Internal assessment

Purpose of internal assessment

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 mathematical studies SL 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.

Guidance and authenticity

The project submitted for internal assessment must be the student's own work. However, it is not the intention that students should decide upon a title or topic and be left to work on the project without any further support from the teacher. The teacher should play an important role during both the planning stage and the period when the student is working on the project. It is the responsibility of the teacher to ensure that students are familiar with:

- the requirements of the type of work to be internally assessed
- the IB academic honesty policy available on the OCC
- the assessment criteria—students must understand that the work submitted for assessment must address these criteria effectively.

Teachers and students must discuss the project. Students should be encouraged to initiate discussions with the teacher to obtain advice and information, and students must not be penalized for seeking guidance. However, if a student could not have completed the project without substantial support from the teacher, this should be recorded on the appropriate form from the *Handbook of procedures for the Diploma Programme*.

It is the responsibility of teachers to ensure that all students understand the basic meaning and significance of concepts that relate to academic honesty, especially authenticity and intellectual property. Teachers must ensure that all student work for assessment is prepared according to the requirements and must explain clearly to students that the project must be entirely their own.

As part of the learning process, teachers can give advice to students on a **first draft** of the project. This advice should be in terms of the way the work could be improved, but this first draft must not be heavily annotated or edited by the teacher. The next version handed to the teacher after the first draft must be the final one.

All work submitted to the IB for moderation or assessment must be authenticated by a teacher, and must not include any known instances of suspected or confirmed malpractice. Each student must sign the coversheet for internal assessment to confirm that the work is his or her authentic work and constitutes the final version of that work. Once a student has officially submitted the final version of the work to a teacher (or the coordinator) for internal assessment, together with the signed coversheet, it cannot be retracted.

Authenticity may be checked by discussion with the student on the content of the work, and scrutiny of one or more of the following:

- the student's initial proposal
- the first draft of the written work
- the references cited
- the style of writing compared with work known to be that of the student.

Authenticity must be verified by the signing of the relevant form from the *Handbook of Procedures for the Diploma Programme* by both student and teacher.

By supervising students throughout, teachers should be monitoring the progress individual students are making and be in a position to discuss with them the source of any new material that appears, or is referred to, in their projects. Often, students are not aware when it is permissible to use material written by others or when to seek help from other sources. Consequently, open discussion in the early stages is a good way of avoiding these potential problems.

However, if teachers are unsure as to whether a project is the student's own work they should employ a range of methods to check this fact. These may include:

- discussing with the student
- asking the student to explain the methods used and to summarize the results and conclusions
- asking the student to replicate part of the analysis using different data
- inviting the student to give a class presentation of his or her project

The requirement for teachers and students to sign the coversheet for internal assessment applies to the work of all students, not just the sample work that will be submitted to an examiner for the purpose of moderation. If the teacher and student sign a coversheet, but there is a comment to the effect that the work may not be authentic, the student will not be eligible for a mark in that component and no grade will be awarded. For further details refer to the IB publication *Academic honesty* and the relevant articles in the *General regulations: Diploma Programme*.

The same piece of work cannot be submitted to meet the requirements of both the internal assessment and the extended essay.

Group work

Group work should not be used for projects. Each project is an individual piece of work based on different data collected or measurements generated.

It should be made clear to students that all work connected with the project, including the writing of the project, should be their own. It is therefore helpful if teachers try to encourage in students a sense of responsibility for their own learning so that they accept a degree of ownership and take pride in their own work.

Time allocation

Internal assessment is an integral part of the mathematical studies SL course, contributing 20% to the final assessment in the course. This weighting should be reflected in the time that is allocated to teaching the knowledge, skills and understanding required to undertake the work as well as the total time allocated to carry out the work.

It is expected that a total of approximately 25 teaching hours should be allocated to the work. This should include:

- time for the teacher to explain to students the requirements of the project
- class time for students to work on the project
- time for consultation between the teacher and each student
- time to review and monitor progress, and to check authenticity.

Using assessment criteria for internal assessment

For internal assessment, a number of assessment criteria have been identified. Each assessment criterion has level descriptors describing specific levels of achievement together with an appropriate range of marks. The level descriptors concentrate on positive achievement, although for the lower levels failure to achieve may be included in the description.

Teachers must judge the internally assessed work against the criteria using the level descriptors.

- The aim is to find, for each criterion, the descriptor that conveys most accurately the level attained by the student.
- When assessing a student's work, teachers should read the level descriptors for each criterion, starting with level 0, until they reach a descriptor that describes a level of achievement that has not been reached. The level of achievement gained by the student is therefore the preceding one, and it is this that should be recorded.
- Only whole numbers should be recorded; partial marks, that is fractions and decimals, are not acceptable.
- Teachers should not think in terms of a pass or fail boundary, but should concentrate on identifying the appropriate descriptor for each assessment criterion.
- The highest level descriptors do not imply faultless performance but should be achievable by a student. Teachers should not hesitate to use the extremes if they are appropriate descriptions of the work being assessed.
- A student who attains a high level of achievement in relation to one criterion will not necessarily attain high levels of achievement in relation to the other criteria. Similarly, a student who attains a low level of achievement for one criterion will not necessarily attain low achievement levels for the other criteria. Teachers should not assume that the overall assessment of the students will produce any particular distribution of marks.
- It is expected that the assessment criteria be made available to students.

Internal assessment details

Project

Duration: 25 teaching hours
Weighting: 20%

The purpose of the project

The aims of the mathematical studies SL course are carried through into the objectives that are formally assessed as part of the course, either through written examination papers, or the project, or both. The assessment criteria for the project have been developed to address these objectives. In addition to formally

testing the objectives of the course, project work provides opportunities for students to achieve competence in areas that will contribute to their overall education, as well as to acquire qualities that are likely to contribute to their personal development.

The specific purposes of the project are to:

- develop students' personal insight into the nature of mathematics and to develop their ability to ask their own questions about mathematics
- encourage students to initiate and sustain a piece of work in mathematics
- enable students to acquire confidence in developing strategies for dealing with new situations and problems
- provide opportunities for students to develop individual skills and techniques, and to allow students with varying abilities, interests and experiences to achieve a sense of personal satisfaction in studying mathematics
- enable students to experience mathematics as an integrated organic discipline rather than fragmented and compartmentalized skills and knowledge
- enable students to see connections and applications of mathematics to other areas of interest
- provide opportunities for students to show, with confidence, what they know and what they can do.

Introduction of the project

Project work should be incorporated into the course so that students are given the opportunity to learn the skills needed for the completion of a successful project.

Time in class can therefore be used:

- for general discussion of areas of study for project work, such as: how data can be collected or measurements generated; where data can be collected; how much data should be collected; different ways of displaying data; what steps should be taken to analyse the data; how data should be evaluated
- to give students the opportunity to review and mark projects from previous years, using the assessment criteria.

Further details on the development of the project are included in the teacher support material.

Requirements and recommendations

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 outside the mathematical studies SL syllabus—however, this is not penalized.

Internal assessment criteria

The project is internally assessed by the teacher and externally moderated by the IB using assessment criteria that relate to the objectives for mathematical studies SL.

Each project is assessed against the following seven criteria. The final mark for each project is the sum of the scores for each criterion. The maximum possible final mark is 20.

Students will not receive a grade for mathematical studies SL if they have not submitted a project.

Criterion A	Introduction
Criterion B	Information/measurement
Criterion C	Mathematical processes
Criterion D	Interpretation of results
Criterion E	Validity
Criterion F	Structure and communication
Criterion G	Notation and terminology

Criterion A: Introduction

In this context, the word "task" is defined as "what the student is going to do"; the word "plan" is defined as "how the student is going to do it". A statement of the task should appear at the beginning of each project. It is expected that each project has a clear title.

Achievement level	Descriptor
0	The project does not contain a clear statement of the task. *There is no evidence in the project of any statement of what the student is going to do or has done.*
1	The project contains a clear statement of the task. *For this level to be achieved, the task should be stated explicitly.*
2	The project contains a title, a clear statement of the task and a description of the plan. *The plan need not be highly detailed, but must describe how the task will be performed. If the project does not have a title, this achievement level cannot be awarded.*
3	The project contains a title, a clear statement of the task and a detailed plan that is followed. *The plan should specify what techniques are to be used at each stage and the purpose behind them, thus lending focus to the task.*

Criterion B: Information/measurement

In this context, generated measurements include those that have been generated by computer, by observation, by prediction from a mathematical model or by experiment. Mathematical information includes geometrical figures and data that is collected empirically or assembled from outside sources. This list is not exhaustive and mathematical information does not solely imply data for statistical analysis. If a questionnaire or survey is used then a copy of this along with the raw data must be included.

Achievement level	Descriptor
0	The project does not contain any relevant information collected or relevant measurements generated. *No attempt has been made to collect any relevant information or to generate any relevant measurements.*
1	The project contains relevant information collected or relevant generated measurements. *This achievement level can be awarded even if a fundamental flaw exists in the instrument used to collect the information, for example, a faulty questionnaire or an interview conducted in an invalid way.*

Achievement level	Descriptor
2	The relevant information collected, or set of measurements generated, is organized in a form appropriate for analysis **or** is sufficient in both quality and quantity. *A satisfactory attempt has been made to structure the information/measurements ready for the process of analysis, **or** the information/measurement collection process has been thoroughly described and the quantity of information justified. The raw data must be included for this achievement level to be awarded.*
3	The relevant information collected, or set of measurements generated, is organized in a form appropriate for analysis **and** is sufficient in both quality and quantity. *The information/measurements have been properly structured ready for analysis **and** the information/measurement collection process has been thoroughly described and the quantity of information justified. If the information/measurements are too sparse or too simple, this achievement level cannot be awarded. If the information/measurements are from a **secondary** source, then there must be evidence of sampling if appropriate. All sampling processes should be completely described.*

Criterion C: Mathematical processes

When presenting diagrams, students are expected to use rulers where necessary and not merely sketch. A freehand sketch would not be considered a correct mathematical process. When technology is used, the student would be expected to show a clear understanding of the mathematical processes used. All graphs must contain all relevant information. The teacher is responsible for determining the accuracy of the mathematics used and must indicate any errors on the final project. If a project contains no simple mathematical processes, then the first two further processes are assessed as simple.

Achievement level	Descriptor
0	The project does not contain any mathematical processes. *For example, where the processes have been copied from a book, with no attempt being made to use any collected/generated information.* *Projects consisting of only historical accounts will achieve this level.*
1	At least two simple mathematical processes have been carried out. *Simple processes are considered to be those that a mathematical studies SL student could carry out easily, for example, percentages, areas of plane shapes, graphs, trigonometry, bar charts, pie charts, mean and standard deviation, substitution into formulae **and any** calculations and/or graphs using technology only.*
2	At least two simple mathematical processes have been carried out correctly. *A small number of isolated mistakes should not disqualify a student from achieving this level. If there is incorrect use of formulae, or consistent mistakes in using data, this level cannot be awarded.*
3	At least two simple mathematical processes have been carried out correctly. All processes used are relevant. *The simple mathematical processes must be relevant to the stated aim of the project.*

Achievement level	Descriptor
4	The simple relevant mathematical processes have been carried out correctly. In addition, at least one relevant further process has been carried out. *Examples of further processes are differential calculus, mathematical modelling, optimization, analysis of exponential functions, statistical tests and distributions, compound probability. For this level to be achieved, it is not required that the calculations of the further process be without error. At least one further process must be calculated, showing full working.*
5	The simple relevant mathematical processes have been carried out correctly. In addition, at least one relevant further process has been carried out. All processes, both simple and further, that have been carried out are without error. *If the measurements, information or data are limited in scope, then this achievement level cannot be awarded.*

Criterion D: Interpretation of results

Use of the terms "interpretation" and "conclusion" refer very specifically to statements about what the mathematics used tells us after it has been used to process the original information or data. Discussion of limitations and validity of the processes is assessed elsewhere.

Achievement level	Descriptor
0	The project does not contain any interpretations or conclusions. *For the student to be awarded this level, there must be no evidence of interpretation or conclusions anywhere in the project, or a completely false interpretation is given without reference to any of the results obtained.*
1	The project contains at least one interpretation or conclusion. *Only minimal evidence of interpretations or conclusions is required for this level. This level can be achieved by recognizing the need to interpret the results and attempting to do so, but reaching only false or contradictory conclusions.*
2	The project contains interpretations and/or conclusions that are consistent with the mathematical processes used. *A "follow through" procedure should be used and, consequently, it is irrelevant here whether the processes are either correct or appropriate; the only requirement is consistency.*
3	The project contains a meaningful discussion of interpretations and conclusions that are consistent with the mathematical processes used. *To achieve this level, the student would be expected to produce a discussion of the results obtained and the conclusions drawn based on the level of understanding reasonably to be expected from a student of mathematical studies SL. This may lead to a discussion of underlying reasons for results obtained.* *If the project is a very simple one, with few opportunities for substantial interpretation, this achievement level cannot be awarded.*

Criterion E: Validity

Validity addresses whether appropriate techniques were used to collect information, whether appropriate mathematics was used to deal with this information, and whether the mathematics used has any limitations in its applicability within the project. Any limitations or qualifications of the conclusions and interpretations should also be judged within this criterion. The considerations here are independent of whether the particular interpretations and conclusions reached are correct or adequate.

Achievement level	Descriptor
0	There is no awareness shown that validity plays a part in the project.
1	There is an indication, with reasons, if and where validity plays a part in the project. *There is discussion of the validity of the techniques used **or** recognition of any limitations that might apply. A simple statement such as "I should have used more information/measurements" is not sufficient to achieve this level. If the student considers that validity is not an issue, this must be fully justified.*

Criterion F: Structure and communication

The term "structure" should be taken primarily as referring to the organization of the information, calculations and interpretations in such a way as to present the project as a logical sequence of thought and activities starting with the task and the plan, and finishing with the conclusions and limitations.

Communication is not enhanced by a large number of repetitive procedures. All graphs must be fully labelled and have an appropriate scale.

It is not expected that spelling, grammar and syntax are perfect, and these features are not judged in assigning a level for this criterion. Nevertheless, teachers are strongly encouraged to correct and assist students with the linguistic aspects of their work. Projects that are very poor linguistically are less likely to excel in the areas that are important in this criterion. Projects that do not reflect the significant time commitment required will not score highly on this assessment criterion.

Achievement level	Descriptor
0	No attempt has been made to structure the project. *It is not expected that many students will be awarded this level.*
1	Some attempt has been made to structure the project. *Partially complete and very simple projects would only achieve this level.*
2	The project has been structured in a logical manner so that it is easily followed. *There must be a logical development to the project. The project must reflect the appropriate commitment for this achievement level to be awarded.*
3	The project has been well structured in accordance with the stated plan **and** is communicated in a coherent manner. *To achieve this level, the project would be expected to read well, and contain footnotes and a bibliography, as appropriate. The project must be focused and contain only relevant discussions.*

Criterion G: Notation and terminology

This criterion refers to the use of correct terminology and mathematical notation. The use of calculator or spreadsheet notation is not acceptable.

Achievement level	Descriptor
0	The project does not contain correct mathematical notation or terminology. *It is not expected that many students will be awarded this level.*
1	The project contains some correct mathematical notation **or** terminology.
2	The project contains correct mathematical notation **and** terminology throughout. *Variables should be explicitly defined. An isolated slip in notation need not preclude a student from achieving this level. If it is a simple project requiring little or no notation and/or terminology, this achievement level cannot be awarded.*