

**ECLASSOPEDIA**

*presents*

# **IB MATHEMATICS**

## **COMPREHENSIVE SUBJECT GUIDE**

*2026 Edition*

Analysis & Approaches • Applications & Interpretation  
Standard Level • Higher Level

## Foreword from Eclassopedia

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Welcome to the Eclassopedia IB Mathematics Comprehensive Subject Guide for 2026. This guide has been carefully developed by our team of experienced IB educators, examiners, and curriculum specialists to serve as an authoritative and student-friendly companion throughout your International Baccalaureate (IB) Mathematics journey. Whether you are embarking on the IB Diploma Programme for the first time or seeking to deepen your conceptual understanding before final examinations, this guide is designed to meet you wherever you are.

At Eclassopedia, our mission is to make world-class education accessible, engaging, and effective. The IB Mathematics curriculum, with its emphasis on inquiry, conceptual understanding, and real-world application, aligns perfectly with our educational philosophy. This guide reflects that shared vision — it does not merely present mathematical content but invites you to explore, question, and connect ideas across disciplines and contexts.

The 2026 edition has been revised and expanded to reflect the most current IB Mathematics curriculum frameworks, including updates to assessment objectives, internal assessment guidance, and the integration of technology in mathematical exploration. Special attention has been paid to higher-order thinking skills, as these are increasingly emphasized in both Standard Level (SL) and Higher Level (HL) examinations.

We are proud to present this guide as a resource for students, teachers, and parents alike. It covers both IB Mathematics courses — Mathematics: Analysis and Approaches (AA) and Mathematics: Applications and Interpretation (AI) — providing clarity on course selection, content coverage, assessment requirements, and examination strategies. Each section has been crafted to be thorough yet accessible, combining formal mathematical language with clear explanations and practical examples.

We hope this guide becomes an indispensable part of your IB Mathematics preparation and that it inspires a genuine love for mathematics — a discipline that is not only essential for further study in science, technology, engineering, and economics, but also deeply beautiful in its own right.

— *The Eclassopedia Academic Team*

## SECTION 1: Introduction to IB Mathematics

### 1. Introduction to IB Mathematics

The International Baccalaureate (IB) Diploma Programme (DP) Mathematics courses are among the most rigorous and respected mathematics qualifications available to pre-university students worldwide. Designed for students aged 16 to 19, the IB Mathematics curriculum is built around a framework of inquiry, critical thinking, and international-mindedness. Students are not merely trained to perform calculations — they are cultivated as mathematical thinkers who can model real-world situations, construct logical arguments, and appreciate the aesthetic dimensions of mathematical reasoning.

#### 1.1 Overview of the IB Diploma Programme

The International Baccalaureate Diploma Programme is a two-year educational programme offered to students around the world. It is recognized by universities globally as an indicator of academic excellence and intellectual maturity. The programme comprises six subject groups, a core element consisting of Theory of Knowledge (TOK), the Extended Essay (EE), and Creativity, Activity, Service (CAS). Mathematics forms Group 5 of the six subject groups and is a compulsory component for all diploma students.

The philosophy of the IB DP emphasizes holistic education. Students are encouraged to develop a genuine passion for learning across disciplines and to understand how different areas of knowledge interconnect. In Mathematics, this translates to an emphasis on mathematical inquiry, exploration of real-world contexts, and reflective thinking about the nature and limitations of mathematical knowledge.

#### 1.2 The Two IB Mathematics Courses

From 2019 onwards (with full implementation through 2026 and beyond), the IB offers two distinct mathematics courses for Diploma students:

- **Mathematics: Analysis and Approaches (AA)** — This course is intended for students who enjoy developing mathematics to a high level and who are interested in exploring real and abstract applications. It is particularly suited for those who wish to pursue mathematics, engineering, physical sciences, economics, or any field that requires strong analytical and theoretical mathematical foundations.
- **Mathematics: Applications and Interpretation (AI)** — This course is designed for students who are interested in developing mathematics for describing our world, modelling, and solving practical problems. It is suited for students entering social sciences, natural sciences, statistics, business, some aspects of computer science, and design.

Each course is offered at two levels:

- Standard Level (SL): Typically 150 teaching hours over two years, covering a broad but moderately deep treatment of the curriculum content.
- Higher Level (HL): Typically 240 teaching hours over two years, offering a more extensive and rigorous treatment, including additional topics not present at SL.

### 1.3 Choosing the Right Course

Selecting the appropriate IB Mathematics course is one of the most consequential academic decisions a student will make during the Diploma Programme. The choice should be guided by several intersecting considerations: the student's mathematical interests and aptitudes, future academic and career aspirations, the requirements of prospective university programmes, and honest self-assessment of mathematical confidence and motivation.

#### Eclassopedia Guidance

Students aiming for STEM or economics at competitive universities should strongly consider Mathematics AA HL. Those pursuing social sciences, humanities, or applied sciences may find Mathematics AI HL or SL more appropriate. Always consult with your IB coordinator and review specific university requirements before making your final choice.

### 1.4 IB Learner Profile in Mathematics

The IB Learner Profile describes ten attributes of internationally minded learners. In Mathematics, these attributes are embodied in the following ways:

- Inquirers: Students develop curiosity about mathematical structures, patterns, and problems.
- Knowledgeable: Students acquire mathematical content spanning algebra, functions, calculus, statistics, and geometry.
- Thinkers: Students apply critical and creative thinking to solve novel mathematical problems.
- Communicators: Students articulate mathematical ideas clearly through symbols, notation, graphs, and written explanation.
- Principled: Students maintain academic integrity in their Internal Assessment and respect mathematical conventions.
- Open-minded: Students appreciate diverse mathematical traditions and the cultural roots of mathematical knowledge.
- Caring: Students consider ethical implications of data use and mathematical modelling.
- Risk-takers: Students are willing to attempt challenging problems and explore unfamiliar mathematical territory.
- Balanced: Students balance rigorous mathematical study with other IB commitments.
- Reflective: Students evaluate their mathematical growth and the quality of their reasoning.

## SECTION 2: Curriculum Content & Core Topics

### 2. Curriculum Content Overview

The IB Mathematics curriculum is organized into five core topic areas, each of which appears in both the AA and AI courses, though with varying emphases, depths, and applications. Understanding the structure of the curriculum is essential for effective planning, studying, and examination preparation. The following sections provide a comprehensive overview of each topic area for both SL and HL across both courses.

#### 2.1 Topic 1: Number and Algebra

Number and Algebra forms the bedrock of both IB Mathematics courses. This topic ensures students are fluent in the fundamental systems and operations of mathematics before progressing to more abstract or applied domains. It lays the groundwork for symbolic reasoning, equation solving, and the formal manipulation of mathematical expressions.

##### 2.1.1 Core Content (SL — Both Courses)

- Operations with numbers in the form  $a \times 10^k$  where  $1 \leq a < 10$  and  $k$  is an integer (scientific notation)
- Arithmetic sequences and series, geometric sequences and series, and their applications
- Financial mathematics: compound interest, depreciation, annuities, and amortization
- Laws of exponents and logarithms, including natural logarithms
- Solving systems of equations, both linear and non-linear
- The binomial theorem, Pascal's triangle, and combinations

##### 2.1.2 Additional HL Content

- Proof by mathematical induction
- Complex numbers: modulus-argument form, Euler's form, De Moivre's theorem
- Conjugate roots theorem and roots of unity
- Partial fractions and their applications
- Systems of three linear equations with three unknowns

The Number and Algebra topic provides students with a rigorous understanding of mathematical structures that underpin more advanced content. Mastery of this topic is essential not just for examinations but for the Internal Assessment, where algebraic fluency is often required to build and analyse mathematical models.

#### 2.2 Topic 2: Functions

Functions are one of the most fundamental organizing principles in mathematics. The Functions topic in IB Mathematics develops students' ability to represent, interpret, and analyse mathematical relationships using multiple representations: equations, tables, graphs, and verbal descriptions. This conceptual flexibility is a hallmark of mathematical maturity.

### 2.2.1 Core Content (SL — Both Courses)

- Concept of a function: domain, range, and inverse functions
- Linear functions, quadratic functions, and their graphs
- Exponential and logarithmic functions and their transformations
- Rational functions: asymptotes, intercepts, and graphical behaviour
- Composite functions and inverse functions
- Solving equations using graphical and algebraic methods
- Transformation of graphs: translations, reflections, stretches

### 2.2.2 Additional HL Content

- Graph theory basics and network diagrams (AI HL)
- Polynomial and rational function analysis, including sign diagrams
- Odd and even functions, and symmetry
- Absolute value functions and reciprocal functions
- The modulus function and solving modulus equations and inequalities

Functions are central to the Internal Assessment. Many students choose to explore functional relationships within real-world data, and a deep understanding of function types, transformations, and properties greatly enhances the quality of mathematical exploration.

## 2.3 Topic 3: Geometry and Trigonometry

This topic encompasses both classical Euclidean geometry and the rich landscape of trigonometric functions, identities, and applications. Geometry and Trigonometry develops spatial reasoning, visualization skills, and the ability to model physical and abstract spatial relationships with mathematical precision.

### 2.3.1 Core Content (SL — Both Courses)

- The sine rule, cosine rule, and the area formula for a triangle
- Radian measure, arc length, and sector area
- The unit circle: sine, cosine, tangent functions and their graphs
- Trigonometric identities including double angle formulas
- Solving trigonometric equations
- Applications of trigonometry to 3D geometry: volume and surface area of prisms, pyramids, cones, spheres
- Bearings and angles of elevation and depression

### 2.3.2 Additional HL Content

- Compound angle identities and their proofs

- Inverse trigonometric functions and their domains and ranges
- Reciprocal trigonometric functions: sec, csc, cot
- Vector geometry in two and three dimensions (detailed in AA HL)
- Voronoi diagrams and their applications (AI HL)
- Graph theory: minimum spanning trees, Chinese Postman, and Travelling Salesman Problems (AI HL)

## 2.4 Topic 4: Statistics and Probability

Statistics and Probability is perhaps the most practically relevant topic in the IB Mathematics curriculum, given the prevalence of data and uncertainty in modern life. This topic develops students' ability to collect, represent, and interpret data, and to reason about randomness and chance with mathematical rigour.

### 2.4.1 Core Content (SL — Both Courses)

- Sampling techniques and data collection methods
- Presentation of data: frequency tables, histograms, cumulative frequency graphs, box plots
- Measures of central tendency and spread: mean, median, mode, variance, standard deviation, IQR
- Correlation and regression: Pearson's correlation coefficient, linear regression lines
- Basic probability: set notation, Venn diagrams, sample spaces
- Conditional probability, mutually exclusive and independent events
- Discrete random variables: probability distributions, expected value
- Binomial distribution: conditions, mean, and variance
- Normal distribution: properties, standardization, z-scores

### 2.4.2 Additional HL Content

- Continuous random variables and probability density functions
- Distribution of the sample mean and the Central Limit Theorem
- Hypothesis testing: null and alternative hypotheses, p-values, Type I and Type II errors
- Chi-squared test for independence and goodness of fit
- Poisson distribution and conditions for its use (AI HL)
- Transition matrices and Markov chains (AI HL)

The Statistics and Probability topic is directly relevant to the Internal Assessment, as many students choose mathematical explorations that involve real-world data analysis. Strong skills in statistical reasoning and interpretation are therefore doubly valuable.

## 2.5 Topic 5: Calculus

Calculus represents one of the most profound intellectual achievements in human history, and it stands at the heart of the IB Mathematics: Analysis and Approaches course. The Calculus topic develops students' understanding of continuous change, the concepts of limits, differentiation, and integration, and their wide-ranging applications across science, engineering, and economics.

### 2.5.1 Core Content (SL — AA Course)

- Concept of a limit and its notation
- Derivative as the gradient of a tangent and as the rate of change
- Differentiation rules: power rule, product rule, quotient rule, chain rule
- Differentiation of trigonometric, exponential, and logarithmic functions
- Applications of differentiation: increasing/decreasing functions, local extrema, optimization, related rates
- The definite and indefinite integral as the antiderivative
- Integration by substitution
- Area under a curve and area between two curves
- Volumes of revolution (HL only)
- Kinematics: displacement, velocity, and acceleration

### 2.5.2 Additional HL Content (AA)

- L'Hôpital's rule and limits of indeterminate forms
- Implicit differentiation
- Integration by parts
- Maclaurin series expansions for standard functions
- First-order differential equations: separation of variables, Euler's method, slope fields
- Coupled systems of differential equations

### 2.5.3 Calculus in AI Course

The AI course includes an introduction to calculus concepts with a strong emphasis on graphical and numerical methods rather than algebraic manipulation. Students use technology to explore derivatives and integrals, focusing on interpretation and application:

- Concept of the derivative and its graphical interpretation
- Differentiation of polynomials and simple functions using technology
- Applications to optimization and modelling
- Integration as the area under a curve using numerical methods and technology
- Trapezoidal rule for numerical integration

## SECTION 3: Assessment Structure

### 3. Assessment Structure and Examination Format

The IB Mathematics assessment system is designed to evaluate a broad range of mathematical competencies, from procedural fluency and conceptual understanding to mathematical communication and independent exploration. Assessment occurs through a combination of external examinations and an internally assessed component. Understanding the assessment structure in detail is crucial for effective examination preparation.

#### 3.1 External Assessment

External assessment in IB Mathematics consists of two written examination papers for SL students and three papers for HL students. These papers are set and marked by the IB and contribute the majority of the final grade.

##### 3.1.1 Paper 1 — No Calculator

Paper 1 tests students on all areas of the syllabus but is specifically designed to assess mathematical thinking without the aid of a graphing calculator or any computing technology. Questions in Paper 1 require exact answers, clean algebraic manipulation, and conceptual understanding. The ability to work fluently with mathematical notation, simplify expressions, and apply theorems without technological assistance is paramount.

- Duration: 90 minutes (SL), 120 minutes (HL)
- Marks: 80 marks (SL), 110 marks (HL)
- Format: Short and extended response questions
- Technology: No calculator permitted
- Weighting: 40% of final grade (SL), 30% of final grade (HL)

##### 3.1.2 Paper 2 — Graphing Calculator Required

Paper 2 permits the use of a graphing calculator (GDC) and is designed to assess mathematical applications in context. Questions typically involve multi-step problems set in real-world scenarios where technology aids exploration, verification, and graphical interpretation. Students must demonstrate not only computational ability but also sound mathematical judgment in selecting appropriate methods and interpreting results.

- Duration: 90 minutes (SL), 120 minutes (HL)
- Marks: 80 marks (SL), 110 marks (HL)
- Format: Short and extended response questions
- Technology: GDC permitted and required

- Weighting: 40% of final grade (SL), 30% of final grade (HL)

### 3.1.3 Paper 3 — HL Only (AA and AI)

Paper 3 is exclusive to HL students and presents two extended problem-solving questions that require sustained mathematical reasoning. These problems are often novel in character — students encounter mathematical scenarios they have not specifically studied — and must demonstrate the ability to apply their knowledge creatively and rigorously. This paper distinguishes HL students as independent mathematical thinkers.

- Duration: 60 minutes
- Marks: 55 marks
- Format: Two extended response questions
- Technology: GDC permitted
- Weighting: 20% of final grade (HL only)

## 3.2 Internal Assessment: The Mathematical Exploration

The Internal Assessment (IA) for IB Mathematics takes the form of a Mathematical Exploration — a piece of independent written work in which students investigate a mathematical topic of personal interest. The Exploration is a cornerstone of the IB Mathematics experience, embodying the programme's commitment to student-centred learning, intellectual inquiry, and mathematical communication.

### 3.2.1 Overview of the Mathematical Exploration

- Word count: Approximately 12 to 20 pages (including mathematical notation, diagrams, and graphs)
- Weighting: 20% of final grade (both SL and HL)
- Developed over the course of the two-year programme
- Submitted for external moderation based on teacher-assigned marks

### 3.2.2 Assessment Criteria

The Mathematical Exploration is assessed against five criteria, each reflecting a different dimension of mathematical competence and intellectual engagement:

- Criterion A — Communication (4 marks): The exploration is organized, coherent, and mathematically precise. Technical language is used appropriately. Work is clearly presented with effective use of notation, diagrams, and technology.
- Criterion B — Mathematical Presentation (4 marks): Mathematical notation, symbols, and conventions are used correctly and appropriately. Graphs, tables, and diagrams are well-labelled and relevant.
- Criterion C — Personal Engagement (3 marks): The student demonstrates initiative, creativity, and genuine personal interest in the topic. The work goes beyond routine exercises to show independent mathematical thinking.
- Criterion D — Reflection (3 marks): The student reflects critically on the results and processes of the exploration, considering implications, limitations, and potential extensions.

- Criterion E — Use of Mathematics (6 marks): The mathematical content is at the appropriate level, is correctly applied, and is relevant to the exploration. At HL, the mathematics must be commensurate with the higher level curriculum.

### **Eclassopedia IA Advice**

Choose a topic that genuinely interests you — personal engagement is both assessed and motivating. Avoid topics that are purely descriptive or lack sufficient mathematical content. Start your exploration early, discuss your ideas with your teacher regularly, and allow time for multiple drafts and revisions.

## **3.3 Grade Boundaries and the 7-Point Scale**

IB grades are awarded on a scale of 1 to 7, where 7 represents the highest level of achievement. Grade boundaries are set by the IB each examination session based on the performance of the global cohort and the difficulty of the papers. While exact boundaries vary each year, the following descriptors provide guidance on the standards expected at each grade level:

- Grade 7 (Excellent): Demonstrates comprehensive knowledge and thorough understanding of the syllabus; applies mathematical skills accurately in a wide variety of contexts; communicates clearly with precision and elegance.
- Grade 6 (Very Good): Demonstrates sound knowledge and understanding; applies mathematical skills accurately in most contexts with minor errors; communicates effectively.
- Grade 5 (Good): Demonstrates satisfactory knowledge and understanding with some gaps; applies mathematical skills in routine contexts with occasional errors; communication is generally clear.
- Grade 4 (Satisfactory): Demonstrates basic knowledge and understanding of the syllabus; applies mathematical skills in familiar contexts with frequent minor errors; communication is adequate.
- Grades 1–3: Indicate varying levels of limited or poor performance, reflecting significant gaps in knowledge and understanding.

## SECTION 4: Study Strategies & IA Guidance

### 4. Study Strategies and Examination Preparation

Success in IB Mathematics is not merely a product of natural aptitude — it is the result of strategic, consistent, and reflective study over the course of the two-year programme. The demands of the IB Mathematics curriculum reward students who approach their learning with discipline, curiosity, and adaptability. This section provides evidence-based study strategies tailored specifically to the IB Mathematics context.

#### 4.1 Building a Study Plan

A well-structured study plan is the single most important tool for IB Mathematics preparation. Given the breadth and depth of the curriculum, leaving revision to the final months before examinations is a high-risk strategy. Instead, students should engage in regular, distributed practice throughout the two years, using examination sessions as milestones for consolidated review.

- Begin by reviewing the full syllabus for your course and level (AA SL/HL or AI SL/HL). Obtain a copy of the IB Mathematics syllabus guide from the IBO or your school and use it as a checklist.
- Divide the five topic areas into manageable subtopics. Allocate study sessions to each subtopic over a realistic timeline, ensuring all content is covered at least once before the first year's end-of-year examinations.
- Schedule regular 'review weeks' every four to six weeks to revisit previously studied material. Spaced repetition significantly improves long-term retention of mathematical concepts and procedures.
- Include dedicated sessions for past paper practice in your plan. Regular exposure to IB examination questions is the most effective form of examination preparation. Aim to complete at least 10 full past papers before your final examinations.
- Use weekends for longer, uninterrupted study sessions that allow you to tackle extended problems and past paper questions in examination conditions.

#### 4.2 Effective Mathematical Practice

Mathematics is a skill as much as a body of knowledge, and skills are developed through consistent, deliberate practice. Passive re-reading of notes or textbooks is far less effective than actively working through problems. The following strategies promote genuine mathematical understanding and examination-ready fluency:

- Work through problems without looking at the solution until you have genuinely attempted them. The struggle of working through difficulty is where real mathematical learning occurs.
- After completing a problem, do not simply check whether your final answer is correct — analyse your method. Could you have solved it more efficiently? Did you use the most appropriate approach? What would happen if the parameters changed?

- Maintain a dedicated 'mistake journal' where you record questions you answered incorrectly, along with the correct solution and a note on where your reasoning went wrong. Review this journal regularly.
- Practice both calculator and non-calculator questions in proportions that match the examination. Many students neglect Paper 1 (non-calculator) practice and pay a significant penalty in the examination.
- Seek to understand not just the 'how' but the 'why' of mathematical procedures. Understanding the conceptual basis of a technique makes it far easier to adapt it to novel problems.

### 4.3 Using Technology Effectively

The use of a Graphing Display Calculator (GDC) is an essential and examined skill in IB Mathematics. The most commonly used calculators are the Texas Instruments TI-84 series and the Casio fx-CG50. Regardless of which model you use, it is vital to develop genuine fluency with your calculator so that it becomes a tool that expands your mathematical capability rather than a crutch that obscures your understanding.

- Learn to graph functions and use trace, intersection, and zero-finding features fluently. These skills are frequently needed in Paper 2 questions.
- Master the statistical functions of your calculator: entering data into lists, calculating summary statistics, performing linear regression, and evaluating binomial and normal distribution probabilities.
- Use your calculator to check algebraic answers computed by hand, but ensure you understand how to verify results analytically as well.
- Practice using your calculator under timed conditions to build speed and accuracy.
- Never use your calculator as a substitute for mathematical understanding. Examiners can distinguish between students who understand the mathematics and those who merely input values into their calculator.

### 4.4 Examination Technique

Even students with excellent mathematical knowledge can underperform in examinations due to poor technique. The following examination-specific strategies are critical for maximising your marks in IB Mathematics papers:

- Read every question carefully before beginning your solution. Underline key terms, identify what is being asked, and note any constraints or given information that may be easy to overlook.
- Show all working clearly and logically. In IB Mathematics, marks are awarded for method as well as for correct final answers. A correct answer without working may receive little or no credit, while a partially correct method with an incorrect final answer may receive significant method marks.
- If you are stuck on a question, move on and return to it later. Do not allow a single difficult question to consume disproportionate examination time.
- In extended response questions, look for 'follow-through' marks — even if your answer to part (a) is incorrect, you can often receive full marks for part (b) if your subsequent work is consistent with your earlier (incorrect) result.
- Check your answers for reasonableness. Does your answer make sense in the context of the problem? Are the units correct? Is the magnitude plausible?

- In Paper 1 (no calculator), leave answers in exact form (e.g., surds, fractions, logarithms) unless the question specifically asks for a decimal approximation.
- Pay close attention to command terms such as 'show that', 'prove', 'find', 'calculate', 'determine', 'state', and 'explain'. Each has a specific meaning in IB examination contexts and carries different expectations for the level of detail required.

## 4.5 Guidance for the Mathematical Exploration (IA)

The Mathematical Exploration offers a unique opportunity to pursue mathematics that genuinely excites you, and to demonstrate mathematical depth, creativity, and independence. Approaching the IA strategically and thoughtfully will result in a piece of work you are genuinely proud of and that earns strong marks.

- **Topic Selection:** Choose a topic at the intersection of personal interest and mathematical depth. Avoid topics that are either too simple (offering insufficient mathematical content) or too ambitious (exceeding your current level). Good explorations typically explore a well-defined question with genuine mathematical substance.
- **Scope and Focus:** Narrow your focus sufficiently. A common mistake is to choose an overly broad topic and produce a superficial survey rather than a deep exploration. A focused investigation of a specific mathematical phenomenon is far more effective.
- **Personal Engagement:** Go beyond textbook mathematics. Introduce your own data, your own parameters, your own twists. Examiners reward originality and genuine intellectual curiosity.
- **Use of Mathematics:** Ensure the mathematics in your exploration is at the appropriate level and correctly applied. At HL, this means demonstrating genuine HL mathematics, not merely SL mathematics with superficial HL terminology.
- **Reflection:** Critically evaluate your findings throughout the exploration. Acknowledge limitations, consider alternative approaches, and discuss potential extensions. Reflection is not an afterthought — it is woven throughout a high-scoring exploration.
- **Communication:** Write for a mathematically informed audience. Define terms, explain your reasoning, label all graphs and diagrams, and present your work in a logical, coherent structure.

## SECTION 5: Technology, TOK, and Resources

# 5. Technology, Theory of Knowledge, and Additional Resources

## 5.1 The Role of Technology in IB Mathematics

Technology plays an increasingly central role in both the learning and assessment of IB Mathematics. The 2026 curriculum explicitly acknowledges that mathematical exploration and discovery are enriched through the intelligent use of technological tools. Students are expected not merely to use technology as a computational shorthand, but to leverage it as a genuine aid to mathematical thinking and understanding.

Beyond the Graphing Display Calculator (GDC), which is required for Paper 2 (and Paper 3 for HL students), students are encouraged to engage with a variety of digital tools throughout their course:

- **GeoGebra:** A free, powerful mathematical software application that integrates geometry, algebra, calculus, statistics, and 3D graphing. GeoGebra is widely used by IB students for visualizing functions, exploring geometric relationships, and enhancing the Internal Assessment.
- **Desmos:** An intuitive and visually appealing online graphing calculator, particularly effective for exploring function transformations, fitting curves to data, and creating interactive mathematical demonstrations.
- **Wolfram Alpha:** A computational knowledge engine that can evaluate complex expressions, solve equations, compute integrals and derivatives, and provide step-by-step solutions. It is a powerful verification tool, though students must develop genuine understanding rather than relying on it uncritically.
- **Statistical Software (R, Python, Excel):** For students engaged in data-heavy explorations, software such as R, Python (with libraries like NumPy, SciPy, and Matplotlib), or Microsoft Excel can significantly enhance the depth and quality of statistical analysis in the Internal Assessment.
- **3D Graphing Tools:** Applications such as GeoGebra 3D or Desmos 3D allow students to visualize surfaces, vectors, and spatial relationships that are central to the HL curriculum.

## 5.2 Mathematics and Theory of Knowledge (TOK)

The Theory of Knowledge (TOK) component of the IB Diploma Programme invites students to reflect on the nature of knowledge across different disciplines. Mathematics occupies a unique and fascinating position within TOK, as it raises profound epistemological questions about the nature of truth, the role of proof, and the relationship between mathematical structures and the physical world.

Some of the most compelling TOK questions in mathematics include:

- Is mathematics discovered or invented? Are mathematical structures inherent features of reality, or are they human constructions? The existence of mathematical objects such as the number  $e$ ,

pi ( $\pi$ ), and the imaginary unit  $i$  seems to suggest an uncanny correspondence between mathematical abstraction and physical reality.

- What is mathematical proof? How does a formal proof differ from inductive evidence or a well-confirmed conjecture? The distinction between mathematical certainty and empirical probability is philosophically significant.
- Can mathematics be certain? Gödel's Incompleteness Theorems demonstrate that within any sufficiently powerful formal mathematical system, there exist true statements that cannot be proved within that system. What does this mean for the reliability of mathematical knowledge?
- What is the role of intuition in mathematical discovery? Many mathematical advances have been guided by aesthetic judgment, analogy, and gut feeling, rather than purely logical deduction.
- How do different cultures engage with mathematics? Mathematical traditions have developed independently in many cultures — from the ancient Babylonians and Egyptians to Indian, Chinese, and Islamic mathematicians — raising questions about the universality and cultural situatedness of mathematical knowledge.

Students preparing TOK essays or presentations are encouraged to draw on specific examples from their mathematics curriculum — such as the development of calculus, the axiomatization of probability, or the paradoxes of infinite series — to ground their epistemological reflections in concrete mathematical content.

### 5.3 Connections to Other IB Subjects

One of the hallmarks of the IB Diploma Programme is its emphasis on connections between different disciplines. Mathematics is intrinsically connected to virtually every other subject in the curriculum, and students who develop awareness of these connections deepen both their mathematical understanding and their appreciation for the interdisciplinary nature of knowledge.

- **Physics:** Calculus is the language of classical mechanics, electromagnetism, and wave theory. IB Physics students who study Mathematics AA HL will find significant synergies in topics such as kinematics, differential equations, and vectors.
- **Chemistry:** Logarithms and exponential functions appear in chemical kinetics, pH calculations, and radioactive decay. Statistical mechanics and probability underpin thermodynamic concepts.
- **Biology:** Statistics and probability are fundamental to experimental biology, genetics (Mendelian inheritance is a probability model), and epidemiology. The binomial distribution models genetic outcomes, while the normal distribution underpins much of biological measurement.
- **Economics:** Financial mathematics (compound interest, present value, annuities) connects directly to economic concepts. Statistical analysis, regression, and correlation are central to economic research methods.
- **Computer Science:** Algorithms, graph theory, discrete mathematics, Boolean logic, and combinatorics provide the mathematical foundations of computer science and artificial intelligence.
- **Psychology and Social Sciences:** Statistics — particularly hypothesis testing, correlation, and experimental design — is fundamental to research in psychology, sociology, and political science.

### 5.4 Eclassopedia's Learning Resources for IB Mathematics

Eclassopedia is committed to providing IB Mathematics students with comprehensive, high-quality resources that support learning at every stage of the two-year programme. Our resource library for IB Mathematics 2026 includes the following:

- **Structured Video Lessons:** For every topic and subtopic across both AA and AI courses at SL and HL, our expert tutors provide clear, step-by-step video explanations that align precisely with the IB syllabus.
- **Practice Question Banks:** Our question bank contains thousands of exam-style questions, organized by topic, difficulty level, and command term. Full worked solutions are provided for every question.
- **Past Paper Archives with Solutions:** Access to past IB Mathematics examination papers dating back to 2019, complete with fully worked solutions and examiner comments.
- **IA Support Programme:** A dedicated programme guiding students through every stage of the Mathematical Exploration, from topic selection and research to drafting, revision, and final submission.
- **Mock Examination Programme:** Full mock examinations under authentic IB conditions, with feedback from experienced IB Mathematics teachers and examiners.
- **Live Tutoring Sessions:** One-to-one and small-group tutoring sessions with IB Mathematics specialists, available online across time zones.
- **Revision Intensives:** Focused revision programmes delivered in the months leading up to the May and November examination sessions, designed to consolidate knowledge and examination technique.
- **Parent Information Resources:** Guides for parents explaining the IB Mathematics curriculum, assessment structure, and how they can best support their children's learning.

## 5.5 Recommended External Resources

In addition to Eclassopedia's own resources, IB Mathematics students are encouraged to engage with the following high-quality external resources:

- **IB Mathematics Textbooks (Oxford and Cambridge):** Both the Oxford University Press and Cambridge University Press publish official IB-approved textbooks for all four courses (AA SL, AA HL, AI SL, AI HL). These texts are closely aligned with the syllabus and provide comprehensive coverage of all content.
- **IBO's Mathematics Resource Centre:** The official IB website provides access to the mathematics syllabus guide, assessment specifications, subject reports, and past examination materials.
- **Khan Academy:** Free online lessons covering many of the mathematical topics in the IB curriculum, particularly valuable for foundational concept review and worked examples.
- **3Blue1Brown (YouTube):** Exceptional video content exploring deep mathematical ideas with stunning visual representations. Particularly recommended for developing intuition about calculus, linear algebra, and number theory.
- **Mathematics Stack Exchange:** A peer-to-peer question-and-answer platform where students can pose mathematical questions and receive answers from the global mathematical community.

## SECTION 6: Looking Ahead

### 6. Looking Ahead: University and Beyond

The IB Mathematics courses, particularly at Higher Level, provide an exceptionally strong foundation for university-level study across a wide range of disciplines. Understanding how your IB Mathematics course connects to university-level requirements and expectations is an important aspect of your strategic planning during the Diploma Programme.

#### 6.1 University Requirements for IB Mathematics

Different university programmes have different minimum requirements for IB Mathematics. It is essential to research the requirements of your target universities and programmes well in advance. The following general guidance reflects common university requirements as of 2026:

- **Mathematics, Engineering, Physics, Computer Science:** Most competitive programmes require Mathematics AA HL with a grade of 6 or 7. Some highly selective institutions specify a minimum score in Paper 3 or require additional placement tests.
- **Economics and Finance:** Many leading economics programmes accept either AA HL or AI HL, though AA HL is preferred at the most selective institutions. A grade of at least 5 or 6 is typically expected.
- **Natural Sciences (Biology, Chemistry):** Mathematics AA SL or AI SL/HL is typically accepted, though students intending to pursue quantitative aspects of natural science (biochemistry, computational biology, neuroscience) are well advised to take AA HL.
- **Medicine and Health Sciences:** Most medical schools accept Mathematics at SL. However, increasing quantitative demands in modern medicine make a stronger mathematics background advantageous.
- **Social Sciences and Humanities:** Mathematics AI SL or higher is generally sufficient for most social science and humanities programmes at the university level.

#### 6.2 Transition to University-Level Mathematics

Students who have studied Mathematics AA HL will find themselves well-prepared for the rigours of first-year university mathematics. Topics such as real analysis, linear algebra, multivariable calculus, and probability theory at the university level build directly on the foundations established in AA HL. AA SL students will have a solid platform for university statistics, mathematical methods courses in science programmes, and quantitative methods in social sciences.

AI HL students will be well-equipped for university courses in applied statistics, operations research, data science, and mathematical modelling. The emphasis on real-world application and technology within the AI curriculum translates well to the practical, computational emphasis of many modern university programmes.

## 6.3 Mathematics as a Lifelong Pursuit

Beyond university admissions and academic credentials, the IB Mathematics programme aims to develop something more fundamental: a lasting appreciation for mathematics as a mode of thought. The habits of mind cultivated through rigorous mathematical study — precision, logical reasoning, systematic problem-solving, and creative abstraction — are among the most transferable and durable intellectual assets a person can develop.

Mathematics is woven into the fabric of modern life, from the algorithms that curate our digital experiences to the statistical models that inform public health policy, the financial instruments that shape global economies, and the physical theories that describe the universe at its most fundamental level. Students who emerge from the IB Mathematics programme with genuine mathematical confidence and curiosity are equipped not merely for academic success, but for meaningful engagement with the complex challenges of the twenty-first century.

At Eclassopedia, we believe that every student who approaches mathematics with courage, curiosity, and commitment can achieve remarkable things — in their IB examinations and far beyond. We are honoured to be part of your mathematical journey, and we look forward to supporting you every step of the way.

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