

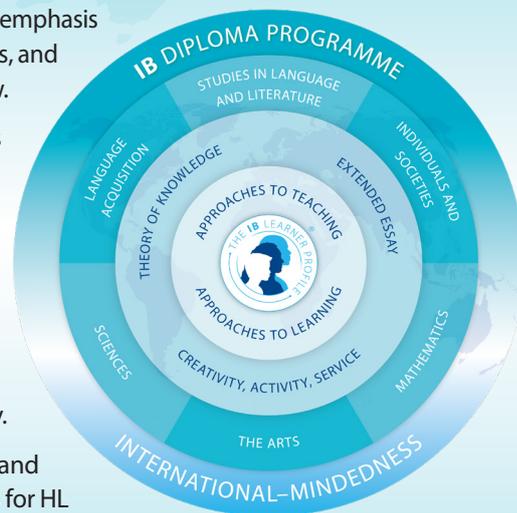
## Mathematics: Analysis and approaches

First assessment 2029

The Diploma Programme (DP) is a rigorous pre-university course of study designed for students in the 16 to 19 age range. It is a broad-based two-year course that aims to encourage students to be knowledgeable and inquiring, but also caring and compassionate. There is a strong emphasis on encouraging students to develop intercultural understanding, open-mindedness, and the attitudes necessary for them to respect and evaluate a range of points of view.

The course is presented as six academic areas enclosing a central core. Students study two modern languages (or a modern language and a classical language), a humanities or social science subject, an experimental science, mathematics and one of the creative arts. Instead of an arts subject, students can choose two subjects from another area. It is this comprehensive range of subjects that makes the Diploma Programme a demanding course of study designed to prepare students effectively for university entrance. In each of the academic areas students have flexibility in making their choices, which means they can choose subjects that particularly interest them and that they may wish to study further at university.

Normally, three subjects (and not more than four) are taken at higher level (HL), and the others are taken at standard level (SL). The IB recommends 240 teaching hours for HL subjects and 150 hours for SL. Subjects at HL are studied in greater depth and breadth than at SL. In addition, three core elements—the extended essay, theory of knowledge and creativity, activity, service—are compulsory and central to the philosophy of the programme.



### I. Course description and aims

The mathematics: analysis and approaches course develops an understanding of the core principles of mathematical reasoning and the capacity to rigorously analyse, construct and communicate arguments through key mathematical concepts. The course encourages students to develop skills in problem-solving, mathematical inquiry, abstract thinking, and applying mathematical techniques in context. It also promotes the dispositions of a successful learner of mathematics. The course allows students to analyse mathematical ideas and solve problems both with and without technology. Students develop strong algebraic skills and procedural fluency and good conceptual understanding. The course has a specific focus on mathematical analysis using **functions and calculus**.

The mathematics: analysis and approaches course is stimulating, accessible, challenging and comprehensive. The course:

- develops a breadth and depth of mathematical understanding
- fosters problem-solving skills in both familiar and unfamiliar situations
- develops a mathematical inquiry process that empowers exploration, innovation and independent investigation
- develops the key attributes of learners of mathematics.

During the course, students engage in a mathematical exploration that allows them to identify a problem or question of interest and apply the mathematical inquiry process to that problem.

The **mathematical inquiry process** involves:

- **specifying problems** by posing and framing mathematical questions
- choosing appropriate methods, tools or data to **abstract problems** into a mathematical form, and form plans to solve problems
- carrying out **computations**, with or without technology
- critically evaluating results for accuracy and relevance to **interpret** the outcomes of computations.

During the course, students develop the understanding and skills to solve problems. This includes the ability to select appropriate mathematical tools and methods, apply these correctly and interpret the results in terms of the original problem. Additionally, students develop the **key attributes** needed to be successful problem-solvers and engage in mathematical inquiry.

The **key attributes** of a learner of mathematics include:

- **reasoning** inductively, deductively, abductively and analogically
- **communicating** mathematical thinking and ideas clearly and coherently, observing shared conventions
- **linking** different elements of mathematics through underlying concepts
- **developing dispositions** that include the identity, agency, purpose, creativity and resilience in learning mathematics.

## II. Curriculum model overview

The mathematics: analysis and approaches course is organized into five main topics and the mathematical exploration.

Each topic is studied with and without a calculator.

Syllabus component	Recommended teaching hours	
	SL	HL
<b>Topic A: Number and algebra</b> A1 Sequences A2 Exponents and logarithms A3 Combinatorics A4 Complex numbers (HL only) A5 Proof and algebraic manipulation	<b>19</b>	<b>42</b>
<b>Topic B: Functions</b> B1 Representation of functions B2 Polynomial functions B3 Functions with asymptotes B4 Trigonometric functions B5 Transformations of graphs and functions	<b>33</b>	<b>46</b>
<b>Topic C: Geometry</b> C1 Surface areas, volumes and measurement in circles C2 Trigonometry and its applications C3 Vectors (HL only)	<b>16</b>	<b>35</b>

<b>Topic D: Probability and statistics</b> D1 Univariate data D2 Probability D3 Probability distributions	<b>22</b>	<b>28</b>
<b>Topic E: Calculus</b> E1 Principles of differential calculus E2 Techniques of differential calculus E3 Techniques of integral calculus E4 Problem-solving using calculus E5 Differential equations (HL only) E6 Maclaurin series (HL only)	<b>30</b>	<b>59</b>
<b>Internal assessment</b> The mathematical exploration	<b>30</b>	<b>30</b>
<b>Total</b>	<b>150</b>	<b>240</b>

### III. Assessment model

The DP mathematics courses assess students' abilities to solve mathematical problems and conduct inquiry in mathematics. The assessment objectives (AOs) for DP mathematics are based on the four stages of the mathematical inquiry process:

- **problem specification**
- **abstraction**
- **computation**
- **interpretation.**

For each stage, there are three levels of cognitive demand, ranging from simple, familiar contexts to complex, unfamiliar contexts. These levels are used to determine the challenge in written assessment and also inform the internal assessment criteria.

### Assessment at a glance

Type of assessment	Format of assessment	Time (weighting of final grade)	
		SL	HL
<b>External</b>		<b>3 hours (80%)</b>	<b>5 hours (80%)</b>
Paper 1	No technology allowed Section A: Compulsory short-response questions Section B: Compulsory extended-response questions	<b>1 hour 30 minutes (40%)</b>	<b>2 hours (30%)</b>
Paper 2	Technology required Section A: Compulsory short-response questions Section B: Compulsory extended-response questions	<b>1 hour 30 minutes (40%)</b>	<b>2 hours (30%)</b>
Paper 3	Technology required Two compulsory extended-response questions	-	<b>1 hour (20%)</b>

<b>Internal</b>			
The mathematical exploration	Written work that involves investigating an area of mathematics using the mathematical inquiry process.	<b>30 hours (20%)</b>	<b>30 hours (20%)</b>

## Internal assessment

The internal assessment is the mathematical exploration that allows students to engage in mathematical inquiry for a personal area of interest. The internal assessment criteria are the same for standard level and higher level and reflect the mathematics inquiry process.

Criterion	Marks	Strands
<b>A: Problem specification</b>	4	<ul style="list-style-type: none"> <li>• Problem in context</li> <li>• Desired outcomes</li> </ul>
<b>B: Abstraction</b>	6	<ul style="list-style-type: none"> <li>• Assumptions</li> <li>• Selected techniques and tools</li> <li>• Mathematical form</li> </ul>
<b>C: Computation</b>	4	<ul style="list-style-type: none"> <li>• Calculations</li> <li>• Mathematical communication</li> </ul>
<b>D: Interpretation</b>	6	<ul style="list-style-type: none"> <li>• Interpretation of results</li> <li>• Evaluation of desired outcomes</li> <li>• Refinement</li> </ul>

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Complete subject guides can be accessed through the Programme Resource Centre or purchased through the IB store: <https://ibo.org/new-store>.

For more on how the DP prepares students for success at university, visit: <https://ibo.org/en/university-admission>.