ОБЩЕОБРАЗОВАТЕЛЬНОЕ ЧАСТНОЕ УЧРЕЖДЕНИЕ
Международная гимназия «Сколково»

Утверждаю	Согласовано	Рассмотрено
Директор ОЧУ МГ «Сколково»	зам. директора по развитию образования	на заседании кафедры
Демьяненко О.Ю.	Фрыкин А.Д.	Сорокин С.С.
«30» августа 2023 г.	«30» августа 2023 г.	«29» августа 2023 г.

Рабочая программа
учебного предмета « Mathematics HL»
10-11 IBкласс

Составители рабочей программы:
учителя математики
Кевин Грейди
Сорокин С.С.

Москва 2023-2024 учебный год

EXPLANATORY NOTE

The present mathematics programme for the 10 and 11 IB HL classes is based on the guide for the IB HL in mathematics (IB Analysis and Approaches Guide, 2019).

The working program specifies the content of the subject topics of the educational standard and shows the distribution of training hours among the sections of the course. According to the curriculum on studying of SL mathematics the total study time is 150 hours at the rate of 6 lessons per week are taken by 10 and 11 IB HL**.**

Math study goals

The aims of all mathematics courses are to enable students 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.

Assessment 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. Having followed a DP mathematics SL course, students will be expected to demonstrate the following.

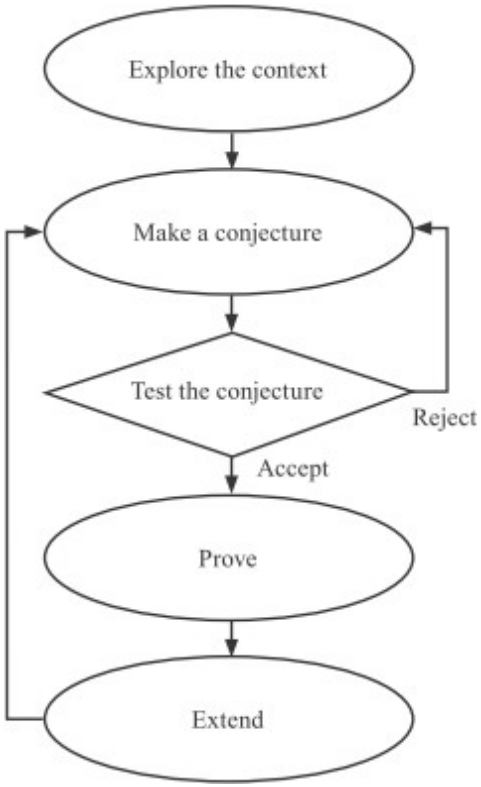
1. **Knowledge and understanding**: recall, select and use their knowledge of mathematical facts, concepts and techniques in a variety of familiar and unfamiliar contexts.
2. **Problem-solving**: recall, select and use their knowledge of mathematical skills, results and models in both real and abstract contexts to solve problems.
3. **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.
4. **Technology**: use technology, accurately, appropriately and efficiently both to explore new ideas and to solve problems.
5. **Reasoning**: construct mathematical arguments through use of precise statements, logical deduction and inference, and by the manipulation of mathematical expressions.
6. **Inquiry approaches**: investigate unfamiliar situations, both abstract and real-world, involving organizing and analysing information, making conjectures, drawing conclusions and testing their validity.

Approaches to the teaching and learning of mathematics SL

Throughout the DP mathematics SL course, students should be encouraged to develop their understanding of the methodology and practice of the discipline of mathematics. The processes of **mathematical inquiry**, **mathematical modelling and applications** and the **use of technology** should be introduced appropriately. These processes should be used throughout the course, and not treated in isolation.

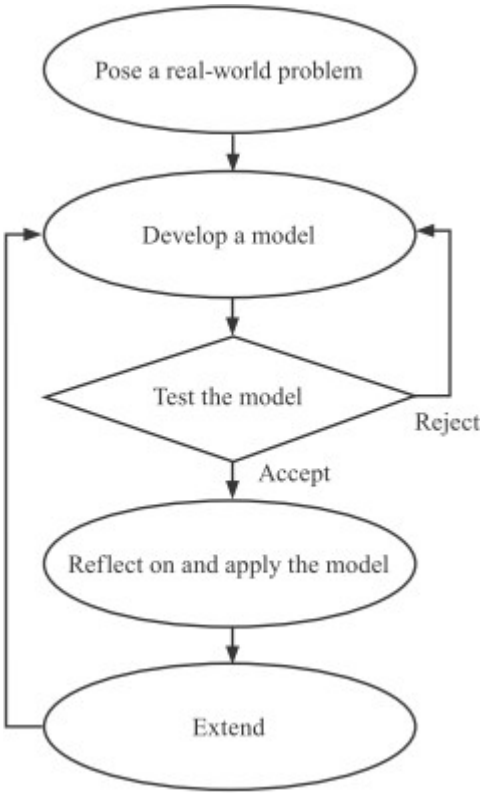
Mathematical inquiry

The IB learner profile encourages learning by experimentation, questioning and discovery. In the IB classroom, students should generally learn mathematics by being active participants in learning activities rather than recipients of instruction. Teachers should therefore provide students with opportunities to learn through mathematical inquiry. This approach is illustrated in figure below.



Mathematical modelling and applications

Students should be able to use mathematics to solve problems in the real world. Engaging students in the mathematical modelling process provides such opportunities. Students should develop, apply and critically analyse models. This approach is illustrated in figure below.



Technology

Technology is a powerful tool in the teaching and learning of mathematics. Technology can be used to enhance visualization and support student understanding of mathematical concepts. It can assist in the collection, recording, organization and analysis of data. Technology can increase the scope of the problem situations that are accessible to students. The use of technology increases the feasibility of students working with interesting problem contexts where students reflect, reason, solve problems and make decisions.

As teachers tie together the unifying themes of mathematical inquiry, mathematical modelling and applications and the use of technology, they should begin by providing substantial guidance, and then gradually encourage students to become more independent as inquirers and thinkers. IB students should learn

to become strong communicators through the language of mathematics. Teachers should create a safe learning environment in which students are comfortable as risk- takers.

Teachers are encouraged to relate the mathematics being studied to other subjects and to the real world, especially topics that have particular relevance or are of interest to their students. Everyday problems and questions should be drawn into the lessons to motivate students and keep the material relevant; suggestions are provided in the "Links" column of the syllabus. The mathematical exploration offers an opportunity to investigate the usefulness, relevance and occurrence of mathematics in the real world and will add an extra dimension to the course. The emphasis is on communication by means of mathematical forms (for example, formulae, diagrams, graphs and so on) with accompanying commentary. Modelling, investigation, reflection, personal engagement and mathematical communication should therefore feature prominently in the DP mathematics classroom.

If distance learning becomes necessary then lessons will continue as timetable but delivered by Skype or Zoom.

Extra support can be found at the websites below.

ELECTRONIC EDUCATIONAL RESOURCES

1. Casio FX CG 50 Graphical Display Caclulator
2. Apple Ipad when using Geogebra and Desmos
3. Apple desktop computers in the library for general research

THE CORE

The three elements of the core, theory of knowledge (TOK), creativity, activity, service (CAS) and the extended essay, are an integral part of the DP experience. The academic disciplines, while separate to the core, are nonetheless linked to it. TOK, CAS and the extended essay will feed into a deeper understanding of the subject matter studied by DP students. This includes:

- transferring the critical-thinking process developed in TOK to the study of academic disciplines
- developing service learning opportunities in CAS that will build on a student's existing subject knowledge and contribute to the construction of new and deeper knowledge in that subject area
- exploring a topic or issue of interest that has global significance in a next ended essay through one or more disciplinary lenses.

Mathematics and theory of knowledge

The Theory of knowledge guide identifies four ways of knowing, and it could be claimed that these all have some role in the acquisition of mathematical knowledge. While perhaps initially inspired by data from sense perception, mathematics is dominated by reason, and some mathematicians argue that their subject is a language, that it is, in some sense, universal. However, there is also no doubt that mathematicians perceive beauty in mathematics, and that emotion can be a strong driver in the search for mathematical knowledge.

As an area of knowledge, mathematics seems to supply a certainty perhaps missing in other disciplines. This may be related to the "purity" of the subject that makes it sometimes seem divorced from reality. However, mathematics has also provided important knowledge about the world, and the use of mathematics in science and technology has been one of the driving forces for scientific advances.

Despite all its undoubted power for understanding and change, mathematics is in the end a puzzling phenomenon. A fundamental question for all

knowers is whether mathematical knowledge really exists independently of our thinking about it. Is it there "waiting to be discovered" or is it a human creation?

Students' attention should be drawn to questions relating theory of knowledge (TOK) and mathematics, and they should be encouraged to raise such questions themselves, in mathematics and TOK classes. This includes questioning all the claims made above. Examples of issues relating to TOK are given in the "Links" column of the syllabus. Teachers could also discuss questions such as those raised in the "Areas of knowledge" section of the TOK guide.

Creativity, activity, service

The emphasis in CAS is on helping students to develop their own identities, in accordance with the ethical principles embodied in the IB mission statement and the IB learner profile. CAS complements a challenging academic programme in a holistic way, providing opportunities for self-determination, collaboration, accomplishment and enjoyment. It involves students in a range of activities alongside their academic studies throughout the DP. The three strands of CAS are creativity (exploring and extending ideas leading to an original or interpretive product or performance), activity (physical exertion contributing to a healthy lifestyle) and service (collaborative and reciprocal engagement with the community in response to an authentic need). CAS contributes to the IB's mission to create a better and more peaceful world through intercultural understanding and respect.

Extended essay

The extended essay offers the opportunity to investigate a topic of special interest, in the form of a 4,000-word piece of independent research. The area of research undertaken is chosen from one of the DP subjects - or in the case of the interdisciplinary world studies extended essay, two subjects - and acquaints them with the independent research and writing skills expected at university. This leads to a major piece of formally presented, structured writing, in which ideas and findings are communicated in a reasoned and coherent manner, appropriate to the subject or subjects chosen. It is intended to promote high-level research and writing skills, intellectual discovery and creativity. As an authentic learning experience, it provides students with an opportunity to engage in personal research on a topic of choice, under the guidance of a supervisor.

SYLLABUS OVERVIEW

The number of hours of study in 10th grade is 148 for HL.
The number of hours of study in 11th grade is 120 for HL.

ATL SKILLS AND SUBJECT KNOWLEDGE

	ATL skills	KNOWLEDGE AND SKILLS
Topic 1 **Exponents and Logarithms**	1. Thinking skills: - recognize the relationship between cause and effect; - use acquired knowledge and concepts in practical or new ways including logical progression of arguments; - challenge accepted knowledge / ideas; -create hypotheses. 2. Social skills: -take on and complete tasks in an appropriate manner; -listen carefully to others and react reasonably to the situation; -accept others including analyzing others' ideas, respecting others' points of view, using ideas critically. 3. Communication skills: - communicate in a clear, concise, logical and persuasive manner using supporting evidence; - use subject specific vocabulary in context. 4. Self-management skills: - demonstrates strategies for documenting the learning process; - is able to follow through on both oral and written instructions. 5. Research skills: - process information by comparing and contrasting, making connections, identifying cause and effect.	- - Laws of Exponents - - - Standard Form - - - Logarithms (but not including the Laws of Logarithms)
Topic 2 **Sequences**	1. Thinking skills: - recognize the relationship between cause and effect; - create hypotheses; - evaluate solutions to problems. 2. Social skills: - be willing to assume a share of the responsibility in tasks / groups; - accept others including analyzing others' ideas, respecting others' points of view, using ideas critically; - listen sensitively to others. 3. Communication skills:	Arithmetic sequences and series. Geometric sequences and series. Financial applications of geometric sequences and series.

	- develop life long reading habits; - know the best method of delivering information in a variety of contexts and situations; - demonstrate effective verbal communication skills that facilitate the successful delivery of information in a. 4. Self-management skills: - know and apply appropriate rules depending on the situation - including all school rules; - set appropriate SMART goals and take appropriate action to achieve these goals; - take responsibility for their own learning including being prepared for class having the right materials and. 5. Research skills: - know the roles and expertise of the people working in the library; - identify primary and Secondary Sources; - understand the type of information that is contained within different resources in both print and electronic.	
Topic 3 **Functions**	1. Thinking skills: - recognize the relationship between cause and effect; - create hypotheses; - evaluate solutions to problems. 2. Social skills: - be willing to assume a share of the responsibility in tasks / groups; - accept others including analyzing others' ideas, respecting others' points of view, using ideas critically; - listen sensitively to others. 3. Communication skills: - develop life long reading habits; - know the best method of delivering information in a variety of contexts and situations; - demonstrate effective verbal communication skills that facilitate the successful delivery of information in a. 4. Self-management skills: - know and apply appropriate rules depending on the situation - including all school rules; - set appropriate SMART goals and take appropriate action to achieve these goals; - take responsibility for their own learning including being prepared for class having the right materials and. 5. Research skills: - know the roles and expertise of the people working in the library; - identify primary and Secondary Sources; understand the type of	Concepts of a function. Sketching graphs.

	information that is contained within different resources in both print and electronic.	
Topic 4 **Coordinate Geometry**	1. Thinking skills: - find unique characteristics of knowledge / ideas; - ask and follow up on all levels of questions; - create hypotheses; - use acquired knowledge and concepts in practical or new ways including logical progression of arguments; - think about two or more different points of view at the same time; - analyze your own and others' thought processes. 2. Social skills: - take on and complete tasks in an appropriate manner; - work cooperatively in groups including delegating and taking responsibility, adapting to roles, resolving. 3. Communication skills: - know when and how to use the appropriate medium; - select appropriate forms of expression to suit various contexts; - show an awareness of audience and purpose when communicating. 4. Self-management skills: - manage notes, folders and handbooks; - is able to follow through on both oral and written instructions; - understands the importance of punctuality. 5. Research skills: - understand the type of information that is contained within different resources in both print and electronic; - distinguish between electronic resources: proprietary databases, Internet etc.; - use a variety of effective note-taking techniques.	Equations of straight lines in two dimensions. Three-dimensional coordinate geometry
Topic 5 **Geometry and Trigonometry**	1. Thinking skills: - see relationships between knowledge / ideas; - develop questions; - create hypotheses; - use acquired knowledge and concepts in practical or new ways including logical progression of arguments; - think about two or more different points of view at the same time; - analyze your own and others' thought processes. 2. Social skills: - negotiate goals and limitations with peers and with teachers; - work cooperatively in groups including delegating and taking responsibility, adapting to roles, resolving.	Volumes and surface areas of three-dimensional solids Rules of Trigonometry Applications of trigonometry

Topic 6 **Statistics**	1. Thinking skills: - recognize the relationship between cause and effect; - use acquired knowledge and concepts in practical or new ways including logical progression of arguments; - challenge accepted knowledge / ideas; -create hypotheses. 2. Social skills: -take on and complete tasks in an appropriate manner; -listen carefully to others and react reasonably to the situation; -accept others including analyzing others' ideas, respecting others' points of view, using ideas critically. 3. Communication skills: - communicate in a clear, concise, logical and persuasive manner using supporting evidence; - use subject specific vocabulary in context. 4. Self-management skills: - demonstrates strategies for documenting the learning process; - is able to follow through on both oral and written instructions. 5. Research skills: - process information by comparing and contrasting, making connections, identifying cause and effect.	Sampling Summarizing data Presenting data Correlation and regression
Topic 7 **Probability**	1. Thinking skills: - outline a plan; - question and challenge information and arguments; - consider a problem from multiple perspectives; understanding those points of view. 2. Social skills: - work cooperatively in groups including delegating and taking responsibility, adapting to roles, resolving; - listen carefully to others and react reasonably to the situation. 3. Communication skills: - know the best method of delivering information in a variety of contexts and situations; - organize information clearly and logically to ensure effective communication; - demonstrate effective verbal communication skills that facilitate the successful delivery of information in a. 4. Self-management skills: - know and apply appropriate rules depending on the situation - including all school rules; - is able to follow through on both oral and written instructions. 5. Research skills:	- - - - Introduction to probability Probability techniques

	- choose the appropriate sources / technologies; filter for relevance; - identify appropriate means to communicate the end product/solution.	
Topic 8 **Probability distributions**	1. Thinking skills: - question and challenge information and arguments; - create hypotheses. 2. Social skills: - take on and complete tasks in an appropriate manner; - accept others including analyzing others' ideas, respecting others' points of view, using ideas critically. 3. Communication skills: - develop presentation skills using a variety of media; - select appropriate forms of expression to suit various contexts. 4. Self-management skills: - take ownership of own progress by setting clear guidelines, targets and a realistic timetable for success in; - plan and prioritize tasks effectively so that tasks receive the appropriate time and effort to achieve the. - 5. Research skills: identify an outcome based on assessment tools (rubrics, checklists, etc.); process information by comparing and contrasting, making connections, identifying cause and effect.	Discrete random variables Binomial Distributions The normal distributions
Topic 9 **Differentiation**	1. Thinking skills: - recognize the relationship between cause and effect; - create hypotheses; - evaluate solutions to problems. 2. Social skills: - be willing to assume a share of the responsibility in tasks / groups; - accept others including analyzing others' ideas, respecting others' points of view, using ideas critically; - listen sensitively to others. 3. Communication skills: - develop life long reading habits; - know the best method of delivering information in a variety of contexts and situations; - demonstrate effective verbal communication skills that facilitate the successful delivery of information in a. 4. Self-management skills: - know and apply appropriate rules depending on the situation - including all school rules; - set appropriate SMART goals and take appropriate action to achieve these goals; - take responsibility for their own learning including being prepared for	Limits and derivatives Graphical interpretations of derivatives Finding and expression for the derivative

	class having the right materials and. 5. Research skills: - know the roles and expertise of the people working in the library; - identify primary and Secondary Sources; - understand the type of information that is contained within different resources in both print and electronic.	
Topic 10 **Integration**	1. Thinking skills: - see relationships between knowledge / ideas; - develop questions; - create hypotheses; - use acquired knowledge and concepts in practical or new ways including logical progression of arguments; - think about two or more different points of view at the same time; - analyze your own and others' thought processes. 2. Social skills: - listen carefully to others and react reasonably to the situation; - accept others including analyzing others' ideas, respecting others' points of view, using ideas critically. 3. Communication skills: - use subject specific vocabulary in context; - demonstrate effective verbal communication skills that facilitate the successful delivery of information in a. 4. Self-management skills: - understands the importance of punctuality; - demonstrates strategies for documenting the learning process. 5. Research skills: - share and recommend media choices to others; - distinguish between electronic resources: proprietary databases, Internet etc.; use a variety of effective note-taking techniques.	Anti-differentiation. Definite integration and the area under a curve.
Topic 11 **Proof**	1. Thinking skills: - use deductive reasoning; - develop questions; - evaluate the quality of the information gathered; - develop a habit of reflection and an attitude of continuous improvement; - analyze your own and others' thought processes. 2. Social skills: - work cooperatively in groups including delegating and taking responsibility, adapting to roles, resolving; - accept others including analyzing others' ideas, respecting others' points of view, using ideas critically.	The structure of mathematical proof

	3. Communication skills: - actively listen; - organize information clearly and logically to ensure effective communication. 4. Self-management skills: - understands the importance of punctuality; - is able to follow through on both oral and written instructions. 5. Research skills: - share and recommend media choices to others; - use a variety of effective note-taking techniques.	
Topic 12 **Exponents and Logarithms II**	1. Thinking skills: - recognize the relationship between cause and effect; - think about how you think and how you learn; identify your learning profile; - reflect at different stages of the learning process. 2. Social skills: - accept others including analyzing others' ideas, respecting others' points of view, using ideas critically; - listen sensitively to others. 3. Communication skills: - actively listen; - use language, symbols and texts interactively; - use writing to generate ideas. 4. Self-management skills: - know and apply appropriate rules depending on the situation - including all school rules; - independently explore their own interests; - seek assistance appropriately from a variety of sources when in doubt. 5. Research skills: - identify an outcome based on assessment tools (rubrics, checklists, etc.); -process information by comparing and contrasting, making connections, identifying cause and effect; - use a variety of effective note-taking techniques.	Laws of exponents with rational exponents Laws of logarithms
Topic 13 **Sequences and Series II**	1. Thinking skills: - consider a problem from multiple perspectives; understanding those points of view; - create hypotheses. 2. Social skills: - take on and complete tasks in an appropriate manner; - accept others including analyzing others' ideas, respecting others' points of view, using ideas critically.	The sum of infinite convergent geometric series. The binomial expansion

	3. Communication skills: - develop presentation skills using a variety of media; - select appropriate forms of expression to suit various contexts. 4. Self-management skills: - take ownership of own progress by setting clear guidelines, targets and a realistic timetable for success in; - plan and prioritize tasks effectively so that tasks receive the appropriate time and effort to achieve the. 5. Research skills: - identify an outcome based on assessment tools (rubrics, checklists, etc.); - process information by comparing and contrasting, making connections, identifying cause and effect.	
Topic 14 **Functions II**	1. Thinking skills: - consider a problem from multiple per-spectives; understanding those points of view; - create hypotheses. 2. Social skills: - take on and complete tasks in an appropriate manner; - accept others including analyzing others' ideas, respecting others' points of view, using ideas critically. 3. Communication skills: - develop presentation skills using a variety of media; - select appropriate forms of expression to suit various contexts. 4. Self-management skills: - take ownership of own progress by setting clear guidelines, targets and a realistic timetable for success in; - plan and prioritize tasks effectively so that tasks receive the appropriate time and effort to achieve the. 5. Research skills: - identify an outcome based on assessment tools (rubrics, checklists, etc.); - process information by comparing and contrasting, making connections, identifying cause and effect.	Composite Functions Inverse functions
Topic 15 **Quadratics**	1. Thinking skills: - see relationships between knowledge / ideas; - develop questions; - create hypotheses; - use acquired knowledge and concepts in practical or new ways including logical progression of arguments; - think about two or more different points of view at the same time; - analyze your own and others' thought processes.	- Graphs of quadratic functions Solving quadratics equations and inequalities The discriminant.

	2. Social skills: - negotiate goals and limitations with peers and with teachers; - work cooperatively in groups including delegating and taking responsibility, adapting to roles, resolving. 3. Communication skills: - know the best method of delivering information in a variety of contexts and situations; - select appropriate forms of expression to suit various contexts; - communicate in a clear, concise, logical and persuasive manner using supporting evidence. 4. Self-management skills: - identify and use the most appropriate study strategies including revision techniques; - is able to follow through on both oral and written instructions; - seek assistance appropriately from a variety of sources when in doubt. 5. Research skills: - understand the type of information that is contained within different resources in both print and electronic; - distinguish between electronic resources: proprietary databases, Internet etc.; use a variety of effective note-taking techniques.	
Topic 16 **Graphs**	1. Thinking skills: - outline a plan; - question and challenge information and arguments; - consider a problem from multiple perspectives; understanding those points of view. 2. Social skills: - work cooperatively in groups including delegating and taking responsibility, adapting to roles, resolving; - listen carefully to others and react reasonably to the situation. 3. Communication skills: - know the best method of delivering information in a variety of contexts and situations; - organize information clearly and logically to ensure effective communication; - demonstrate effective verbal communication skills that facilitate the successful delivery of information in a. 4. Self-management skills: - know and apply appropriate rules depending on the situation - including all school rules; - is able to follow through on both oral and written instructions. 5. Research skills:	Transformations of graphs Rational functions Exponential and logarithmic functions

	- choose the appropriate sources / technologies; filter for relevance; - identify appropriate means to communicate the end product/solution.	
Topic 17 **Equations**	1. Thinking skills: - question and challenge information and arguments; - create hypotheses. 2. Social skills: - take on and complete tasks in an appropriate manner; - accept others including analyzing others' ideas, respecting others' points of view, using ideas critically. 3. Communication skills: - develop presentation skills using a variety of media; - select appropriate forms of expression to suit various contexts. 4. Self-management skills: - take ownership of own progress by setting clear guidelines, targets and a realistic timetable for success in; - plan and prioritize tasks effectively so that tasks receive the appropriate time and effort to achieve the. 5. Research skills: - identify an outcome based on assessment tools (rubrics, checklists, etc.); - process information by comparing and contrasting, making connections, identifying cause and effect.	Solving equations analytically Solving equations graphically Applications of equations
Topic 18 **Trigonometry**	1. Thinking skills: - see relationships between knowledge / ideas; - develop questions; - create hypotheses; - use acquired knowledge and concepts in practical or new ways including logical progression of arguments; - think about two or more different points of view at the same time; - analyze your own and others' thought processes. 2. Social skills: - listen carefully to others and react reasonably to the situation; - accept others including analyzing others' ideas, respecting others' points of view, using ideas critically. 3. Communication skills: - use subject specific vocabulary in context; - demonstrate effective verbal communication skills that facilitate the successful delivery of information in a. 4. Self-management skills: - understands the importance of punctuality; - demonstrates strategies for documenting the learning process. 5. Research skills:	Radian measure of angles Trigonometric functions Trigonometric identities Graphs of trigonometrical functions Trigonometric equations

	- share and recommend media choices to others; - distinguish between electronic resources: proprietary databases, Internet etc.; - use a variety of effective note-taking techniques.	
Topic 19 **Statistics and probability**	1. Thinking skills: - consider a problem from multiple perspectives; understanding those points of view; - reflect at different stages of the learning process. 2. Social skills: - work cooperatively in groups including delegating and taking responsibility, adapting to roles, resolving; listen sensitively to others. 3. Communication skills: - actively listen; - communicate in a clear, concise, logical and persuasive manner using supporting evidence; - use writing to generate ideas. 4. Self-management skills: - manage notes, folders and handbooks; - is able to follow through on both oral and written instructions. 5. Research skills: - explore the topic using a variety of sources; identify appropriate means to communicate the end product/solution.	Linear regression Conditional probability Normal Distribution
Topic 20 **Differentiation**	1. Thinking skills: - use deductive reasoning; - develop questions; - evaluate the quality of the information gathered; - develop a habit of reflection and an attitude of continuous improvement; - analyze your own and others' thought processes. 2. Social skills: - work cooperatively in groups including delegating and taking responsibility, adapting to roles, resolving; - accept others including analyzing others' ideas, respecting others' points of view, using ideas critically. 3. Communication skills: - actively listen; - organize information clearly and logically to ensure effective communication. 4. Self-management skills: - understands the importance of punctuality; - is able to follow through on both oral and written instructions.	Extending differentiation The chain rule for composite functions The product and quotient rule The second derivative Local maximums and minimums Points of inflection with zero and non-zero gradients

	5. Research skills: - share and recommend media choices to others; - use a variety of effective note-taking techniques.	
Topic 21 **Integration**	1. Thinking skills: - recognize the relationship between cause and effect; - think about how you think and how you learn; identify your learning profile; - reflect at different stages of the learning process. 2. Social skills: - accept others including analyzing others' ideas, respecting others' points of view, using ideas critically; - listen sensitively to others. 3. Communication skills: - actively listen; - use language, symbols and texts interactively; - use writing to generate ideas. 4. Self-management skills: - know and apply appropriate rules depending on the situation - including all school rules; - independently explore their own interests; - seek assistance appropriately from a variety of sources when in doubt. 5. Research skills: - identify an outcome based on assessment tools (rubrics, checklists, etc.); -process information by comparing and contrasting, making connections, identifying cause and effect; - use a variety of effective note-taking techniques.	Further indefinite integration Further links between area and integrals Kinematics
Topic 22 **Counting** **principles**	1. Thinking skills: - find unique characteristics of knowledge / ideas; - ask and follow up on all levels of questions; - create hypotheses; - use acquired knowledge and concepts in practical or new ways including logical progression of arguments; - think about two or more different points of view at the same time; - analyze your own and others' thought processes. 2. Social skills: - take on and complete tasks in an appropriate manner; - work cooperatively in groups including delegating and taking responsibility, adapting to roles, resolving. 3. Communication skills: - know when and how to use the appropriate medium; - select appropriate forms of expression to suit various contexts;	Basic techniques Problem solving

	- show an awareness of audience and purpose when communicating. 4. Self-management skills: - manage notes, folders and handbooks; - is able to follow through on both oral and written instructions; - understands the importance of punctuality. 5. Research skills: - understand the type of information that is contained within different resources in both print and electronic; - distinguish between electronic resources: proprietary databases, Internet etc.; - use a variety of effective note-taking techniques.	
Topic 23 **Algebra**	1. Thinking skills: - see relationships between knowledge / ideas; - develop questions; - create hypotheses; - use acquired knowledge and concepts in practical or new ways including logical progression of arguments; - think about two or more different points of view at the same time; - analyze your own and others' thought processes. 2. Social skills: - negotiate goals and limitations with peers and with teachers; - work cooperatively in groups including delegating and taking responsibility, adapting to roles, resolving.	Extension of the binomial theorem to fractional and negative indices Partial fractions Solutions of systems of equations
Topic 24 **Trigonometry**	1. Thinking skills: - use deductive reasoning; - develop questions; - evaluate the quality of the information gathered; - develop a habit of reflection and an attitude of continuous improvement; - analyze your own and others' thought processes. 2. Social skills: - work cooperatively in groups including delegating and taking responsibility, adapting to roles, resolving; - accept others including analyzing others' ideas, respecting others' points of view, using ideas critically. 3. Communication skills: - actively listen; - organize information clearly and logically to ensure effective communication. 4. Self-management skills: - understands the importance of punctuality;	Further trigonometric functions Compound angle identities

	- is able to follow through on both oral and written instructions. 5. Research skills: - share and recommend media choices to others; use a variety of effective note-taking techniques.	
Topic 25 **Complex numbers**	1. Thinking skills: - see relationships between knowledge / ideas; - develop questions; - create hypotheses; - use acquired knowledge and concepts in practical or new ways including logical progression of arguments; - think about two or more different points of view at the same time; - analyze your own and others' thought processes. 2. Social skills: - listen carefully to others and react reasonably to the situation; - accept others including analyzing others' ideas, respecting others' points of view, using ideas critically. 3. Communication skills: - use subject specific vocabulary in context; - demonstrate effective verbal communication skills that facilitate the successful delivery of information in a. 4. Self-management skills: - understands the importance of punctuality; - demonstrates strategies for documenting the learning process. 5. Research skills: - share and recommend media choices to others; - distinguish between electronic resources: proprietary databases, Internet etc.; - use a variety of effective note-taking techniques.	Cartesian forms Modulus argument form and Euler form Complex conjugate roots of quadratic and polynomial equations Powers and roots of complex numbers Trigonometric identites
Topic 26 **Mathematical proof**	1.Thinking skills: - use deductive reasoning; - develop questions; - evaluate the quality of the information gathered; - develop a habit of reflection and an attitude of continuous improvement; - analyze your own and others' thought processes. 2. Social skills: - work cooperatively in groups including delegating and taking responsibility, adapting to roles, resolving; - accept others including analyzing others' ideas, respecting others' points of view, using ideas critically. 3. Communication skills: - actively listen;	Proof by induction Proof by contradiction Disproof by counterexample.

	- organize information clearly and logically to ensure effective communication. 4. Self-management skills: - understands the importance of punctuality; - is able to follow through on both oral and written instructions. 5. Research skills: - share and recommend media choices to others; use a variety of effective note-taking techniques.	
Topic 27 **Polynomials**	1. Thinking skills: - outline a plan; - question and challenge information and arguments; - consider a problem from multiple perspectives; understanding those points of view. 2. Social skills: - work cooperatively in groups including delegating and taking responsibility, adapting to roles, resolving; - listen carefully to others and react reasonably to the situation. 3. Communication skills: - know the best method of delivering information in a variety of contexts and situations; - organize information clearly and logically to ensure effective communication; - demonstrate effective verbal communication skills that facilitate the successful delivery of information in a. 4. Self-management skills: - know and apply appropriate rules depending on the situation - including all school rules; - is able to follow through on both oral and written instructions. 5. Research skills: - choose the appropriate sources / technologies; filter for relevance; identify appropriate means to communicate the end product/solution.	Graphs and equations of polynomial functions The factor and remainder theorem Sum and product of roots of polynomial equations
Topic 28 **Functions III**	1. Thinking skills: - see relationships between knowledge / ideas; - develop questions; - create hypotheses; - use acquired knowledge and concepts in practical or new ways including logical progression of arguments; - think about two or more different points of view at the same time; - analyze your own and others' thought processes. 2. Social skills: - negotiate goals and limitations with peers and with teachers; - work cooperatively in groups including delegating and taking	Rational functions of the type $f(x) = \frac{ax+b}{cx^2+dx+e}$ or $f(x) = \frac{ax^2+bx+c}{dx+e}$ Solutions of g(x) ≫ f(x) both analytically and graphically Graphs of functions $\lvert f(x)\rvert$ and $f(\lvert x\rvert)$ Graphs pf the functions $y = \frac{1}{f(x)}$ and $f(ax+b)$ and $(f(x))^2$ Properties of functions

	responsibility, adapting to roles, resolving.	
Topic 29 **Vectors**	1. Thinking skills: - see relationships between knowledge / ideas; - develop questions; - create hypotheses; - use acquired knowledge and concepts in practical or new ways including logical progression of arguments; - think about two or more different points of view at the same time; - analyze your own and others' thought processes. 2. Social skills: - listen carefully to others and react reasonably to the situation; - accept others including analyzing others' ideas, respecting others' points of view, using ideas critically. 3. Communication skills: - use subject specific vocabulary in context; - demonstrate effective verbal communication skills that facilitate the successful delivery of information in a. 4. Self-management skills: - understands the importance of punctuality; - demonstrates strategies for documenting the learning process. 5. Research skills: - share and recommend media choices to others; - distinguish between electronic resources: proprietary databases, Internet etc.; use a variety of effective note-taking techniques.	Introduction to vectors Vectors and geometry Scalar product and angles Equations of a line in three-dimensions Intersection of lines Vector products and areas Equation of a plane Angle and intersection between lines and planes
Topic 30 **Probability**	1. Thinking skills: - see relationships between knowledge / ideas; - develop questions; - create hypotheses; - use acquired knowledge and concepts in practical or new ways including logical progression of arguments; - think about two or more different points of view at the same time; - analyze your own and others' thought processes. 2. Social skills: - negotiate goals and limitations with peers and with teachers; - work cooperatively in groups including delegating and taking responsibility, adapting to roles, resolving.	Bayes' theorem Variance of a discrete random variable Continuous random variables
Topic 31 **Further calculus**	1. Thinking skills: - use deductive reasoning; - develop questions; - evaluate the quality of the information gathered;	Fundamentals of calculus L'Hopital's rule

	- develop a habit of reflection and an attitude of continuous improvement; - analyze your own and others' thought processes. 2. Social skills: - work cooperatively in groups including delegating and taking responsibility, adapting to roles, resolving; - accept others including analyzing others' ideas, respecting others' points of view, using ideas critically. 3. Communication skills: - actively listen; - organize information clearly and logically to ensure effective communication. 4. Self-management skills: - understands the importance of punctuality; - is able to follow through on both oral and written instructions. 5. Research skills: - share and recommend media choices to others; - use a variety of effective note-taking techniques.	Implicit differentiation Related rates of change Optimisation Calculus applied to more functions Integration by substitution Integration by Parts Further geometric interpretation of integrals
Topic 32 **Series and differential equations**	1. Thinking skills: - see relationships between knowledge / ideas; - develop questions; - create hypotheses; - use acquired knowledge and concepts in practical or new ways including logical progression of arguments; - think about two or more different points of view at the same time; - analyze your own and others' thought processes. 2. Social skills: - negotiate goals and limitations with peers and with teachers; - work cooperatively in groups including delegating and taking responsibility, adapting to roles, resolving.	First order differential equations and Euler's method Separating variables and homogeneous differential equations Integrating factors Maclaurin's series Using Maclaurin's series to solve differential equations

Syllabus component	Teaching hours
	HL
All topics are compulsory. Students must study all the sub-topics in each of the topics in the syllabus as listed in this guide. Students are also required to be familiar with the topics listed as prior learning.	
Topic 1 – **Exponents and Logarithms**	– 9
Topic 2 **Sequences**	13
Topic 3 **Functions**	8
Topic 4 **Coordinate geometry**	7
Topic 5 **Geometry and Trigonometry**	8
Topic 6 **Statistics**	13
Topic 7 **Probability**	14
Topic 8 **Probability distributions**	12
Topic 9 **Differentiation**	15
Topic 10 **Integration**	8

Topic 11 **Proof**	7
Topic 12 **Exponents and Logarithms II**	6
Topic 13 **Sequences and Series II**	8
Topic 14 **Functions II**	7
Topic 15 **Quadratics**	8
Topic 16 **Graphs**	8
Topic 17 **Equations**	6
Topic 18 **Trigonometry**	6
Topic 19 **Statistics and probability 2**	6
Topic 20 **Differentiation 2**	6
Topic 21 **Integration2**	9
Topic 22 **Counting principles**	9

Topic 23 **Algebra**	18
Topic 24 **Trigonometry**	6
Topic 25 **Complex numbers**	18
Topic 26 **Mathematical proof**	10
Topic 27 **Polynomials**	17
Topic 28 **Functions**	18
Topic 29 **Vectors**	17
Topic 30 **Further Probability**	10
Topic 31 **Further calculus**	12
Topic 32 **Series and differential equations**	18
Topic 33 **Toolbox and exploration**	48
Topic 33 **Revision**	17

Total	402

Year 10

Topic	Hours
Number and Algebra	**37**
Functions	**38**
Geometry and Trigonometry	**39**
Statistics and Probability	**34**
Calculus	**38**
Toolkit and Exploration	**18**
Reserve	**18**
Total	**222**

Year 11

Topic	Hours
Number and Algebra	**22**
Functions	**15**
Geometry and Trigonometry	**34**
Statistics and Probability	**15**
Calculus	**45**
Toolkit and Exploration	**27**
Reserve	**22**
Total	**180**

Assessment

External assessment (5 hours) Paper 1 (2 hours) No calculator allowed. (120 marks) *Section A* Compulsory short-response questions based on the core syllabus. *Section B* Compulsory extended-response questions based on the core syllabus.	**30%**
Paper 2 (hours) Graphic display calculator required. (120 marks) *Section A* Compulsory short-response questions based on the core syllabus. *Section B* Compulsory extended-response questions based on the core syllabus.	**30%**
Paper 3 (1 hour) Investigative type questions	**20%**
Internal assessment This component is internally assessed by the teacher and externally moderated by the IB at the end of the course. **Mathematical exploration** Internal assessment in mathematics HL is an individual exploration. This is a piece of written work that involves investigating an area of mathematics. (20 marks)	**20%**

Bibliography for Students

1. Mathematics -Analysis and Approaches SL and HL. by Paul Fanon et al. 2019