# ST. JOSEPH'S INSTITUTION INTERNATIONAL MALAYSIA

# MATHEMATICS HANDBOOK 2017-18

# Why study Mathematics?

The nature of mathematics is varied. To some, it is a useful tool to explore and explain the world around us. To others it is a body of knowledge that describes and abstract system of ideas. Scientists view mathematics as a universal language that transcends politics, religion and nationality.

Ultimately, mathematics is all of these things and more. At SJIIM, the study of mathematics aims to develop the skills and knowledge necessary to solve complex problems and communicate those solutions in a logical, coherent manner. Critical and creative thinking skills are built systematically to ensure that students can develop an appreciation of the elegance and power of mathematics.

As a subject, many universities require Mathematics for the study of engineering, natural sciences, architecture, business and economics.

At SJII Malaysia, Mathematics is offered at both higher (HL) & standard level (SL).

# Approaches to teaching and learning in Mathematics

There are three main facets in the approaches to teaching and learning in mathematics. These facets bring focus to the students' learning as they develop their understanding of the methodology and practice within the discipline of mathematics:

- mathematical inquiry
- mathematical modeling and applications
- use of technology

**Mathematical Inquiry** – the IB learner profile encourages learning by experimentation, questioning and discovery. By being active participants in their learning, students are more able to build strong connections with the subject material, thus providing the basis for further and deeper application of their skills and knowledge when faced with unfamiliar concepts and problems.

**Mathematical Modeling and Applications** – the greatest learning experiences for students come from analyzing the world around them and trying to make predications from that analysis. Throughout their studies and in their lives beyond school, students will be asked to develop models to better understand real-world problems. Through testing these models, reflecting critically on the construction and outcomes of these models, students are better prepared to make sense of the world around them.

**Use of Technology** – technology is a powerful tool in the teaching and learning of mathematics. When using technology, students are able to enhance visualization of complex problems as well as support their understanding of the fundamentals and underlying principles of the subject. Coupled with the other facets described above, students will be able to use technology to explore and extend their knowledge and application of mathematical concepts throughout their studies.

There are five main skills that students will be encouraged to develop throughout their studies in the IB Diploma Programme. How these skills can relate to the study of Mathematics is outlined below.

***Research skills*** – whether it is doing formal research for extended essays or the internal assessment (IA) or informal research as you try to find further examples to solidify the concepts presented in class, research skills are vital to success in the IB. Through research, students are able to create a solid foundation in the subject from which they can explore the many interesting pathways that comprise mathematics.

***Communication skills*** – as a symbolic language, mathematics depends on well developed communication skills. Presenting logical and coherent communication during extended problem solving activities allows both the communicator and the reader the opportunity to reflect critically on the work as they strive for elegance in their solutions.

***Social skills*** – no mathematician is an island – the development of ideas has always depended on building upon the work of those who came before. As such, there is a very social aspect to mathematical discovery that students are encouraged to tap into as they build and develop their own knowledge and skill in the subject.

***Thinking skills*** – analysis of problems, evaluation of solutions and critical reflection are all part of the learning experience, especially in mathematics.

***Self-management skills*** – success in the subject, as well as the IBDP itself, depends on self-management. The most successful students will be able to make the best use of their time, reflect critically to better understand their strengths and areas for improvement, and will be able to make time to address these areas for improvement, whether it be through further research or seeking assistance from the teacher.

This means that your teacher will also use a ***broad set of approaches***, including:

***Inquiry*** – students will be encouraged to develop their knowledge through experiential and problem-based learning activities.

***Emphasising concepts*** – teaching and learning should be directed towards the “big ideas”, allowing students to move from concrete to abstract thinking. This will allow them greater opportunity to understanding the underlying principles so that they can apply their knowledge to new contexts

***Differentiation*** – teachers will use a variety of teaching strategies and approaches to develop, pursue and achieve appropriate personal learning goals for each student

***Effective teamwork and collaboration*** – through effective dialogue, feedback and collaboration, students can enhance their understanding as they develop and build upon the perspectives of those around them

***Assessment*** – assessment will be used in a variety of manners including assessment of learning to see what each student knows, assessment for learning to determine the next steps in the teaching process, and assessment as learning to allow opportunities for students to reflect on their own learning and develop strategies that will put them on the pathway to success.

# Mathematics and the IB learner profile

While you progress through your diploma programme studies and activities, you will develop a number of attributes. The IB calls this the IB "learner profile". This table shows you what the learner profile attributes are and some examples of how Mathematics can help you develop these,

| We hope you will become … | Examples in Mathematics |
|---|---|
| Inquirers | As students develop their natural curiosity, they will be able to use their research skills to explore their chosen topics for the IA. This will allow them to ask questions such as "how does this link in with my previous knowledge?" and "how can I apply this new knowledge effectively?" |
| Knowledgeable | Throughout the course, students are building upon previous knowledge so that they can explore the subject to greater depths. |
| Thinkers | Students are encouraged to explore and exploit the links between the various concepts in mathematics. |
| Communicators | Communication is key in well developed, well reasoned, logical solutions so that the reader can understand and appreciate the thought processes from start to finish. |
| Principled | Through out both daily work and extended work such as the IA and EE, students are encouraged to act with integrity and honesty. |
| Open Minded | Students are encouraged to explore concepts from multiple perspectives, taking the best ideas from these perspectives so that they can build their personal knowledge in the subject |
| Caring | As a learning community, all students are valued and have the opportunity to develop their skills and advance their learning through effective collaboration and personal development. |
| Risk Takers | Students are encouraged to approach unfamiliar situations and uncertainty with courage. By doing so, they will become better problem solvers when faced with complex situations. |
| Balanced | Since mathematics is multifaceted and has links between these facets, students are encouraged to also be multifaceted in their approaches to learning the subject. |
| Reflective | By reflecting on the links between the various topics and concepts in mathematics, students are able to view problems from multiple perspectives – algebraic, geometric, etc. |

# Topics studied

- Algebra
- Functions and equations
- Trigonometry and circular functions
- Vectors
- Statistics
- Probability
- Calculus

***PLUS***

One option, which is chosen by the teacher from the following:

Topic 7 – Statistics and Probability

Topic 8 – Sets, Relations and Groups

Topic 9 – Calculus

Topic 10 – Discrete Mathematics

# Mathematics in the timetable at SJIIM

The IB requires 240 hours of teaching for HL and 150 hours of teaching for SL. At SJIIM, HL Mathematics is allocated three double lessons per week and SL Mathematics is allocated two double lessons per week.

It sometimes happens that HL and SL Mathematics are taught in the same class. In this case, the teacher will let the SL students know when they do not need to come to lessons. Sometimes students will find they need to go to all three lessons in a week; sometimes they will only attend one or two of the lessons in a week and sometimes there will be periods of time when they will not be required to attend at all.

# The IB Mathematics course

Mathematics, like all IB DP subjects, consists of two “components”.

The first of these is the theory and practical work taught during lessons, and which may be examined in the examination papers at the end of the course. Completed examination papers are sent to IB and marked by IB examiners.

The second of these is the ‘coursework’. In Mathematics, this in an individual exploration of about 10 hours work, that each student much complete. The student, with the teacher’s advice, chooses his or her own topic, investigating an area of mathematics. The investigation is marked by the teacher according to a set of criteria, then sent to IB and checked by IB moderators.

# Assessment criteria for the Mathematics Exploration

So that you have some idea of what will be expected of you in advance, these are the criteria that teachers use to mark the individual investigation.

| CRITERION | EVIDENCE |
|---|---|
| **A: Communication** | This criterion assesses the organization and coherence of the exploration. A well-organized exploration includes an introduction, has a rationale (which includes explaining why this topic was chosen), describes the aim of the exploration and has a conclusion. A coherent exploration is logically developed and easy to follow. |
| **B: Mathematical Presentation** | This criterion assesses the extent to which students use appropriate mathematical language, define key terms, constraints and variables, and their ability to use multiple forms of mathematical representations to enhance their exploration. |
| **C: Personal Engagement** | This criterion assesses the extent to which the student engages with the exploration and makes it their own. Personal engagement may be recognized in different attributes and skills. These include thinking independently and/or creatively, addressing personal interest and presenting mathematical ideas in their own way. |
| **D: Reflection** | This criterion assesses how the student reviews, analyses and evaluates the exploration. Although reflection may be seen in the conclusion to the exploration, it may also be found throughout the exploration. |
| **E: Use of Mathematics** | This criterion assesses to what extent and how well students use mathematics in the exploration. |

# Difference between higher and standard level Mathematics

The difference between higher and standard level Mathematics is two-fold: the amount of material and the depth of the material. In HL Mathematics, students will extend their knowledge by going deeper into each concept that is studied. There is a greater emphasis on abstract thinking as well as utilizing the links between the concepts. Additionally, there are a number of HL only topics that allows for greater breadth of learning within the subject.

# Final assessment in Mathematics

An overview of how you will be assessed on the final set of skills and knowledge that you have acquired is as follows.

| LEVEL | ASSESSMENT | WEIGHTING (%) |
|---|---|---|
| HIGHER | 3 exam papers<br>- Paper 1 – short and extended response (non-calculator)<br>- Paper 2 – short and extended response (calculator)<br>- Paper 3 – extended response based on the chosen option | 80<br>- 30% Paper 1<br>- 30% Paper 2<br>- 20% Paper 3 |
| STANDARD | 2 exam papers<br>- Paper 1 – short and extended response (non-calculator)<br>- Paper 2 – short and extended response (calculator) | 80<br>- 40% Paper 1<br>- 40% Paper 2 |
| Both HIGHER and STANDARD | Mathematical Exploration | 20 |

# IBDP Mathematics HL Curriculum

| Year | Term | Topics Learned | Summative Assessment |
|---|---|---|---|
| 1 | 1 | Functions and Graphing<br>Fundamentals of Algebra<br>Sequences and Series | Functions and Algebra Test<br>Sequences and Series Test<br>Mathematical Investigation Task I |
| | 2 | Trigonometry<br>Complex Numbers | Trigonometry Test<br>Complex Numbers Test<br>Mathematical Investigation Task II |
| | 3 | Differential Calculus<br>Integral Calculus<br>Exam Preparation<br>Initial Work on the Internal Assessment | Calculus Test<br>End of Year Examination |

| Year | Term | Topics Learned | Summative Assessment |
|---|---|---|---|
| 2 | 1 | Completion of Internal Assessment<br>Applications of Calculus<br>Vectors<br>Statistics and Probability | Internal Assessment<br>Applications of Calculus Test<br>Vectors Test |
| | 2 | Statistics and Probability<br>Discrete Mathematics Option (48 hours) | Statistics and Probability Test<br>Discrete Mathematics Test |
| | 3 | Exam Preparation | Mock Examinations<br>External Examinations |

# IBDP Mathematics SL Curriculum

| Year | Term | Topics Learned | Summative Assessment |
|---|---|---|---|
| 1 | 1 | Functions and Graphing<br>Fundamentals of Algebra<br>Sequences and Series | Functions and Algebra Test<br>Sequences and Series Test<br>Mathematical Investigation Task I |
| | 2 | Trigonometry | Trigonometry Test<br>Mathematical Investigation Task II |
| | 3 | Differential Calculus<br>Exam Preparation<br>Initial Work on the Internal Assessment | Calculus Test<br>End of Year Examination |

| Year | Term | Topics Learned | Summative Assessment |
|---|---|---|---|
| 2 | 1 | Completion of Internal Assessment<br>Integral Calculus<br>Applications of Calculus<br>Vectors | Internal Assessment<br>Applications of Calculus Test<br>Vectors Test |
| | 2 | Statistics and Probability | Statistics and Probability Test |
| | 3 | Exam Preparation | Mock Examinations<br>External Examinations |

# Mathematics resources

## Textbooks

The textbooks we use are:

- Mathematics Higher Level for the IB Diploma – Paul Fannon et. al. – Cambridge University Press
- Mathematics Standard Level for the IB Diploma – Paul Fannon et. al. – Cambridge University Press

This is a list of **other Mathematics textbooks** available for reference or loan in the school library:

Mathematics Higher Level Course Companion – Oxford University Press
Mathematics Standard Level Course Companion – Oxford University Press

This list is growing all the time so do keep a look out.

## Books of mathematical interest

There are **other books** of mathematical interest too, such as "The Moscow Puzzles", "The Joy of X: A Guided Tour of Math, from One to Infinity", "The Number Devil: A Mathematical Adventure" and many more, which will broaden your appreciation of Mathematics.

## Websites and apps

There are many websites and apps – not all of them reputable, so beware. Reputable and useful ones include:

Khan Academy (app)
Myimaths.com – www.myimaths.com
Thinking Mathematics! - http://www.jamestanton.com
Graph Theory - http://www.math.cornell.edu/~mec/2003-2004/graphtheory/graphtheory.html
National Library of Virtual Manipulatives - http://nlvm.usu.edu/en/nav/category_g_4_t_3.html
IB Mathematics Exam Preparation for Calculator Papers – maximizing success using TI-NSpire - http://www.nlcsmaths.com/uploads/2/6/3/6/26365454/ib_tinspire_booklet_web.pdf