IB Mathematics HL Analysis & Approaches

Welcome to IB Mathematics Higher Level at ThunderRidge High School. I look forward to the coming year as we explore and expand your conceptual knowledge of mathematics.

IB Maths HL is a college preparatory course. Examinations will be given in May of your senior year along with an internal assessment to be completed during your senior year. Successful completion of these assessments could provide you with college credit.

The purpose of IB Math HL is to guide students to use the knowledge and skills obtained in this course for the improvement of the global society. Upon completion of the course the student will be required to demonstrate proficiency for the IB Maths HL objectives and aims.

IB Maths HL Core Topic Content Objectives may be found at the following link: HERE. The Core Topics outline the specific Understandings (knowledge), Applications and Skills, Theory of Knowledge Connection and International-Mindedness Area of Focus.

Course Aims and Objectives

Topic I – Core: **Algebra** → The aim of this topic is to introduce students to some basic algebra concepts and applications.

- 1.1 – Arithmetic sequences and series – Presumed knowledge
- 1.2 – Exponents and logarithms – Presumed knowledge
- 1.3 – Counting principles – Presumed knowledge
- 1.4 – Proof by Mathematical Induction – Presumed knowledge
- 1.5 – Complex Numbers
- 1.6 – Modulus – argument (Polar) form
- 1.7 – Powers of complex numbers: deMoivre's Theorem
- 1.8 – Conjugate roots of polynomial equations with real coefficients – Presumed knowledge
- 1.9 – Solutions of systems of linear equations – Presumed knowledge

Topic 2 – Core: **Functions and Equations** → The aims of this topic are to explore the notion of function as a unifying theme in mathematics, and to apply functional methods to a variety of mathematical situations. It is expected that extensive use will be made of technology in both the development and the application of this topic.

- 2.1 – Concept of function – Presumed knowledge
- 2.2 – The graph of a function: its equation $y = f(x)$ – Presumed knowledge
- 2.3 – Transformation of graphs: translations; stretches; reflections – Presumed knowledge
- 2.4 – The rational function $x \to \frac{ax+b}{cx+d}$, and its graph – Presumed knowledge
- 2.5 – Polynomial functions and their graphs – Presumed knowledge
- 2.6 – Solving quadratic equations using the quadratic formula – Presumed knowledge

2.7 – Solutions of $g(x) \geq f(x)$ – Presumed knowledge

Topic 3 – Core: **Circular functions and trigonometry** → The aims of this topic are to explore the circular functions, to introduce some important trigonometric identities and to solve the triangles using trigonometry. On examination papers, radian measure should be assumed unless otherwise indicated.

3.1 – The circle – Presumed knowledge
3.2 – Definition of $cos\ \theta$, $sin\ \theta$, and $tan\ \theta$ – Presumed knowledge
Definition of $sec\ \theta$, $csc\ \theta$ and $cot\ \theta$ – Presumed knowledge
3.3 – Compound angle identities, Double angle identities – Presumed knowledge
3.4 – Composite functions of the form $f(x) = asin\ (b(x + c)) + d$ – Presumed knowledge
3.5 – The inverse functions and their graphs – Presumed knowledge
3.6 – Algebraic and graphical methods of solving trig equations – Presumed knowledge
3.7 – The Law of Cosines, Law of Sines – Presumed knowledge

Topic 4 – Core: **Vectors** → The aim of this topic is to introduce the use of vectors in two and three dimensions, and to facilitate solving problems involving points, lines and planes.

4.1 – Concept of a vector
4.2 – The definition of the scalar product of two vectors
4.3 – Vector equation of a line in two and three dimensions: $r = a + \lambda b$
4.4 – Coincident, parallel, intersecting and skew lines; distinguishing between these cases
4.5 – The definition of the vector product of two vectors
4.6 – Vector equation of a plane; $r = a + \lambda b + \mu c$
4.7 – Intersection of a line with a plane; two planes; three planes

Topic 5 – Core: **Statistics and Probability** → The aim of this topic is to introduce basic concepts. It may be considered as three parts: manipulation and presentation of statistical data, the laws of probability and random variables and their probability distributions. It is expected that most of the calculations required will be done on a GDC. The emphasis is on understanding and interpreting the results obtained. Statistical tables will no longer be allowed in examinations.

5.1 – Concepts of population, sample, random sample and frequency distribution of discrete and continuous data.
5.2 – Concepts of trial, outcome, equally likely outcomes, sample space and event
5.3 – Combined events; the formula for $P(A \cup B)$
5.4 – Conditional probability; the definition $P(B) = \frac{P(A \cap B)}{P(B)}$
5.5 – Concept of descrete and continuous random variables and their probability distributions.
5.6 – Binomial distribution, its mean and variance. Poisson distribution, its mean and variance.
5.7 – Normal distribution

Topic 6 – Core: **Calculus** →The aim of this topic is to introduce students to the basic concepts and techniques of differential and integral calculus and their applications.

6.1 – Informal ideas of limit, continuity and convergence – Presumed knowledge
6.2 – Derivatives of x^n, $sin\ x$, $cos\ x$, $tan\ x$, e^x, lnx – Presumed knowledge
6.3 – Local maximum and minimum values; Optimization Problems – Presumed knowledge
6.4 – Indefinite integration as anti-differentiation – Presumed knowledge
6.5 – Anti-differentiation with a boundary condition to determine the constant of integration
6.6 – Kinematic problems involving displacement *s*, velocity *v* and acceleration a.
6.7 – Integration by substitution and by parts.

Topic 9 – Option: **Further Calculus** → The aims of this option are to introduce limit theorems and convergence of series, and to use calculus to solve differential equations.

9.1 – Infinite sequences of real numbers and their convergence/divergence
9.2 – Convergence of infinite series
9.3 – Continuity and differentiability of a function at a point
9.4 – The integral as a limit of a sum; lower and upper Riemann sums
9.5 – First order differential equations
9.6 – Rolle's Theorem, Mean Value Theorem, Taylor Polynomials
9.7 – The evaluation of limits of the form $lim_{x \to a} \frac{f(x)}{g(x)}$ using L'Hopitals Rule or Taylor Series

International Mindedness

International mindedness will be a strand through all curricular units. By studying the historical perspective of mathematics knowledge over time and the discovery and innovations of application of mathematics, students will be exposed to the collaborative efforts of a global mathematical community. Ethics plays a role in the application of mathematical decisions. Each global community has their own beliefs concerning moral, ethical, socioeconomic issues, which have global environmental implications (TOK). By exploring these issues, students will gain an understanding of other people and their perspectives.

IB Assessments

Assessment is an integral part of teaching and learning. The most important aims of assessment in the Diploma Programme are that it should support curricular goals and encourage appropriate student learning. Both the external and internal assessment are used in the Diploma Programme. IB examiners mark work produced for external assessment, while work produced for internal assessment is marked by teachers and externally moderated by the IB.

There are two types of assessment identified by the IB.

- Formative assessment informs both teaching and learning. It is concerned with providing accurate and helpful feedback to students and teachers on the kind of learning taking place and the nature of students' strengths and weaknesses in order to help develop students' understanding and capabilities. Formative assessment can also help to improve teaching quality, as it can provide information to monitor progress towards meeting the course aims and objectives.
- Summative assessment gives an overview of previous learning and is concerned with measuring student achievement.

Internal Assessment (20%)

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 IB Maths HL is an individual project. This is a piece of written work based on personal research involving the collection, analysis and evaluation of data. It is marked according to seven assessment criteria

Each project must contain:

- a title
- a statement of the task and plan
- measurements, information or data that have been collected and/or generated
- an analysis of the measurements, information or data
- interpretation of results, including a discussion of validity
- appropriate notation and terminology.

Historical projects that reiterate facts but have little mathematical content are not appropriate and should be actively discouraged.

Work set by the teacher is not appropriate for a project. Students can choose from a wide variety of project types, for example, modelling, investigations, applications and statistical surveys.

The project should not normally exceed **2,000** words, excluding diagrams, graphs, appendices and bibliography. However, it is the quality of the mathematics and the processes used and described that is important, rather than the number of words written.

The teacher is expected to give appropriate guidance at all stages of the project by, for example, directing students into more productive routes of inquiry, making suggestions for suitable sources of information, and providing general advice on the content and clarity of a project in the writing-up stage.

Teachers are responsible for indicating to students the existence of errors but should not explicitly correct these errors. It must be emphasized that students are expected to consult the teacher throughout the process.

All students should be familiar with the requirements of the project and the criteria by which it is assessed. Students need to start planning their projects as early as possible in the course. Deadlines, preferably reached by agreement between students and teachers, need to be firmly established. There needs to be a date for submission of the project title and a brief outline description, a date for the completion of data collection or generation, a date for the submission of the first draft and, of course, a date for project completion.

In developing their projects, students should make use of mathematics learned as part of the course. The level of sophistication of the mathematics should be similar to that suggested by the syllabus. It is not expected that students produce work that is above the IB Maths HL syllabus—however, this is not penalized.

External Assessment (80%)

Paper 1 – No Calculator	30%
Paper 2 – Calculator Required	30%
Paper 3 – Calculator Required (Option Material)	20%

Non – IB Assessments

Assessment practices will follow the ThunderRidge High School Balanced Assessment System. Students will be provided the learning targets of each curricular unit and will monitor their progress through formative, interim and summative assessments. Formative and interim assessments will drive instructional and reinforcement activities/lessons.

Course Delivery

Instructional Approach: Classroom Practices that Support the IB Philosophy

In this course the students will have the opportunity to understand and appreciate both the practical use of mathematics and its aesthetic aspects. They will be encouraged to build on knowledge from prior learning in mathematics and other subjects, as well as their own experience. It is important that students develop mathematical intuition and understand how they can apply mathematics in life.

Application and discussion of TOK

The Theory of knowledge guide (March 2006) 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.

Aims

The aims of all mathematics courses in group 5 are to enable students to:

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

Prior Knowledge

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.

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
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 analyzing information, making conjectures, drawing conclusions and testing

EE/CAS

Teachers are a sponsor of students' extended essay and CAS.

IB Maths HL Classroom Policies

All students have the right to learn and participate to best of their abilities. I follow the:

- Academic Honesty Policy
- Inclusion Policy

- Language Policy
- Assessment Policy
- Resolution Process

Class Policies and Procedures

Students are expected to be active learners. Self-evaluation and creation of learning plans is a requirement of all students. The grade will reflect what a student knows and the skills obtained over the course of year. Students will be assessed formatively during each class based upon warm-ups, homework questions, and class discussions. Each chapter covered will have a summative exam, which will be in IB format. The last month of study will consist of 4 to 6 practice papers. The practice papers will be graded under the correct IB grading policies.

IB Maths HL Grade Break Down

First Semester	**Second Semester**
70% Assessments	90% Assessments
10% Homework	10% Homework
20% Final Exam	

Research has shown that students who take IB courses perform better in college regardless of their exam score. Students who perform well in IB Maths HL can expect to do well on the IB Maths HL examination given in May, and may be eligible to receive college credit for your high school efforts.

Course Success

In order to be successful, you must commit the time and effort to acquire the necessary knowledge and skills.

- Develop a study schedule. Studying should be interactive in order to foster learning.
- Attend scheduled study sessions throughout the year.
- Become an active member of a study group. All students are expected to participate.
- Ask for additional assistance when you are struggling.

Attendance and Behavioural Expectations

When you are absent, you should complete regular assignments during your absence. For an Excused Absence, you will have one school day for each day excused to complete assigned work. YOU are responsible for getting all necessary details and information about your work.

Additional Resources

http://www.ibo.org/en/programmes/diploma-programme/curriculum/mathematics/mathematics/