Stony Point High School
IB Diploma Programme
2020-2021 Course Syllabus

IB Mathematics
Analysis & Approaches SL

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Tutorials: Every morning, 8:00AM – 8:50AM and Thursdays after school, 4:30PM – 5:30PM

I. Course Description:

This course recognizes the need for analytical expertise in a world where innovation is increasingly dependent on a deep understanding of mathematics. This course includes topics that are both traditionally part of a pre-university mathematics course (for example, functions, trigonometry, calculus) as well as topics that are amenable to investigation, conjecture and proof, for instance the study of sequences and series at both SL and HL, and proof by induction at HL.

The course allows the use of technology, as fluency in relevant mathematical software and hand-held technology is important regardless of choice of course. However, Mathematics: analysis and approaches has a strong emphasis on the ability to construct, communicate and justify correct mathematical arguments.

(Mathematics Analysis and Approaches Course Guide, IBO. 2019)

II. Prior Learning for Course:

It is expected that most students embarking on a DP mathematics course will have studied mathematics for at least 10 years. There will be a great variety of topics studied, and differing approaches to teaching and learning. Thus, students will have a wide variety of skills and knowledge when they start their mathematics course. Most will have some background in arithmetic, algebra, geometry, trigonometry, probability and statistics. Some will be familiar with an inquiry approach, and may have had an opportunity to complete an extended piece of work in mathematics.

(Mathematics Analysis and Approaches Course Guide, IBO. 2019)

III. Course Aims & Objectives:

The aims of all DP mathematics courses are to enable students to:

1. develop a curiosity and enjoyment of mathematics, and appreciate its elegance and power
2. develop an understanding of the concepts, principles and nature of mathematics
3. communicate mathematics clearly, concisely and confidently in a variety of contexts
4. develop logical and creative thinking, and patience and persistence in problem solving to instil confidence in using mathematics
5. employ and refine their powers of abstraction and generalization

6. 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
7. appreciate how developments in technology and mathematics influence each other
8. appreciate the moral, social and ethical questions arising from the work of mathematicians and the applications of mathematics
9. appreciate the universality of mathematics and its multicultural, international and historical perspectives
10. appreciate the contribution of mathematics to other disciplines, and as a particular "area of knowledge" in the TOK course
11. develop the ability to reflect critically upon their own work and the work of others
12. independently and collaboratively extend their understanding of mathematics

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 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 abstract and real-world 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; use appropriate notation and terminology.
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 from the real world, involving organizing and analyzing information, making conjectures, drawing conclusions, and testing their validity.

(Mathematics Analysis and Approaches Course Guide, IBO. 2019)

IV. How the course will address TOK:

The relationship between each subject and theory of knowledge (TOK) is important and fundamental to the DP. The theory of knowledge course provides an opportunity for students to reflect on questions about how knowledge is produced and shared, both in mathematics and also across different areas of knowledge. It encourages students to reflect on their assumptions and biases, helping them to become more aware of their own perspective and the perspectives of others and to become "inquiring, knowledgeable and caring young people" (IB mission statement).

As part of their theory of knowledge course, students are encouraged to explore tensions relating to knowledge in mathematics. As an area of knowledge, mathematics seems to supply a certainty perhaps impossible in other disciplines and in many instances provides us with tools to debate these certainties. This may be related to the "purity" of the subject, something that

can sometimes make it seem divorced from reality. Yet 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? Indeed, the philosophy of mathematics is an area of study in its own right.

(Mathematics Analysis and Approaches Course Guide, IBO. 2019)

This course will have class lessons and activities (warm up journals and others) designed to get students thinking on their own and be able to connect novel ideas and concepts to their previously learned content. Proof based questions in particular will challenge students to show why and how they know something to me mathematically correct. Class discussions will also be incorporated throughout the year to promote critical thinking and communication skills.

V. How the course will address CAS:

CAS and mathematics can complement each other in a number of ways. Mathematical knowledge provides an important key to understanding the world in which we live, and the mathematical skills and techniques students learn in the mathematics courses will allow them to evaluate the world around them which will help them to develop, plan and deliver CAS experiences or projects.

An important aspect of the mathematics courses is that students develop the ability to systematically analyse situations and can recognize the impact that mathematics can have on the world around them. An awareness of how mathematics can be used to represent the truth enables students to reflect critically on the information that societies are given or generate, and how this influences the allocation of resources or the choices that people make. This systematic analysis and critical reflection when problem solving may be inspiring springboards for CAS projects.

Students may also draw on their CAS experiences to enrich their involvement in mathematics both within and outside the classroom, and mathematics teachers can assist students in making links between their subjects and students' CAS experiences where appropriate. Purposeful discussion about real CAS experiences and projects will help students to make these links.

The challenge and enjoyment of CAS can often have a profound effect on mathematics students, who might choose, for example, to engage with CAS in the following ways:

•plan, write and implement a "mathematics scavenger hunt" where younger students tour the school answering interesting mathematics questions as part of their introduction to a new school
•as a CAS project students could plan and carry out a survey, create a database and analyse the results, and make suggestions to resolve a problem in the students' local area. This might be, for example, surveying the availability of fresh fruit and vegetables within a community, preparing an action plan with suggestions of how to increase availability or access, and

presenting this to a local charity or community group
•taking an element of world culture that interests students and designing a miniature Earth (if the world were 100 people) to express the trend(s) numerically.

(Mathematics Analysis and Approaches Course Guide, IBO. 2019)

VI. How the course will address Approaches to Learning skills:

All students will be active learners by working individually and together in small groups to communicate mathematical ideas and collaborate to solve real world problems. Through the internal assessment, students will manage their time effectively to complete a mathematical exploration of their choice which will require research and mathematical inquiry.

1. Thinking skills - Hit on a daily basis with various types of lessons, activities, and assignments
2. Communication skills - Practice writing and speaking with precise mathematical language
3. Social skills - Interacting in class with their teacher and classmates
4. Self-management skills - Daily time and work management with classwork and homework
5. Research skills - Internal Assessment Exploration

VII. The approach to teaching the course.

Students will encounter lectures, collaborative and individual learning and assignments, and exams composed of free-response IB style questions which mimic the paper exam format. Primarily the lessons in the course are structured in such a way to build off of the students' prior knowledge and enable them to connect that previously learned material to the new content that is being learned. The use of technology (graphing calculator) will be involved in roughly half of the course work.

VIII. How the course will address the Learner Profile.

This course will require all students to uphold the elements of the IB Learner Profile:

1. **Inquirers:** Develop the skills needed to nurture mathematical curiosity.
2. **Knowledgeable:** Use conceptual understanding to develop the properties existing in higher level mathematical courses.
3. **Thinkers:** Use critical and creative thinking to develop solutions to real world problems.
4. **Communicators:** Be able to communicate mathematical ideas symbolically, verbally, and numerically.
5. **Principled:** Act with integrity and honesty with all assignments given.
6. **Open-Minded:** Be willing to listen and share various approaches to problem solving respectfully.
7. **Caring:** Exhibit empathy and compassion in the classroom.
8. **Risk-Takers:** Approach problems with determination and grit despite their level of difficulty.
9. **Balanced:** Achieve well-being for one self and encourage others to do the same.
10. **Reflective:** Understand strengths and weaknesses and use them to grow academically.

IX. Assessment details for Internal and External Requirements:

For the external assessment, two paper exams will be given at the end of the academic school year in May.

These papers are externally set and externally marked. Together, they contribute 80% of the final mark for the course. These papers are designed to allow students to demonstrate what they know and what they can do.

Paper 1

Students are not permitted access to any calculator. Questions will mainly involve analytic approaches to solutions, rather than requiring the use of a GDC. The paper is not intended to require complicated calculations, with the potential for careless errors. However, questions will include some arithmetical manipulations when they are essential to the development of the question.

Paper 2

Students must have access to a GDC at all times. However, not all questions will necessarily require the use of the GDC. Regulations covering the types of GDC allowed are provided in the *Handbook of procedures for the Diploma Programme*.

The internal assessment is an integral part of the course and is compulsory for all students. It enables students to demonstrate the application of their skills and knowledge, and to pursue their personal interests, without the time limitations and other constraints that are associated with written examinations. The internal assessment should, as far as possible, be woven into normal classroom teaching and not be a separate activity conducted after a course has been taught. Internal assessment in mathematics SL is an individual exploration. This is a piece of written work that involves investigating an area of mathematics. It is marked according to five assessment criteria.

Criterion A: Presentation

Achievement level	Descriptor
0	The exploration does not reach the standard described by the descriptors below.
1	The exploration has some coherence or some organization.
2	The exploration has some coherence and shows some organization.
3	The exploration is coherent and well organized.
4	The exploration is coherent, well organized, and concise.

Criterion B: Mathematical communication

Achievement level	Descriptor
0	The exploration does not reach the standard described by the descriptors below.
1	The exploration contains some relevant mathematical communication which is partially appropriate.
2	The exploration contains some relevant appropriate mathematical communication.
3	The mathematical communication is relevant, appropriate and is mostly consistent.
4	The mathematical communication is relevant, appropriate and consistent throughout.

Criterion C: Personal engagement

Achievement level	Descriptor
0	The exploration does not reach the standard described by the descriptors below.
1	There is evidence of some personal engagement.
2	There is evidence of significant personal engagement.
3	There is evidence of outstanding personal engagement.

Criterion D: Reflection

Achievement level	Descriptor
0	The exploration does not reach the standard described by the descriptors below.
1	There is evidence of limited reflection.
2	There is evidence of meaningful reflection.
3	There is substantial evidence of critical reflection.

Criterion E: Use of mathematics—SL

Achievement level	Descriptor
0	The exploration does not reach the standard described by the descriptors below.
1	Some relevant mathematics is used.
2	Some relevant mathematics is used. Limited understanding is demonstrated.
3	Relevant mathematics commensurate with the level of the course is used. Limited understanding is demonstrated.
4	Relevant mathematics commensurate with the level of the course is used. The mathematics explored is partially correct. Some knowledge and understanding are demonstrated.
5	Relevant mathematics commensurate with the level of the course is used. The mathematics explored is mostly correct. Good knowledge and understanding are demonstrated.
6	Relevant mathematics commensurate with the level of the course is used. The mathematics explored is correct. Thorough knowledge and understanding are demonstrated.

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X. Grading Policy & Scale:

All students will receive a numerical grade on a 100 point scale throughout the school year to measure comprehension of the material. Formative Assessments comprise 60% of the overall grade, and Summative Assessments the remaining 40%. A grade above a 70 will not secure satisfaction for an IB diploma (only local credit for graduation requirements). Only a fall semester exam will be administered and will be weighted 16% of the fall semester grade. Students must successfully complete two IB paper exams (which weigh 40% each) and an internal assessment (weighing 20%) in order to satisfy the group 5 component of the IB diploma program.

Students will typically have two formative assignments per week, and three summative assessments in each grading period.

XI. Course Sequence:

Year 1 - Advanced Precalculus: Number and Algebra (Topic 1), Functions (Topic 2), Geometry and Trigonometry (Topic 3)

Year 2 Fall semester: Differential calculus (5), Integral calculus (5), IA
Year 2 Spring semester: Probability (4), Statistics (4), IB exam review

XII. IA Checkpoint Dates and final IA Deadlines:
October 16 (A) or 19 (B)- topic due
October 22 (A) or 23 (B) - introduction due
December 1 (A) or 2 (B) - body/mathematical exploration due
December 7 (A) or 8 (B) - conclusion/bibliography due
December 14-17 (final exam date) - rough draft due
March 10 (A) or 11 (B) - final draft due

Note: These dates are subject to change as the IB Department works together to make sure IAs from multiple classes don't all overlap at one time.

XIII. Sample exam questions:

Paper 1

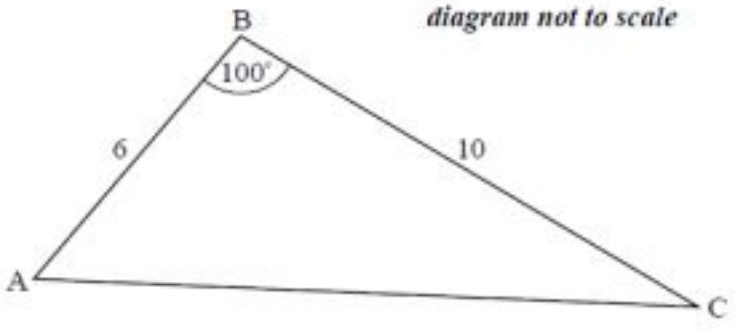
Let $f(x) = a(x-h)^2 + k$. The vertex of the graph of f is at $(2, 3)$ and the graph passes through $(1, 7)$.

(a) Write down the value of h and of k.

(b) Find the value of a.

Paper 2

The following diagram shows triangle ABC.



$AB = 6\text{cm}$, $BC = 10\text{cm}$, and $\hat{ABC} = 100°$.

(a) Find AC.

(b) Find $\hat{BCA}$.

XIV. Stony Point Academic Honesty Policy:

All students are expected to abide by the SPHS Academic Honesty Policy. This policy is available on the SPHS IB website at www.stonypointib.com under Handbooks. The password is Tiger2021.

Students are allowed to collaborate with other students to solve problems on assignments but are not allowed to directly copy off of each other's work. Assessments will be completely individual assignments and students will not be allowed to work together. For the purposes of this class, cheating is the presentation of someone else's work and trying to claim credit for it as your own.

XV. Writing an Extended Essay in IB Mathematics SL:

If a student chooses to write an extended essay in this subject, these titles have proved successful in the past:

What is the percentage return of a particular 3 reel slot machine?

What are alternatives to Euclidean Geometry and what practical applications do they have?

A comparative study of population growth models for Country X over the last n years, with future predictions.

The sound of mathematics - investigation of geometric series in musical instruments - the position of the frets on a guitar, for example.

How many convex polygons can be made from the seven tangram pieces?

XVI. Classroom Policy & Procedure

Late Paper Policy- Late assignments will not be accepted after the 10^{th} calendar day from when an assignment is due as specified in the electronic gradebook. The late penalty at Stony Point HS is a 70. Students who are absent are still held to these guidelines and should maintain responsibility for their work in a timely manner.

Make Up Work Policy- Each student will be responsible for obtaining and completing the make-up work, to include tests, in a satisfactory manner and will be governed by a "day for a day" procedure. For example, if a student is absent for two days, they will have two days upon their return to turn in all required work that was missed due to the absence. Students shall be permitted to complete make-up work in any class missed because of an absence, truancy or suspension. No grade penalties shall be imposed for make-up work, unless turned in after the teacher's specified due date.
Students are expected to make arrangements with teachers in advance of school-related absences for work due during the time period absent.

Classroom Expectations- Students are expected to respect the teacher and their fellow students and their property and behave in ways that promote a positive academic environment. Students are expected to abide by all of the school rules. Students who violate these rules will be penalized. Additionally, the following will be enforced:

No food or drink
No headphones or earbuds; no iPods, MP3 players
No cell phones

All food and drink items, cell phones, iPods, etc. including the headphones must be placed out of sight in backpacks before entering the classroom and remain put away until you have left the room.

Cell phones and music players must be turned off. Electronic devices such as calculators, tablets, and laptop computers may be used only for academic purposes as approved by the teacher. Cell phones may not be used as calculators or as cameras.

Students are expected to maintain an organized notebook of notes, class activities, homework assignments, and all handouts distributed in class including this syllabus

Needed Supplies: These supplies must be brought to each class meeting unless otherwise directed.

- TI-83+ or TI-84+ graphing calculator (I will have a class set students are allowed to use only during class. A calculator from the class set may only be checked out with a valid form of ID. It may be in your best interest to purchase one for personal use at home as well as for college in the future. These can be bought anywhere. Used ones can be found online or at pawn shops for a less expensive price.)
- Three-ring binder with loose-leaf paper and dividers or a comparable alternative. •

A spiral notebook for daily warm ups and assignments

- Pens/pencils with contrasting colors