table of values must include rational zeros and at least one other point. ➢ All have real zeros. **Skill Statement** Given one or more of the following: • a verbal description • a graph • a table of values • a function in equation form the student will be able to do each of the following: • find one or more of the essential characteristics • write the function in equation form • graph the function • approximate the value of f(x) for a given number x • determine x for a given value of f(x).	**Conic Sections** **1.1.2.0 The student will determine and interpret information from models of simple conic sections.** **Assessment Limits** ➢ The majority of the items should be in context. ➢ Ellipses and hyperbolas will have axes parallel to the x and y axes and centers at the origin. **Skill Statement** ➢ Given its center and radius, the student will write an equation of a circle. ➢ Given an equation of a circle, the student will find the center and radius of the circle. ➢ The student will graph equations of circles. ➢ The student will graph ellipses and hyperbolas.

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1.1 The student will model and interpret real-world situations, using the language of mathematics and appropriate technology. **1.1.3 The student will determine and interpret an exponential function when given a graph, table of values, essential characteristics of the function, or a verbal description of a real-world situation.** **Assessment Limits** ➢ The majority of the items should be in context. ➢ Essential characteristics are y-intercepts, asymptotes, increasing or decreasing. ➢ For $f(x) = a\,b^{x}$, $b > 0$, a and b are rational numbers, b is not 1. ➢ The y-values for x =0 and x = 1 will be given. **Skill Statement** Given one or more of the following: • a verbal description • a graph • a table of values • a function in equation form the student will be able to do each of the following: • find one or more of the essential characteristics • write the function in equation form • graph the function • approximate the value of f(x) for a given number x • determine x for a given value of f(x). **1.1.4 The student will be able to use logarithms to solve problems that can be modeled using an exponential function.** **Assessment Limits** ➢ The majority of the items should be in context. ➢ Properties used to solve problems may include the product, quotient, and/or power properties of logarithms. **Skill Statement** ➢ Given verbal descriptions and formulas in exponential form, the student will be able to use the properties of logarithms to solve problems such as exponential growth and decay.	

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1.2 Given an appropriate real-world situation, the student will choose an appropriate linear, quadratic, polynomial, absolute value, piecewise-defined, simple rational or exponential model and apply that model to solve the problem. **Assessment Limits** ➢ The majority of the items should include a verbal description of a real-world situation. **Skill Statement** ➢ Given a scatter plot of approximately linear data, the student will write an equation of best fit and/or use that equation to find values for x or f(x) using a graphing calculator. ➢ Given a verbal description and/or a table of values of a function, the students will recognize that the function is linear, quadratic, polynomial, absolute value, piecewise-defined, simple rational or exponential and/or write the appropriate equation that models the situation. **1.3 The student will communicate the mathematical results in a meaningful manner.** **1.3.1 The student will describe the reasoning and processes used in order to reach the solution to a problem.** **Assessment Limits** ➢ This indicator is assessed through the implementation of the Core Learning Goal rubric for the constructed response items. **1.3.2 The student will ascribe a meaning to the solution in the context of the problem and consider the reasonableness of the solution.** **Assessment Limits** ➢ This indicator is assessed through the implementation of the Core Learning Goal rubric for the constructed response items.	**Correlation Coefficient** 1.2.0.1 The student will communicate when it is appropriate to use a line of best fit to make predictions based on its correlation coefficient. **Statistics** 1.3.0.1 The student will compute and interpret summary statistics for distributions of data including measures of center (mean, median, and mode) and spread (range, percentiles, variance, and standard deviation). 1.3.0.2 The student will interpret the meaning of the characteristics of the Gaussian normal distribution (bell-shaped curve).

Voluntary State Curriculum – Algebra II

Algebra II Voluntary State Curriculum (VSC)	
Algebra II Goal 2: Mathematical Concepts, Language, and Skills **The student will demonstrate the ability to analyze a wide variety of patterns and functional relationships using the language of mathematics and appropriate technology.**	**Additional Topics Would Include**
2.1 The student will be familiar with basic terminology and notation of functions. **2.1.1 The student will identify and use alternative representations of linear, piecewise-defined, quadratic, polynomial, simple rational and exponential functions.** **Assessment Limits** ➢ These items are not in context. **Skill Statement** ➢ Given one or more of the following: • a verbal description • a graph • a table of values • an equation • two or more essential characteristics the student will be able to do each of the following: • find a value for x or f(x) • find real roots • find maximum and/or minimum • find intervals on which the function is increasing and/or decreasing. ➢ Given an absolute value function, the student will graph the function and/or calculate a numeric value of the function.	

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2.1 The student will be familiar with basic terminology and notation of functions. **2.1.2 The student will identify the domain, range, the rule or other essential characteristics of a function.** **Assessment Limits** ➢ Vertical and horizontal lines are included. ➢ Functions with restricted domain and/or range are included. ➢ Absolute value, step, and other piecewise-defined functions are included. ➢ Rational functions should have denominators that are: o linear o quadratic o sum and/or difference of two cubes in factored form. ➢ Essential characteristics of a polynomial function include degree, intercepts, end behavior and symmetry of even or odd power functions. **Skill Statement** ➢ Given one or more of the following: • a graph of a linear or non-linear function or relation including polynomial functions • an equation over a specified interval • a written description of a real-world situation with a restricted domain • a simple rational function the student will be able to do each of the following: • describe the domain • describe the range • describe the end behavior of a polynomial function • describe the symmetry of even or odd power functions • describe the interrelationship between the degree of a polynomial function and the number of intercepts ➢ Given the equation of a function, the student will produce the graph and describe the domain and range using inequalities.	

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2.2 The student will perform a variety of operations and geometrical transformations on functions. **2.2.1 The student will add, subtract, multiply, and divide functions.** **Assessment Limits** ➢ Items involving factoring will be restricted to quadratics or the sum or difference of two cubes. ➢ Long division is restricted to linear, binomial, or monomial terms in the denominator. **2.2.2 The student will find the composition of two functions and determine algebraically and/or graphically if two functions are inverses.** **Assessment Limits** ➢ Functions given in equation form can include linear, quadratic, exponential, logarithmic, or rational functions such as $f(x) = (ax+b)/(cx+d)$. **Skill Statement** ➢ Given a function in equation form, the student will find the inverse function in equation form. ➢ Given a one-to-one function as a graph, the student will graph the inverse of the function. ➢ Given a function as a table of values, the student will determine the domain and/or range of the inverse of the function. **2.2.3 The student will perform translations, reflections, and dilations on functions.** **Assessment Limits** ➢ Translations are either vertical or horizontal shifts. ➢ Dilations either shrink or stretch a function. ➢ This indicator assesses recognition of translations, reflections, and dilations on functions. ➢ Transformations for absolute value functions are restricted to translations and reflections. They do not include dilations. ➢ Exponential functions are restricted to translations. **Skill Statement** ➢ The student will describe the effect that changes in the parameters of a linear, quadratic or exponential function have on the shape and position of its graph. ➢ Given a verbal description of a transformed linear, quadratic, or exponential function, the student will write the function in equation form. ➢ Given a transformed linear, quadratic, or exponential function in equation form, the student will give a verbal description of the transformation.	

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Algebra II Goal 2: Mathematical Concepts, Language, and Skills **The student will demonstrate the ability to analyze a wide variety of patterns and functional relationships using the language of mathematics and appropriate technology.**	**Additional Topics Would Include**
2.3 The student will identify linear and nonlinear functions expressed numerically, algebraically, and graphically. **Assessment Limits** ➢ Functions can include linear, quadratic, exponential, logarithmic or functions such as f(x) = (ax + b)/(cx + d) ➢ The items may have no real world context given. ➢ Graphs may include piece-wise functions. **Skill Statement** Given one or more of the following: • a table of values • a graph the student will be able to do each of the following: • choose the correct equation or graph from the same family of functions • choose the correct equation or graph from a variety of families of functions. **2.4 The student will describe or graph notable features of a function using standard mathematical terminology and appropriate technology.** **Assessment Limits** ➢ Essential characteristics of a linear, quadratic, or exponential function are those listed for 1.1.1, 1.1.2, and 1.1.3. ➢ Transformations for an absolute value function in one variable are restricted to translations and reflections. They do not include dilations. **Skill Statement** ➢ Given one or more of the essential characteristics of a function, the student will graph the function. ➢ Given the equation form of a linear, quadratic, or exponential function, the student will find one or more required essential characteristic and/or graph the function.	**Binomial Theorem** 2.3.0.1 The student will expand powers of binomials by using Pascal's triangle and the binomial theorem. 2.3.0.2 The student will use the binomial theorem to determine the probability of an event.

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Algebra II Voluntary State Curriculum (VSC)	
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2.5 The student will use numerical, algebraic, and graphical representations to solve equations and inequalities. **Assessment Limits** ➢ Equations may be in one or two variables. ➢ Quadratic equations and inequalities are included. ➢ Higher-order polynomial equations will be factorable. ➢ Absolute value equations and inequalities are single variable and may be linear or quadratic. ➢ Radical equations will lead to a linear or quadratic equation. ➢ Rational equations will lead to a linear or quadratic equation. ➢ Simple rational inequalities will lead to a linear inequality. ➢ Exponential equations are either of the form $f(x) = a\,b^{x}$, $b > 0$, a and b are rational numbers, b is not 1 or the form $c^{nx+d} = g^{mx+f}$, where c and g are powers of the same base. **Skill Statement** ➢ Given an equation or inequality, the student will find the solution and express the solution algebraically and graphically. For constructed response items the student will also justify their method and/or solution. **2.6 The student will solve systems of linear equations and inequalities.** **Assessment Limits** ➢ Systems of linear equations will be 2 x 2 or simple 3 x 3 that do not take too much time to solve without a calculator. ➢ Systems of linear inequalities will be 2 x 2. **Skill Statement** ➢ Algebraically and graphically solve 2 x 2 systems of linear equations and algebraically solve simple 3 x 3 systems of linear equations. ➢ Solve systems of two linear inequalities in two variables and graph the solution set. ➢ Interpret the solution(s) to systems of equations and inequalities in terms of the context of the problem.	

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2.7 The student will use the appropriate skills to assist in the analysis of functions. **2.7.1 The student will add, subtract, multiply, and divide polynomial expressions.** **Assessment Limits** ➢ Rational expressions may include monomials, quadratics, and the sum and difference of two cubes. **2.7.2 The student will perform operations on complex numbers.** **Skills Statements** ➢ The student will represent the square root of a negative number in the form bi, where b is real; simplify powers of pure imaginary numbers. ➢ The student will add, subtract, and multiply complex numbers. ➢ The student will simplify rational expressions containing complex numbers in the denominator. **2.7.3 The student will determine the nature of the roots of a quadratic equation and solve quadratic equations of the form $y = ax^2 + bx + c$ by factoring and the quadratic formula.** **Assessment Limits** ➢ The solutions may be real or complex numbers. **2.7.4 The student will simplify and evaluate expressions with rational exponents.** **2.7.5 The student will perform operations on radical and exponential forms of numerical and algebraic expressions.** **Skills Statements** ➢ The student will convert between and among radical and exponential forms of expressions. ➢ The student will add, subtract, multiply, and divide radical expressions. ➢ The student will apply the laws of exponents to expressions with rational and negative exponents to order and rewrite in alternative forms. **Assessment Limits** ➢ Denominators in problems requiring rationalizing the denominator are restricted to square roots. ➢ Radicals containing a numerical coefficient are restricted to square roots and cube roots. **2.7.6 The student will simplify and evaluate expressions and solve equations using properties of logarithms.** **Assessment Limits** ➢ Properties of logarithms include the Change of Base Formula, property of equality for logarithmic functions, and the product, quotient, and power properties of logarithms.	

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2.8 The student will use literal equations and formulas to extract information. **Assessment Limits** ➢ Problems may include addition/subtraction and multiplication/division properties of equality, factoring a common factor, and terms that are rational.	**Arithmetic and Geometric Series** 2.9.0.1 The student will represent the general term of an arithmetic or geometric sequence and use it to determine the value of any particular term. 2.9.0.2 The student will represent partial sums of an arithmetic or geometric sequence and determine the value of a particular partial sum. 2.9.0.3 The student will find the sum of an infinite geometric series whose common ratio, r, is in the interval (-1, 1). 2.9.0.4 The student will recognize and solve problems that can be modeled using a finite arithmetic or geometric series.