

High School - Mathematics

Middle Years Programme / IB Diploma Programme

Introduction

Mathematics at Alto is taught in an integrated approach so that students build solid foundations and have regular exposure to the four main areas of mathematics which are number, algebra, shape, and data. The regular revisiting of topics permits students to be sure in their understanding as they push the boundaries of other standard curricula.

Middle Years Programme

Grade 9

Major Unit	Statement of Inquiry	Topics / Content
Quadratic relationships	Modeling helps understand relationships between variables and can inform behavior	<ul style="list-style-type: none"> Factorization of quadratic expressions Solving quadratic equations algebraically and graphically Analyzing and using well-defined procedures for solving complex problems
Linear functions	Patterns in the natural world can be represented as relationships and thus help in making predictions	<ul style="list-style-type: none"> The linear function $f(x) = mx + c$, its graph, gradient and y-intercept Parallel and perpendicular lines and the relationships between their gradients Solving equations algebraically and graphically Solving simultaneous equations
Coordinate geometry	Systems of representation have their limitations	<ul style="list-style-type: none"> Understanding and using the Cartesian plane and plotting points. Finding distances between points and finding the midpoint
Similarity and Right-angle trigonometry	Using knowledge it is possible to calculate what we cannot measure	<ul style="list-style-type: none"> Properties of similar triangles Trigonometric ratios in right-angled triangles Relating angles and sides of right-angled triangles using sine, cosine, and tangent Solving problems involving similarity Solving problems in right-angled triangles using trigonometric ratios
3D and complex shapes	Appropriate calculations can save natural resources	<ul style="list-style-type: none"> Finding the perimeter (circumference), area and volume of regular and irregular two-dimensional (2D) and three-dimensional (3D) shapes Compound shapes
Central tendency and range for continuous data	Logic can help us justify our choices	<ul style="list-style-type: none"> Calculating the mean, median and mode, and choosing the best measure of central tendency Box-and-whisker plots Representation using box and whisker diagram

Grade 10

Major Unit	Statement of Inquiry	Topics / Content
Quadratic functions	Using a model to represent a relationship can improve decision making	<ul style="list-style-type: none"> Graphing quadratic function and understanding its characteristics Determining composite functions and their graphs. Addition and subtraction of functions Describing and analyzing transformed quadratic functions Determining the range, given the domain Translating, reflecting and dilating functions
Linear programming	Representing a system of relationships can help us understand how to make better use of resources	<ul style="list-style-type: none"> Solving and graphing linear inequalities Linear programming
Sinusoidal functions	Changing parameters of a shape can lead to desired outcomes	<ul style="list-style-type: none"> Transformation of sine and cosine functions Graphing sine and cosine functions and understanding their characteristics Using the sine and cosine rules to solve problems Trigonometric identities The unit circle
Exponentials and logarithms	Discovering relationships can lead to understanding how systems evolve	<ul style="list-style-type: none"> Finding and justifying a general rule for a sequence Arithmetic and geometric series Developing, and justifying or proving, general rules/formulae for sequences Finding the sum of the series, including infinite series Using the laws of logarithms Determining inverse functions and their graphs
Circle geometry	Logic can be used to justify what we discover through measurement	<ul style="list-style-type: none"> Using circle theorems to find lengths of chords and measures of angles Converting angles between degrees and radians Solving problems using radians
Vectors	Using different forms of representation can help to make more successful journeys	<ul style="list-style-type: none"> Addition, subtraction and scalar multiplication of vectors, both algebraically and graphically Dot product
Probability	Decisions reached through logic may not reflect beliefs and values	<ul style="list-style-type: none"> Calculating probabilities of independent events, mutually exclusive events, and combined events Solving problems using tree diagrams and Venn diagrams Calculating conditional probability

IB Diploma Programme

Students select either higher level (HL) or standard level (SL) mathematics analysis and approaches. Both levels share a core set of topics in the five units, and HL students learn additional topics and content for each unit. [Read more.](#)

Grade 11 - Standard Level and Higher Level

Major Unit	SL/HL topics and content	HL additional topics and content
Number and Algebra	<ul style="list-style-type: none"> Operations with numbers in the form $ax10^k$ Arithmetic sequences and series Geometric sequences and series Financial applications or geometric sequences and series Laws of exponents and introduction to logarithms Simple deductive proof Laws of exponents with rational exponents, the laws of logarithms including change of base and solving exponential equations Sum of an infinite convergent geometric sequence Binomial theorem and Pascal's triangle Permutations, combinations, and binomial theorem for fractional and negative indices 	<ul style="list-style-type: none"> Partial fractions Basic operations with complex numbers and the complex plane Different forms of complex numbers and operations with them Complex conjugate roots of quadratic and polynomial equations and De Moivre's theorem Proof by induction, contradiction, and counterexample Solution of a system of linear equations in up to three equations in three unknowns
Functions	<ul style="list-style-type: none"> Straight lines, including parallel and perpendicular Functions, inverses, domain, and range Graphs of a function Key features of graphs including points of intersection Composite and identity functions Quadratic equation Solution of quadratic equations and inequalities, the use of the discriminant to determine the nature of roots Reciprocal and rational functions, equations of asymptotes Exponential and logarithmic functions and their graphs Solving equations graphically, analytically, and using technology Transformations of graphs 	<ul style="list-style-type: none"> Graphs of equations of polynomial functions, factor and remainder theorem, sum and product of roots of polynomial equations Rational functions involving a quadratic function Odd and even functions, finding inverse functions, self-inverse functions Solving inequalities graphically and analytically Graphs of functions involving absolute value
Geometry and trigonometry	<ul style="list-style-type: none"> Three-dimensional space, volumes, and surface areas of three-dimensional solids Sine, cosine, and tangent in right-angled triangles. Sine rule and cosine rule Applications of right-angled and non-right angled trigonometry Arc length and sector area Unit circle, definition of $\tan x$, exact trigonometric values and the ambiguous case of the sine rule Pythagorean identity, double angle identity and the relationship between trigonometric ratios Graphs of trigonometric functions, amplitude, period and application in real life Solving trigonometric equations infinite intervals using graphical and analytical methods 	<ul style="list-style-type: none"> Reciprocal trigonometric identities, their use in the Pythagorean identities and inverse trigonometric functions Compound angle formulae and double angle identity for \tan Relationship between trigonometric functions and the symmetry properties of their graphs Basic properties of vectors including algebraic and geometric approaches Scalar product, angle between two vectors, parallel and perpendicular lines Vector equation of a line, angle between two lines and simple applications to kinematics Coincident, parallel, intersecting, and skew lines and finding points of intersection Vector product including properties and geometric interpretation

		<ul style="list-style-type: none"> • Vector equations of a plane • Intersection between a line and a plane, two planes, three planes. Angle between a line and plane, two planes
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Grade 12 - Standard Level and Higher Level

Major Unit	SL/HL topics and content	HL additional topics and content
Mathematical exploration	<ul style="list-style-type: none"> • An individual exploration into a research question that investigates an area of mathematics. 	
Statistics and probability	<ul style="list-style-type: none"> • Samples, populations, and outliers • Presentation of data, cumulative frequency curves, box and whisker plots • Mean, median, mode, standard deviation, and quartiles • Linear correlation, scatter diagrams, and lines of regression • Basic probability • Venn diagrams, tree diagrams, combined events, conditional probability, independent events • Discrete random variables and expectation • Binomial distribution including mean and variance • Normal distribution • Equation of regression line of x on y and using the equation for prediction purposes • Formal definitions and using formulae for conditional probability and independent events • Standardization of normal variables including inverse normal calculations where the mean and the standard deviation are unknown • Use of Bayes' theorem for a maximum of 3 events 	<ul style="list-style-type: none"> • Continuous and discrete random variables, finding the mean and variance for both, finding mode and median for continuous random variables
Calculus	<ul style="list-style-type: none"> • Basic concept of a limit and derivative as a gradient function • Increasing and decreasing functions • Derivatives of powers of x • Finding the equations of tangents and normals to curves • Integration as anti-differentiation, using boundary conditions and finding simple areas under curves • Derivatives of functions, chain rule, product rule, quotient rule • Second derivatives and graphical behavior • Local maximum and minimum points and their tests, optimization, and points of inflection • Kinematic problems • Indefinite integration of functions, and integration using reverse chain rule and substitution • Definite integration, areas of regions, areas between curves 	<ul style="list-style-type: none"> • Continuity and differentiability at a point. Derivatives from first principles. Higher derivatives. • L'Hôpital's rule including cases involving repeated use • Implicit differentiation, related rates of change and optimization • Derivatives of inverse trigonometric functions, integrals where the result is an inverse trigonometric function or natural logarithm, using partial fractions to integrate • Integration by substitution. Integration by parts, including examples which require repeated use of the technique • Areas under curves and volumes of revolution • Solving differential equations using variables separable and homogeneous equations using substitution. Solving first-order differential equations using Euler's method • Maclaurin series including formation from differential equations

Detailed scope and sequences for each grade might vary. Teachers are encouraged to incorporate current events into the curriculum and adapt their statement of inquiry-based on classroom discussions.