

XV. GIMNAZIJA
International Baccalaureate Department
Diploma Programme



MATHEMATICS:
ANALYSIS AND APPROACHES
Year 1
COURSE OUTLINE

WHAT IS THE COURSE ABOUT?

Mathematics has been described as the study of structure, order and relation that has evolved from the practices of counting, measuring and describing objects. It provides the unique language to describe, explore and communicate the nature of the world we live in, and is a constantly building body of knowledge and truth in itself that is distinctive in its certainty. Mathematics is used in a diverse range of disciplines as both a language and a tool to explore the universe.

This course recognizes the need for analytical expertise in a world where innovation is increasingly dependent on a deep understanding of mathematics. It includes topics that are both traditionally part of a pre-university mathematics course as well as topics that are amenable to investigation, conjecture and proof. The course allows and requires the use of technology, especially graphic display calculators, but has a strong emphasis on the ability to construct, communicate and justify correct mathematical arguments. Mathematics: analysis and approaches outlines five branches of mathematical study: Number and algebra, Functions, Geometry and Trigonometry, Statistics and probability, and Calculus and sixth for HL - Discrete mathematics.

AIMS:

The aims of teaching and studying Mathematics: analysis and approaches are to:

- develop a curiosity and enjoyment of mathematics, and appreciate its elegance and power
- develop an understanding of the concepts, principles and nature of mathematics
- communicate mathematics clearly, concisely and confidently in a variety of contexts
- develop logical and creative thinking, and patience and persistence in problem solving to instil confidence in using mathematics
- employ and refine their powers of abstraction and generalization
- take action to apply and transfer skills to alternative situations, to other areas of knowledge and to future developments in their local and global communities
- appreciate how developments in technology and mathematics influence each other
- appreciate the moral, social and ethical questions arising from the work of mathematicians and the applications of mathematics
- appreciate the universality of mathematics and its multicultural, international and historical perspectives
- appreciate the contribution of mathematics to other disciplines, and as a particular “area of knowledge” in the TOK course
- develop the ability to reflect critically upon their own work and the work of others
- independently and collaboratively extend their understanding of mathematics.

OBJECTIVES:

The objectives of teaching and studying Mathematics: analysis and approaches are to achieve at our students the following:

- **Knowledge and understanding:** The students will recall, select and use their knowledge of mathematical facts, concepts and techniques in a variety of familiar and unfamiliar contexts.
- **Problem solving:** They will recall, select and use their knowledge of mathematical skills, results and models in both abstract and real-world contexts to solve problems.
- **Communication and interpretation:** They will transform common realistic contexts into mathematics; comment on the context; sketch or draw mathematical diagrams, graphs or constructions both on paper and using technology; record methods, solutions and conclusions using standardized notation; use appropriate notation and terminology.
- **Technology:** Use technology accurately, appropriately and efficiently both to explore new ideas and to solve problems.
- **Reasoning:** Construct mathematical arguments through use of precise statements, logical deduction and inference and by the manipulation of mathematical expressions.
- **Inquiry approaches:** Investigate unfamiliar situations, both abstract and from the real world, involving organizing and analysing information, making conjectures, drawing conclusions, and testing their validity.

ASSESSMENT:

- **Unit test:** Unit tests are written after the completion of each unit. Duration of a test is 2 school hours.
- **Progress test:** Student's progress during the work on big units is assessed through 1 school hour tests, one per big unit.
- **Quiz:** Written approximately three times per month, containing short answer questions based on homework tasks with working time of 15 minutes each or less. Grade is given as the average result of three consecutive quizzes.
- **Semester/Year Exam:** Two Papers (non-calculator and calculator) assess different course assessment objectives. Two grades are provided, one for each part of the exam (P1 and P2).

Throughout course teachers use **formative assessments** to determine students' strengths and limitations in accessing required content knowledge and skills, provide needed support in making progress and to allow for students to actively engage in and reflect on their educational experience in each class. While preparing students for the summative assessments, teachers use a variety of formative assessments to scaffold student development of content knowledge and skills.

All pieces of work will be marked on the 1 to 7 grading scale.

GRADING SCALE:

grades	unit and progress tests (%)	quizzes (%)	semester and mock exams (%)
7	90-100	90-100	88-100
6	80-89	80-89	76-87
5	70-79	70-79	64-75
4	60-69	60-69	52-63
3	45-59	50-59	40-51
2	30-44	40-49	25-39
1	0-29	0-39	0-24

At the end of the year the class grade is calculated as follows:

End of the year grade:
Class grades - 60%
Mock exam Paper 1 - 20%
Mock exam Paper 2 - 20%

IMPLEMENTATION:

DP Year 1: The school offers 4 lessons per week (SL) and 5 lessons per week (HL), each lesson 45 min.

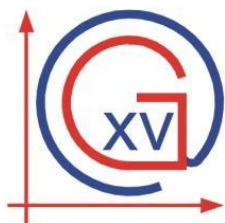
TOPICS:

The same topics are studied in both SL and HL course, with additional extensions for HL. Students who choose Mathematics: analysis and approaches at SL or HL should be comfortable in the manipulation of algebraic expressions and enjoy the recognition of patterns and understand the mathematical generalization of these patterns. Students who wish to take Mathematics: analysis and approaches at higher level will have strong algebraic skills and the ability to understand simple proof. They will be students who enjoy spending time with problems and get pleasure and satisfaction from solving challenging problems. Throughout the course students should be given the opportunity to use technology, such as graphing calculators to develop and apply their knowledge.

DP Year 1		
UNIT 1	From patterns to generalisation	The aim of the unit is to introduce students to numerical concepts and techniques which, combined with an introduction to arithmetic and geometric sequences and series, can be used for financial and other applications. Students will also be introduced to the formal concept of proof.
UNIT 2	Representing relationships: functions	The aim of the unit is to introduce students to the important unifying theme of a function in mathematics and to apply functional methods to a variety of mathematical situations.
UNIT 3	Measuring change: differentiation	The aim of the unit is to introduce students to the concepts and techniques of differential and integral calculus and their applications
UNIT 4	Relationships in space: geometry and trigonometry	The aim of the unit is to introduce students to geometry in three dimensions and to non right-angled trigonometry. Students will explore the circular functions and use properties and identities to solve problems in abstract and real-life contexts.

Textbooks:

- Paul La Rondie, Jill Stevens, Natasha Awada, Jennifer Chang Wathall, Ellen Thompson, Laurie Buchanan, Ed Kemp: *Oxford IB Diploma Programme IB Mathematics: analysis and approaches, Standard Level, Print and Enhanced Online Course Book Pack*, Oxford 2019
- Marlene Torres Skoumal, Rose Harrison, Josip Harcet, Jennifer Chang Wathall, Lorraine Heinrichs: *Oxford IB Diploma Programme: IB Mathematics: analysis and approaches, Higher Level, Print and Enhanced Online Course Book Pack*, Oxford 2019



MATHEMATICS:
ANALYSIS AND APPROACHES
Year 2
COURSE OUTLINE

WHAT IS THE COURSE ABOUT?

Mathematics plays an essential role both within the school and in society. It promotes a powerful universal language, analytical reasoning and problem-solving skills that contribute to the development of logical, abstract and critical thinking. Mathematical knowledge provides an important key to understanding the world in which we live. This prevalence of mathematics in our lives, with all its interdisciplinary connections, provides a clear and sufficient rationale for making the study of this subject compulsory for students studying the full diploma.

Mathematics Standard Level is intended for the students who will expect to need a sound mathematical background as they prepare for future studies in subjects such as chemistry, economics, psychology and business administration.

Mathematics Higher Level is intended for the students who have an interest in Mathematics and will be expecting to include mathematics as a major component of their university studies, either as a subject in its own right or within courses such as physics, engineering and technology. Others may take this subject because they have a strong interest in mathematics and enjoy meeting its challenges and engaging with its problems.

This course outlines five branches of mathematical study: Number and algebra, Function, Geometry and Trigonometry, Statistics and probability, and Calculus; and sixth for HL only - Vectors.

AIMS:

The aims of teaching and studying Mathematics SL and HL are to:

- enjoy mathematics, and develop an appreciation of the elegance and power of mathematics
- develop an understanding of the principles and nature of mathematics
- communicate clearly and confidently in a variety of contexts
- develop logical, critical and creative thinking, and patience and persistence in problem-solving
- employ and refine their powers of abstraction and generalization
- apply and transfer skills to alternative situations, to other areas of knowledge and to future developments
- appreciate how developments in technology and mathematics have influenced each other
- appreciate the moral, social and ethical implications arising from the work of mathematicians and the applications of mathematics
- appreciate the international dimension in mathematics through an awareness of the universality of mathematics and its multicultural and historical perspectives
- appreciate the contribution of mathematics to other disciplines, and as a particular “area of knowledge” in the TOK course.

OBJECTIVES:

Problem-solving is central to learning mathematics and involves the acquisition of mathematical skills and concepts in a wide range of situations, including non-routine, open-ended and real-world problems.

Students will be expected to demonstrate the following.

- **Knowledge and understanding:** recall, select and use their knowledge of mathematical facts, concepts and techniques in a variety of familiar and unfamiliar contexts.
- **Problem-solving:** recall, select and use their knowledge of mathematical skills, results and models in both real and abstract contexts to solve problems.
- **Communication and interpretation:** transform common realistic contexts into mathematics; comment on the context; sketch or draw mathematical diagrams, graphs or constructions both on paper and using technology; record methods, solutions and conclusions using standardized notation.
- **Technology:** use technology, accurately, appropriately and efficiently both to explore new ideas and to solve problems.
- **Reasoning:** construct mathematical arguments through use of precise statements, logical deduction and inference, and by the manipulation of mathematical expressions.
- **Inquiry approaches:** investigate unfamiliar situations, both abstract and real-world, involving organizing and analysing information, making conjectures, drawing conclusions and testing their validity.

ASSESSMENT:

- **Unit test:** Unit tests are written after the completion of each unit. Duration of a test is 2 school hours.
- **Progress test:** Student's progress during the work on big units is assessed through 1 school hour tests, one per big unit.
- **Quiz:** Written approximately three times per month, containing short answer questions based on homework tasks with working time of 15 minutes each or less. Grade is given as the average result of two consecutive quizzes.
- **Semester/Mock Exam:** Two Papers (non-calculator and calculator) assess different course assessment objectives. Two grades are provided (P1 and P2) for each part of the exam. (SL) While for HL student there is a Paper 3 in the End-of-the year Mock exam. Hence HL students will obtain three grades for End-of-the year exam.
- **Exploration:** Exploration is a report (at an appropriate level for the course) on exploration of a topic in which a student is genuinely interested. It is assessed according the IB criteria descriptors.

Throughout course teachers use **formative assessments** to determine students' strengths and limitations in accessing required content knowledge and skills, provide needed support in making progress and to allow for students to actively engage in and reflect on their educational experience in each class. While preparing students for the summative assessments, teachers use a variety of formative assessments to scaffold student development of content knowledge and skills.

All pieces of work will be marked on the 1 to 7 grading scale.

GRADING SCALE:

grades	unit and progress tests (%)	quizzes (%)	semester and mock exams (%)
7	90-100	90-100	88-100
6	80-89	80-89	76-87
5	70-79	70-79	64-75
4	60-69	60-69	52-63
3	45-59	50-59	40-51
2	30-44	40-49	25-39
1	0-29	0-39	0-24

At the end of the year the class grade is calculated as follows:

SL	HL
Class grades - 60% Mock exam Paper 1 - 20% Mock exam Paper 2 - 20%	Class grades - 60% Mock exam Paper 1 - 16% Mock exam Paper 2 - 16% Mock exam Paper 3 - 8%

IMPLEMENTATION:

DP Year 2: The school offers 5 lessons per week (SL) and 6 lessons per week (HL), each lesson is 45 min.

TOPICS:

UNIT 1	Trigonometry	The aim of this topic is to introduce basic concepts in non-right-angled trigonometry, including understanding the Unit circle, solving trigonometric equations and sketching and interpreting graphs of trigonometric functions. Also, the emphasis is on understanding the possible applications in real life problems.
UNIT 2	Statistics and Probability	The aim of this topic is to introduce basic concepts. It is expected that most of the calculations required will be done using technology, but explanations of calculations by hand may enhance understanding. The emphasis is on understanding and interpreting the results obtained, in context.
UNIT 3	Calculus	The aim of this topic is to introduce students to the basic concepts and techniques of differential and integral calculus and their applications.
UNIT 4	Random variables	The aim of this topic is to introduce basic concepts of discrete and continuous random variables and their probability distributions.

UNIT 5 HL only	Vectors	The aim of this topic is to provide an elementary introduction to vectors, including both algebraic and geometric approaches, to introduce the use of vectors in two and three dimensions, and to facilitate solving problems involving points, lines and planes The use of dynamic geometry software is extremely helpful to visualize situations in three dimensions.
UNIT 6 HL only	Discrete mathematics	The aim of this option is to provide the opportunity for students to engage in logical reasoning, algorithmic thinking and applications.

Textbook:

- Paul La Rondie, Jill Stevens, Natasha Awada, Jennifer Chang Wathall, Ellen Thompson, Laurie Buchanan, Ed Kemp: *Oxford IB Diploma Programme IB Mathematics: analysis and approaches, Standard Level, Print and Enhanced Online Course Book Pack*, Oxford 2019
- Marlene Torres Skoumal, Rose Harrison, Josip Harcet, Jennifer Chang Wathall, Lorraine Heinrichs: *Oxford IB Diploma Programme: IB Mathematics: analysis and approaches, Higher Level, Print and Enhanced Online Course Book Pack*, Oxford 2019