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UNIVERSITY PRESS

Mapping of

International Baccalaureate Diploma Programme Mathematics:
Analysis and Approaches syllabus

with Cambridge University Press Coursebooks:
(Published in 2012)

Mathematics Higher Level for the IB Diploma,
Mathematics Standard Level for the IB Diploma,
and Mathematical Studies Standard Level for the IB Diploma

Brighter Thinking

Better Learning

The new syllabus is categorised into Mathematics Analysis and Approaches SL and HL and Mathematics Applications and Interpretation SL and HL. Having looked at the content of both categories, it is clear that each consists of the blend of topics from previous syllabuses: Mathematical Studies SL, Mathematics SL, Mathematics HL, and Further Mathematics HL, and some additional topics not listed in the previous syllabus.

Consequently, teachers who previously used the IB Mathematics coursebooks by Cambridge University Press* can still use these books for teaching the new syllabus. The purpose of this document is to align the content of the **Mathematics Analysis and Approaches syllabus with the content of the Cambridge University Press coursebooks that published in 2012.**

The alignment itself is structured into four columns: Mathematics Analysis and Approaches (Number and Algebra, Functions, Geometry and Trigonometry, Statistics and Probability, and Calculus), Mathematics HL, Mathematics SL, and Mathematical Studies SL contents. For ease of reference, the numbering in this document follows the exact format that is printed in the syllabus and the coursebooks.

Please use this document as a guide as it may not cater for all the details.

Best wishes,

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**Mathematical Studies Standard Level for IB Diploma, Mathematics Standard Level for IB Diploma, Mathematics Higher Level for IB Diploma, and 4 Option books: Mathematics Higher Level Topic 7 Statistics and Probability, Topic 8 Set, Relations and Groups, Topic 9 Calculus, and Topic 10 Discrete Mathematics*

Topic 1 : Number and algebra

Mathematics: analysis and approaches First assessment 2021		Mathematics Higher Level for the IB Diploma Coursebook		Mathematics Standard Level for the IB Diploma Coursebook		Mathematical Studies Standard Level for the IB Diploma Coursebook	
Standard Level							
SL 1.1	Operations with numbers in the form $a \times 10^k$ where $1 \leq a < 10$ and k is an integer					1.3	Expressing very large and very small numbers in standard form
SL 1.2	Arithmetic sequences and series	7C 7D	Arithmetic sequences Arithmetic series	6C 6D	Arithmetic sequences Arithmetic series	3.1 3.2	Arithmetic sequence Arithmetic series: the sum of an arithmetic sequence
	Use of the formulae for the n th term and the sum of the first n terms of the sequence.	7D	Arithmetic series	6D	Arithmetic series	3.1 3.2	Arithmetic sequence Arithmetic series: the sum of an arithmetic sequence
	Use of sigma notation for sums of arithmetic sequences.	7B	General series and sigma notation	6B	General series and sigma notation		
	Applications	7H	Mixed questions	6H	Mixed question on sequences and series	3.2	Arithmetic series: the sum of an arithmetic sequence
	Analysis, interpretation and prediction where a model is not perfectly arithmetic in real life.	7C 7D	Arithmetic Sequence Arithmetic Series	6C 6D	Arithmetic sequences Arithmetic series	3.1 3.2	Arithmetic sequence Arithmetic series: the sum of an arithmetic sequence

Mathematics: analysis and approaches First assessment 2021		Mathematics Higher Level for the IB Diploma Coursebook		Mathematics Standard Level for the IB Diploma Coursebook		Mathematical Studies Standard Level for the IB Diploma Coursebook	
SL 1.3	Geometric sequences and series.	7E	Geometric sequence	6E	Geometric sequences	3.3	Geometric sequences
		7F	Geometric series	6F	Geometric series	3.4	Geometric series: the sum of a geometric sequence
	Use of the formulae for the n th term and the sum of the first n terms of the sequence.	7F	Geometric series	6F	Geometric series	3.4	Geometric series: the sum of a geometric sequence
	Use of sigma notation for sums of geometric sequences.	7B	General series and sigma notation	6B	General series and sigma notation		
	Applications.	7H	Mixed questions	6H	Mixed questions on sequences and series	3.4	Geometric series: the sum of a geometric sequence
SL 1.4	Financial applications of geometric sequences and series: <ul style="list-style-type: none"> • compound interest • annual depreciation 	7H	Mixed questions	6H	Mixed questions on sequences and series	4.2	Compound interest
SL 1.5	Laws of exponents with integer exponents.	2A	Laws of exponents	2A	Laws of exponents		
	Introduction to logarithms with base 10 and e .	2C 2D	The value e Introducing logarithms	2C 2D	The number e Introduction to logarithms		

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	Numerical evaluation of logarithms using technology	2C	The value e	2C	The number e		
		2D	Introducing logarithms	2D	Introduction to logarithms		
SL 1.6	Simple deductive proof, numerical and algebraic; how to lay out a left-hand side to right-hand side (LHS to RHS) proof.	25A	The principle of mathematical induction				
	The symbols and notation for equality and identity.	25F	Induction and inequality				
SL 1.7	Laws of exponents with rational exponents.	2A	Laws of exponents	2A	Laws of exponents		
	Laws of logarithms. $\log_a xy = \log_a x + \log_a y$						
	$\log_a \frac{x}{y} = \log_a x - \log_a y$	2E	Laws of logarithms	2E	Law of logarithms		
	$\log_a x^m = m \log_a x$						
	For $a, x, y > 0$						
	Change of base of a logarithm.	2E	Laws of logarithms	2E	Law of logarithms		

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	$\log_a x = \frac{\log_b x}{\log_b a}$, for $a, b, x > 0$			
	Solving exponential equations, including using logarithms	2G Solving exponential equations	2G Solving exponential equations	
SL 1.8	Sum of infinite convergent geometric sequences	7G Infinite geometric series	6G Infinite geometric series	
SL 1.9	The binomial theorem: Expansion of $(a + b)^n, n \in \mathbb{N}$.	8A Introducing the binomial theorem 8B Applying the binomial theorem 8C Products of binomial expansions 8D Binomial expansions as approximations	7A Introduction to the binomial theorem 7B Binomial coefficients 7C Applying the binomial theorem	
	Use of Pascal's triangle and ${}^n C_r$.	8A Introducing the binomial theorem	7A Introduction to the binomial theorem	
Higher Level				
AHL 1.10	Counting principles, including permutations and combinations	1A The product principle and the addition principle 1B Counting arrangements 1C Algebra of factorials		

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		1D Counting selection 1E Exclusion principle 1F Counting ordered selections 1G Keeping objects together or separated		
	Extension of the binomial theorem to fractional and negative indices, i.e. $(a + b)^n$, $n \in \mathbb{Q}$.	8C Products of binomial expansions	7C Applying the binomial theorem	
AHL 1.11	Partial fractions			
AHL 1.12	Complex numbers: the number i , where $i^2 = -1$. Cartesian form $z = a + bi$; the terms real part, imaginary part, conjugate, modulus and argument.	15A Definition and basic arithmetic of i		
	The complex plane	15B Geometric interpretation		
AHL 1.13	Modulus-argument (polar) Norm $z = r(\cos \theta + i \sin \theta)$ $= r \operatorname{cis} \theta$	15B Geometric interpretation 15C Properties of complex conjugates		

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	Euler form: $z = re^{i\theta}$	15G Complex exponents		
	Sums, products and quotients in Cartesian, polar or Euler forms and their geometric interpretation.	15C Properties of complex conjugates		
AHL 1.14	Complex conjugate roots of quadratic and polynomial equations with real coefficients	15D Complex solutions to polynomial equations 15E Sums and products of roots of polynomials		
	De Moivre's theorem and its extension to rational exponents	15F Operations in polar form		
	Power and roots of complex numbers	15G Complex exponents 15H Roots of complex numbers		
AHL 1.15	Proof by mathematical induction	25A The principle of mathematical induction		
	Proof by contradiction.	25B Induction and series 25C Induction and 25D sequences Induction and 25E differentiation 25F Induction and divisibility		

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		Induction and inequalities		
	Use of a counterexample to show that a statement is not always true.	25B Induction and series 25C Induction and 25D sequences 25E Induction and differentiation 25F Induction and divisibility Induction and inequalities		
AHL 1.16	Solutions of systems of linear equations (a maximum of three equations in three unknowns), including cases where there is a unique solution, an infinite number of solutions or no solution.	4F Systems of linear equations		2.1 Linear equations 2.2 Pairs of linear equations

Topic 2 : Functions

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Standard Level				
SL 2.1	Different forms of the equation of a straight line.	<i>(Prior Learning Topics : Coordinate Geometry, Mathematics HL Syllabus)</i>		14.4 The equation of a straight line
	Gradient; intercepts.			14.1 The gradient of a line
	Lines with gradients m_1 and m_2 .			The gradient of a line
	Parallel line $m_1 = m_2$.			
	Perpendicular lines $m_1 \times m_2 = -1$			
SL 2.2	Concept of a function, domain, range and graph	5A Relations, functions and graphs 5C Domain and range	4B Domain and range	17.1 What is a function? 17.2 Functions in more detail

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	Function notation, for example, $f(x)$, $v(t)$, $C(n)$.	5B	Function notation	4A	Function notation	17.2	Function in more detail
	The concept of a function as a mathematical model	5B	Function notation	2B	Exponential function		
	Informal concept that an inverse function reverses or undoes the effect of a function.	5E	Inverse functions	4D	Inverse functions		
	Inverse function as a reflection in the line $y = x$, and the notation $f^{-1}(x)$.	5E	Inverse functions	4D	Inverse functions		
SL 2.3	The graph of a function ; its equation $y = f(x)$.	5A	Relations, functions and graphs	4B	Domain and range	17.4	Drawing graphs and diagrams
	Creating a sketch from information given or a context, including transferring a graph from screen to paper.					17.4	Drawing graphs and diagrams
	Using technology to graph functions including their sums and differences.						

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SL 2.4	Determine key feature of graphs	4C Features of graphs	3C Features of graphs	17.4 Drawing graphs and diagrams
	Finding the point of intersection of two curves or lines using technology.			17.4 Drawing graphs and diagrams
SL 2.5	Composite functions.	5D Composite functions	4C Composite functions	
	Identity function. Finding the inverse function $f^{-1}(x)$.	5E Inverse functions	4D Inverse functions	
SL 2.6	The quadratic function $f(x) = ax^2 + bx + c$: its graph, y – intercept $(0, c)$. Axis of symmetry.	3D The quadratic formula and discriminant	1A The quadratic form $y = ax^2 + bx + c$	2.3 Quadratic equations 18.2 Quadratic functions and their graphs
	The form of $f(x) = a(x - p)(x - q)$, x – intercepts $(p, 0)$, $(q, 0)$.	<i>(Prior Learning Topics : Algebra, Mathematics HL Syllabus)</i>	1C The factorised form $y = a(x - p)(x - q)$	
	The form $f(x) = a(x - h)^2 + k$, vertex (h, k)	<i>(Prior Learning Topics : Algebra, Mathematics HL Syllabus)</i>		
SL 2.7	Solution of quadratic equations and inequalities.	4G Solving inequalities	3B Solving equations by substitution	
	The quadratic formula.	3D The quadratic formula and discriminant	1D The quadratic formula and the discriminant	

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	The discriminant $\Delta = b^2 - 4ac$ and the nature of the roots, that is, two distinct real roots, two equal real roots, no real roots.			
SL 2.8	The reciprocal function $f(x) = \frac{1}{x}, x \neq 0$: its graph and self-inverse nature form $f(x) = \frac{ax + b}{cx + d}$ and their graphs.	5F Rational functions	4E Rational functions	
	Rational functions of the			17.3 Rational functions
	Equations of vertical and horizontal asymptotes.			17.3 Rational functions
SL 2.9	Exponential functions and their graphs: $f(x) = a^x, a > 0, f(x) = e^x$	2B Exponential functions 16F The exponential and natural logarithm functions	2B Exponential functions	19.1 Exponential functions and their graphs
	Logarithmic functions and their graphs: $f(x) = \log_a x, x > 0,$ $f(x) = \ln x, x > 0.$	16F The exponential and natural logarithm functions	2F Graphs of logarithms	

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SL 2.10	Solving equations, both graphically and analytically	4A Solving equations by factorising 4B Solving equations by substitution	3A Solving equations by factorising	2.1 Linear equations 2.2 Pairs of linear equations 2.3 Quadratic equations
	Use of technology to solve a variety of equations, including those where there is no appropriate analytic approach.	4D Using a graphical calculator to solve equations	3D Using a graphical calculator to solve equations	
	Applications of graphing skills and solving equations that relate to real-life situations.	4D Using a graphical calculator to solve equations	8F Modelling using trigonometric functions	2.1 Linear equations 2.2 Pairs of linear equations 2.3 Quadratic equations
SL 2.11	Transformation of graphs Translations: $y = f(x) + b$; $y = f(x - a)$	6A Translations	5A Translations	
	Reflections (in both axes): $y = -f(x)$; $y = f(-x)$.	6C Reflections	5C Reflections	
	Vertical stretch with scale factor p : $y = pf(x)$.	6B Stretches	5B Stretches	

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	Horizontal stretch with scale factor $\frac{1}{q}$: $y = f(qx)$	6B Stretches	5B Stretches	
	Composite transformations.	6E Consecutive transformation	5D Consecutive transformation	
Higher Level				
AHL 2.12	Polynomial functions, their graphs and equations; zeros, roots and factors	3A Working with polynomial		
	The factor and remainder theorems.	3B Remainder and factor theorems		
	Sums and product of the roots of polynomial equations.	15E Sums and products of roots of polynomials		
AHL 2.13	Rational functions of the form $f(x) = \frac{ax + b}{cx^2 + dx + e},$ and $f(x) = \frac{ax^2 + bx + c}{dx + e}$			
AHL 2.14	Odd and even functions	6G Symmetries of graphs and functions		

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	Finding the inverse functions, $f^{-1}(x)$, Including domain restriction.	5E Inverse functions	4D Inverse functions	
	Self-inverse functions.	5E Inverse functions	4D Inverse functions	
AHL 2.15	Solution of $g(x) \geq f(x)$, both graphically and analytically.	4G Solving Inequalities		
AHL 2.16	The graphs of the functions, $y = f(x) $ and $y = f(x)$, $y = \frac{1}{f(x)}$, $y = f(ax + b)$, $y = [f(x)]^2$ Solution of modulus equations and inequalities.	6D Modulus transformation		

Topic 3: Geometry and trigonometry

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Standard Level							
SL 3.1	The distance between two points in three dimensional space, and their midpoint.	9A	Radian measure	8A	Measuring angles	16.1	Finding the length of a line within a three-dimensional solid
	Volume and surface area of three-dimensional solids including right-pyramid, right cone, sphere, hemisphere and combinations of these solids.	9B	Definitions and graphs of sine and cosine functions	8B	Definitions and graphs of the sine and cosine function		
		<i>(Prior Learning Topics : Geometry, HL Syllabus)</i>				16.3	Calculating volumes and surface areas of three-dimensional solids
SL 3.2	The size of an angle between two intersecting lines or between a line and a plane.	11E	Trigonometry in three dimensions	10E	Trigonometry in three dimensions	16.2	Finding the size of an angle in a three-dimensional solid
	Use of sine, cosine and tangent ratios to find the sides and angles of right-angled triangles.	14E	Angles and intersections between lines and planes				
SL 3.2	The sine rule:	11A	Right-angled triangles	10A	Right-angled triangles	15.1	Trigonometric ratios
		11B	The sine rule	10B	The sine rule	15.4	The sine rule

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	$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$			
	The cosine rule: $c^2 = a^2 + b^2 - 2ab \cos C$ $\cos C = \frac{a^2 + b^2 - c^2}{2ab}$;	11C The cosine rule	10C The cosine rule	15.5 The cosine rule
	Area of a triangle as $\frac{1}{2} ab \sin C$.	11D Area of a triangle	10D Area of a triangle	15.6 Area of a triangle
SL 3.3	Applications of right and non-right angled trigonometry, including Pythagoras' theorem.	11E Trigonometry in three dimensions	10E Trigonometry in three dimensions	15.1 Trigonometric ratios
	Angles of elevation and depression.	11A Right-angled triangles	10A Right-angled triangles	15.2 Angles of elevation and depression
	Construction of labeled diagrams from written statements.			15.7 Constructing labeled diagrams
SL 3.4	The circle: radian measure of angles; length of an arc; area of a sector.	9A Radian measure 11F Length of an arc 11G Area of a sector	8A Measuring angles 10F Length of an arc 10G Area of a sector	

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SL 3.5	Definition of $\cos \theta$, $\sin \theta$ In terms of the unit circle.	9B Definitions and graphs of sine and cosine functions	8B Definitions and graphs of the sine and cosine functions	15.1 Trigonometric ratios
	Definition of $\tan \theta = \frac{\sin \theta}{\cos \theta}$	9C Definition and graph of the tangent function	8C Definition and graph of the tangent function	
	Exact values of trigonometric ratios of $0, \frac{\pi}{6}, \frac{\pi}{4}, \frac{\pi}{3}, \frac{\pi}{2}$ and their multiples.	9D Exact values of trigonometric functions	8D Exact values of trigonometric functions	
	Extension of the sine rule to the ambiguous case.	11B The sine rule	10B The sine rule	
SL 3.6	The Pythagorean identity $\sin^2 \theta + \cos^2 \theta = 1$.	10C Trigonometric identities	9C Trigonometric identities	
	Double angle identities for sine and cosine.	12A Double angle identities	9E Double angle identities	
	The relationship between trigonometric ratios.	10D Using identities to solve equations	9D Using identities to solve equations	

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SL 3.7	The circular functions $\sin x$, $\cos x$, and $\tan x$; Amplitude, their periodic nature, and their graphs	9B Definitions and graphs of sine and cosine functions	8B Definitions and graphs of the sine and cosine functions	
	Composite functions of the form $f(x) = a \sin(b(x + c)) + d$	9E Transformations of trigonometric graphs	8E Transformations of trigonometric graphs	
	Transformations.	9E Transformations of trigonometric graphs	8F Modeling using trigonometric functions	
	Real-life contexts.	9F Modeling using trigonometric functions		
SL 3.8	Solving trigonometric equations in a finite interval, both graphically and analytically	10A Introducing trigonometric equations	9A Introducing trigonometric equations	
	Equations leading to quadratic equations in $\sin x$, $\cos x$, or $\tan x$.	10B Harder trigonometric equations	9B Harder trigonometric equations	
Higher Level				
AHL 3.9	Definition of the reciprocal trigonometric ratios $\sec \theta$, $\operatorname{cosec} \theta$, and $\cot \theta$.	12D Reciprocal trigonometric functions		
	Pythagorean identities: $1 + \tan^2 \theta = \sec^2 \theta$	12D Reciprocal trigonometric functions	9C Trigonometric identities	

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	$1 + \cot^2 \theta = \operatorname{cosec}^2 \theta$ The inverse functions $f(x) = \arcsin x$, $f(x) = \arccos x$ $f(x) = \arctan x$, their domain and ranges; their graphs.	9G Inverse trigonometric functions		
AHL 3.10	Compound angle identities	12D Reciprocal trigonometric functions	9E Double angle identities	
	Double angle identity for tan.	12A Double angle identities	9E Double angle identities	
AHL 3.11	Relationships between trigonometric functions and the symmetry properties of their graphs.	9B Definitions and graphs of sine and cosine functions	8B Definitions and graphs of the sine and cosine functions	
AHL 3.12	Concepts of a vector; position vectors; displacement vectors.	13A Positions and displacements	11A Positions and displacements	
	Representation of vectors using directed line segments.	13A Positions and displacements	11A Positions and displacements	
	Base vectors i, j, k .	13A Positions and displacements	11A Positions and displacements	
	Components of a vector:	13A Positions and displacements	11A Positions and displacements	

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$\mathbf{v} = \begin{bmatrix} v_1 \\ v_2 \\ v_3 \end{bmatrix}$ $= v_1\mathbf{i} + v_2\mathbf{j} + v_3\mathbf{k}.$			
Algebraic and geometric approaches to the following: <ul style="list-style-type: none"> the sum and difference of two vectors 	13B Vector Algebra	11B Vector algebra	
<ul style="list-style-type: none"> the zero vector \mathbf{O}, the vector $-\mathbf{v}$ 	13B Vector Algebra	11B Vector algebra	
<ul style="list-style-type: none"> multiplication by a scalar, $k\mathbf{v}$, parallel vectors 	13B Vector Algebra	11B Vector algebra	
<ul style="list-style-type: none"> magnitude of a vector, \mathbf{v}; unit vector, $\frac{\mathbf{v}}{ \mathbf{v} }$ 	13C Distances	11C Distances	
<ul style="list-style-type: none"> position vectors $\overrightarrow{OA} = \mathbf{a}$, $\overrightarrow{OB} = \mathbf{b}$ 	13A Positions and displacements	11A Positions and displacements	
<ul style="list-style-type: none"> displacement vector $\overrightarrow{AB} = \mathbf{b} - \mathbf{a}$ 	13A Positions and displacements	11A Positions and displacements	

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	Proofs of geometrical properties using vectors.			
AHL 3.13	The definition of the scalar product of two vectors.	13E Properties of the scalar product	11E Properties of the scalar product	
	The angle between two vectors.	13D Angles	11D Angles	
	Perpendicular vectors; parallel vectors.	13E Properties of the scalar product	11G Solving problems involving lines	
AHL 3.14	Vector equation of a line in two and three dimensions: $\mathbf{r} = \mathbf{a} + \lambda\mathbf{b}$	14A Vector equation of a line	11F Vector equation of a line	
	The angle between two lines.	14E Angles and intersections between lines and planes	11D Angles	
	Simple applications to kinematics.	14B Solving problems with lines	11G Solving problems involving lines	
AHL 3.15	Coincident, parallel, intersecting and skew lines, distinguishing between these cases.	14B Solving problems with lines	11G Solving problems involving lines	
	Point of intersection.			

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AHL 3.16	The definition of the vector product of two vectors.	13G Properties of the vector product		
	Properties of the vector product.	13G Properties of the vector product		
	Geometric interpretation of $ \mathbf{v} \times \mathbf{w} $	13G Properties of the vector product		
AHL 3.17	Vector equations of a plane: $\mathbf{r} = \mathbf{a} + \lambda \mathbf{b} + \mu \mathbf{c}$, where \mathbf{b} and \mathbf{c} are non-parallel vectors within the plane.	14D Equations of a plane	11G Solving problems involving lines	
	$\mathbf{r} \cdot \mathbf{n} = \mathbf{a} \cdot \mathbf{n}$, where \mathbf{n} is a normal to the plane and \mathbf{a} is the position vector on a point on the plane.	14D Equations of a plane		
	Cartesian equation of a plane $ax + by + cz = d$	14D Equations of a plane		
AHL 3.18	Intersections of : a line with a plane; two planes; three planes.	14E Angles and intersections between lines and planes		
	Angle between: a line and a plane; two planes.	14E Angles and intersections between lines and planes		

Topic 4 : Statistics and probability

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Standard Level					
SL 4.1	Concepts of population, sample, random sample, discrete and continuous data.	21A	Some important concepts in statistics	5.1 Classifying data	
	Reliability of data sources and bias in sampling.	21A	Some important concepts in statistics	5.1 Classifying data	
	Interpretation of outliers.	21A	Some important concepts in statistics	5.8 Box and whisker diagrams	
	Sampling techniques and their effectiveness.	21A	Some important concepts in statistics	7.1 Range and interquartile range	
SL 4.2	Presentation of data (discrete and continuous): frequency distributions (tables).	21C	Frequency tables and group data	5.2 Simple discrete data	
	Histograms.	21B	Measures of spread	5.6 Frequency histogram	
	Cumulative frequency; cumulative frequency graphs; use to find median, quartiles, percentiles, range and	21B	Measures of spread	5.7 Cumulative frequency	
			16B	Measures of spread	7.1 Range and interquartile range

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	interquartile range (IQR).			
	Production and understanding of box and whisker diagrams.		16D Cumulative frequency	5.8 Box and whisker diagrams
SL 4.3	Measures of central tendency (mean, median and mode).	21C Frequency tables and group data	16A Measures of the centre of data	6.1 Finding the median for simple data 6.2 Finding the mean for discrete and continuous data
	Estimation of mean from grouped data.	21C Frequency tables and group data	16C Frequency tables and grouped data	6.3 Identifying the mode or modal class
	Modal class.			
	Measures of dispersion (interquartile range, standard deviation and variance)	21B Measures of spread	16B Measures of spread	7.1 Range and interquartile range 7.2 Standard deviation
	Effect of constant changes on the original data.	21B Measures of spread	16F Constant changes to data	
	Quartiles of discrete data.	<i>(Prior Learning: Statistics and probability, Mathematics HL Syllabus)</i>	16B Measures of spread	7.1 Range and interquartile range
SL 4.4	Linear correlation of bivariate data.		16G Correlation	12.1 The concept of correlation

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	Pearson's product-moment correlation coefficient, r .		16G Correlation	12.4 Pearson's product moment correlation coefficient, r
	Scatter diagrams; lines of best fit, by eye, passing through the mean point.		16G Correlation	12.2 Scatter diagrams 12.3 Line of best fit
	Equation of the regression line of y on x .		16H Linear regression	12.5 Regression line of y on x
	Use of the equation of the regression line for prediction purposes.		16H Linear regression	12.6 Using the equation of the regression line
	Interpret the meaning of the parameters, a and b , in a linear regression $y = ax + b$		16H Linear regression	12.6 Using the equation of the regression line
SL 4.5	Concepts of trial, outcome, equally likely outcomes, relative frequency, sample space (U) and event.	22A Introduction to probability 22B Combined events and Venn diagrams 22C Tree diagrams and finding the intersection	17A Empirical probability 17B Theoretical probability	10.2 Sample space diagrams
	The probability of an event A is $P(A) = \frac{n(A)}{n(U)}$	22A Introduction to probability	17A Empirical probability	10.3 Calculating probability and the expected value

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	The complementary events A and A' (not A).	22A Introduction to probability	17A Empirical probability	10.1 Introduction to probability
	Expected number of occurrences.		18B Expectation of a discrete random variable	10.3 Calculating probability and the expected value
SL 4.6	Use of Venn diagrams, tree diagrams, sample space diagrams and tables of outcomes to calculate probabilities.	22C Tree diagrams and finding the intersection	17C Combined events and Venn diagrams	10.6 The diagrams and Venn diagrams
	Combined events: $P(A \cup B) = P(A) + P(B) - P(A \cap B)$	22B Combined events and Venn diagrams	17C Combined events and Venn diagrams	10.5 Tree diagrams and Venn diagrams
	Mutually exclusive events: $P(A \cap B) = 0$.	22B Combined events and Venn diagrams	17C Combined events and Venn diagrams	10.4 Mutually exclusive events
	Conditional probability: $P(A B) = \frac{P(A \cap B)}{P(B)}$.	22F Conditional probability	17D Tree diagrams and finding intersections	10.8 Conditional probability
	Independent events: $P(A \cap B) = P(A)P(B)$.	22D Independent events	17E Independent events	10.5 Probability of combined events
SL 4.7	Concept of discrete random variables and their probability distributions.	23A Random variables	18B Expectation of a discrete random variable	
	Expected value (mean), for discrete data.	23B Expectations, median and variance of a	18B Expectation of a discrete random variable	

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			discrete random variable				
	Applications.						
SL 4.8	Binomial distribution.	23C	The binomial distribution	18C	The binomial distribution		
	Mean and variance of the binomial distribution.	23C	The binomial distribution	18C	The binomial distribution		
SL 4.9	The normal distribution and curve.	24C	The normal distribution	18D	The normal distribution	11.1	The normal distribution curve
	Properties of the normal distribution.	24C	The normal distribution	18D	The normal distribution	11.1	The normal distribution curve
	Diagrammatic representation.					11.1	The normal distribution curve
	Inverse normal calculations.	24D	Inverse normal distribution	18E	The inverse normal distribution	11.4	Inverse normal calculations
SL 4.10	Equation of the regression line of x on y .						
	Use of the equation for prediction purposes.						
SL 4.11	Format definition and use of the formulae: $P(A B) = \frac{P(A \cap B)}{P(B)}$ for a conditional probabilities, and	22F	Conditional probability	17D	Tree diagrams and finding intersections	10.8	Conditional probability

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	$P(A B) = P(A) = P(A B')$ for independent events.			
SL 4.12	Standardization of normal variables (z-values)	24C The normal distribution	18D The normal distribution	11.4 Inverse normal calculations
	Inverse normal calculations where mean and standard deviation are unknown.		18E The inverse normal distribution	11.4 Inverse normal calculations
Higher Level				
AHL 4.13	Use of Bayes' theorem for a minimum of three.	22H Bayes' theorem		
AHL 4.14	Variance of a discrete random variable	23B Expectation, median and variance of a discrete random variable	18C The binomial distribution	
	Continuous random variables and their probability density functions	24A Continuous random variables	18A Random variables	
	Mode and median of continuous random variables.	24B Expectation and variance of continuous random variables		
	Mean, variance and standard deviation of both discrete and	23B Expectation, median and variance of a discrete random variable	18B Expectation of a discrete random variable	

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	continuous random variables.	24B Expectation and variance of continuous random variables		
	The effect of linear transformations of X .	1A Adding and multiplying all the data by a constant Mathematics Higher Level Topic 7-Option: Statistics and probability for IB Diploma Coursebook		

Topic 5 : Calculus

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Standard Level				
SL 5.1	Introduction to the concept of a limit	1A The limit of a sequence Mathematics Higher Level Topic 9- Option: Calculus for IB Diploma Coursebook		
	Derivative interpreted as gradient function and as rate of change	16D Interpreting derivatives and second derivatives	12D Interpreting derivatives and second derivatives	20.1 The derivative 20.3 Rates of change
SL 5.2	Increasing and decreasing functions.	16D Interpreting derivatives and second derivatives	12D Interpreting derivatives and second derivatives	20.1 The derivative
	Graphical interpretations of $f'(x) > 0, f'(x) = 0, f'(x) < 0$	16D Interpreting derivatives and second derivatives	12D Interpreting derivatives and second derivatives	20.1 The derivative
SL 5.3	Derivative of $f(x) = ax^n$ is $f'(x) = anx^{n-1}, n \in \mathbb{Z}$	16C Rules of differentiation	12C Rules of differentiation	20.2 differentiation
	The derivative of functions of the form $f(x) = ax^n + bx^{n-1} \dots$ Where all exponents are integers.	16C Rules of differentiation	12C Rules of differentiation	

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SL 5.4	Tangents and normals at a given point, and their equations.	16G Tangent and normals	12G Tangent and normals	20.6 Equation of the tangent at a given point 20.7 Equation of the normal at a given point
SL 5.5	Introduction to integration as anti-differentiation of functions of the form $f(x) = ax^n + bx^{n-1} \dots$ where $n \in \mathbb{Z}$, $n \neq -1$	17C Rules of integration	13A Reversing differentiation	
	Anti-differentiation with a boundary condition to determine the constant term.	17G Definite integration	13G Definite integration	
	Definite integrals using technology.	17H Geometrical significance of definite integration	13H Geometrical significance of definite integration	
	Area of a region enclosed by a curve $y = f(x)$ and the x -axis, where $f(x) > 0$	17I The area between a curve and the y -axis	13I The area between two curves	
SL 5.6	Derivative x^n ($n \in \mathbb{Q}$), $\sin x$, $\cos x$, e^x and $\ln x$.	16E Trigonometric functions 16F The exponential and natural logarithm	12E Differentiating trigonometric functions 12F Differentiating exponential and natural logarithm functions	

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	Differentiation of a sum and a multiple of these functions	16E	Trigonometric functions				
		16F	The exponential and natural logarithm				
	The chain rule for composite functions.	18A	Differentiating composite functions using the chain rule	14A	Differentiating composite functions using the chain rule		
	The product and quotient rules.	18B	Differentiating products using the product rule	14B	Differentiating products using the product rule		
		18C	Differentiating quotients using the quotient rule	14C	Differentiating quotients using the quotient rule		
SL 5.7	The second derivative	16D	Interpreting derivatives and second derivatives	12D	Interpreting derivatives and second derivatives	20.4	The second derivative
	Graphical behavior of functions, including the relationship between the graphs of f , f' and f'' .	16D	Interpreting derivatives and second derivatives				
SL 5.8	Local maximum and minimum points	16H	Stationary points	12H	Stationary points	21.2	Stationary points, maxima and minima
	Testing for maximum and minimum	16H	Stationary points	12H	Stationary points	21.3	Optimization
	Optimization.	16H	Stationary points	12H	Stationary points		

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	Points of inflexion with zero and non-zero gradients.	16I	General points of inflexion	12I	Optimization	21.2	Stationary points, maxima and minima
SL 5.9	Kinematic problems involving displacement s , velocity v , acceleration a and total distance travelled.	20B	Kinematics	15C	Kinematics	20.4	The second derivative
SL 5.10	Indefinite integral x^n ($n \in \mathbb{Q}$), $\sin x$, $\cos x$, $\frac{1}{x}$ and e^x .	17D	Integrating x^{-1} and e^x	13D	Integrating x^{-1} and e^x		
	The composite of any of these with the linear function $ax + b$.	17E	Integrating trigonometric functions	13E	Integrating trigonometric functions		
	Integration by inspection (reverse chain rule) or by substitution for expressions of the form: $\int kg'(x)f(g(x))dx$.	19B	Integration by substitution	15B	Integration by substitution		
SL 5.11	Definite integrals, including analytical approach.	17G	Definite integration	13G	Definite integration		
		17H	Geometrical significance of definite integration	13H	Geometrical significance of definite integration		

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	Areas of a region enclosed by a curve $y = f(x)$ and the x -axis, where $f(x)$ can be positive or negative without the use of technology.	17I The area between a curve and the y -axis	13I The area between two curves	
	Areas between curves.	17J The area between two curves	13I The area between two curves	
Higher Level				
AHL 5.12	Informal understanding of continuity and differentiability of a function at a point.	1E Continuous functions 1F Differentiable functions 1A Limit of a sequence Mathematics Higher Level Topic 9- Option: Calculus Coursebook		
	Understanding of limits (convergence and divergence).	1E Continuous functions 1F Differentiable functions 1A Limit of a sequence Mathematics Higher Level Topic 9- Option: Calculus Coursebook		
	Definition of derivative from first principles $f'(x)$ $= \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$	16B Differentiation from first principle	12B Differentiation from first principle	

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	Higher derivatives			
AHL 5.13	The evaluation of limits of the form $\lim_{x \rightarrow a} \frac{f(x)}{g(x)}$ and $\lim_{x \rightarrow \infty} \frac{f(x)}{g(x)}$ using l'Hospital rule of the Maclaurin series.	4A Maclaurin series 4C Maclaurin series of composite functions 1D l'Hospital's Rule Mathematics Higher Level Topic 9-Option: Calculus Coursebook		
	Repeated use of l'Hospital rule.	4A Maclaurin series 4C Maclaurin series of composite functions 1D l'Hospital's Rule Mathematics Higher Level Topic 9-Option: Calculus Coursebook		
AHL 5.14	Implicit differentiation. Related rates of change.	18D Implicit differentiation		
	Optimization problems	16D Interpreting derivatives and second derivatives	14D Optimization with constraints	21.3 Optimization
AHL 5.15	Derivatives of $\tan x$, $\sec x$, $\operatorname{cosec} x$, $\cot x$, a^x , $\log_a x$, $\arcsin x$, $\arccos x$, $\arctan x$.	16E Trigonometric functions 18E Differentiating inverse trigonometric functions 17E Integrating trigonometric functions		

Mathematics: analysis and approaches First assessment 2021		Mathematics Higher Level for the IB Diploma Coursebook	Mathematics Standard Level for the IB Diploma Coursebook	Mathematical Studies Standard Level for the IB Diploma Coursebook
	Indefinite integrals of the derivatives of any of the above functions.	19D Integration using inverse trigonometric functions		
	The composites of any of these with a linear function.	19D Integration using inverse trigonometric functions		
	Use of partial fractions to rearrange the integrand.	19E Other strategies for integrating quotients		
AHL 5.16	Integration by substitution	19B Integration by substitution	15B Integration by substitution	
	Integration by parts.	19F Integration by parts		
	Repeated integration by parts.			
AHL 5.17	Area of the region enclosed by a curve and the y -axis in a given interval	17I The area between a curve and the y -axis	13I The area between two curves	
	Volumes of revolution about the x -axis or y -axis.	20C Volumes of revolution	15D Volumes of revolution	
AHL 5.18	First order differential equations.	5D Linear differential equations Mathematics Higher Level Topic 9-Option: Calculus Coursebook		
	Numerical solution of	5E Approximations to solutions		

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	$\frac{dy}{dx} = f(x, y)$ using Euler's method.	Mathematics Higher Level Topic 9- Option: Calculus Coursebook		
	Variables separable.	5B Separation of variables Mathematics Higher Level Topic 9- Option: Calculus Coursebook		
	Homogeneous differential equation $\frac{dy}{dx} = f\left(\frac{y}{x}\right)$ using the substitution $y = vx$.	5C Homogenous differential equations Mathematics Higher Level Topic 9- Option: Calculus Coursebook		
	Solution of $y' + P(x)y = Q(x)$, using the integrating factor.	5D Linear differential equations Mathematics Higher Level Topic 9- Option: Calculus Coursebook		
AHL 5.19	Maclaurin series to obtain expansions for $e^x, \sin x, \cos x, \ln(1+x), (1+x)^n, n \in \mathbb{Q}$.	4A Maclaurin series Mathematics Higher Level Topic 9- Option: Calculus Coursebook		
	Use of simple substitution, products, integration and	4C Maclaurin series of composite functions		

Mathematics: analysis and approaches First assessment 2021		Mathematics Higher Level for the IB Diploma Coursebook	Mathematics Standard Level for the IB Diploma Coursebook	Mathematical Studies Standard Level for the IB Diploma Coursebook
	differentiation to obtain other series.	Mathematics Higher Level Topic 9- Option: Calculus Coursebook		
	Maclaurin series developed from differential equations.			