

Assessment in the Diploma Programme

General

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 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.

The Diploma Programme primarily focuses on summative assessment designed to record student achievement at or towards the end of the course of study. However, many of the assessment instruments can also be used formatively during the course of teaching and learning, and teachers are encouraged to do this. A comprehensive assessment plan is viewed as being integral with teaching, learning and course organization. For further information, see the IB *Programme standards and practices* document.

The approach to assessment used by the IB is criterion-related, not norm-referenced. This approach to assessment judges students' work by their performance in relation to identified levels of attainment, and not in relation to the work of other students. For further information on assessment within the Diploma Programme, please refer to the publication *Diploma Programme assessment: Principles and practice*.

To support teachers in the planning, delivery and assessment of the Diploma Programme courses, a variety of resources can be found on the OCC or purchased from the IB store (<http://store.ibo.org>). Teacher support materials, subject reports, internal assessment guidance, grade descriptors, as well as resources from other teachers, can be found on the OCC. Specimen and past examination papers as well as markschemes can be purchased from the IB store.

Methods of assessment

The IB uses several methods to assess work produced by students.

Assessment criteria

Assessment criteria are used when the assessment task is open-ended. Each criterion concentrates on a particular skill that students are expected to demonstrate. An assessment objective describes what students should be able to do, and assessment criteria describe how well they should be able to do it. Using assessment criteria allows discrimination between different answers and encourages a variety of responses. Each criterion

comprises a set of hierarchically ordered level descriptors. Each level descriptor is worth one or more marks. Each criterion is applied independently using a best-fit model. The maximum marks for each criterion may differ according to the criterion's importance. The marks awarded for each criterion are added together to give the total mark for the piece of work.

Markbands

Markbands are a comprehensive statement of expected performance against which responses are judged. They represent a single holistic criterion divided into level descriptors. Each level descriptor corresponds to a range of marks to differentiate student performance. A best-fit approach is used to ascertain which particular mark to use from the possible range for each level descriptor.

Markschemes

This generic term is used to describe analytic markschemes that are prepared for specific examination papers. Analytic markschemes are prepared for those examination questions that expect a particular kind of response and/or a given final answer from the students. They give detailed instructions to examiners on how to break down the total mark for each question for different parts of the response. A markscheme may include the content expected in the responses to questions or may be a series of marking notes giving guidance on how to apply criteria.

Assessment outline

First examinations 2014

Assessment component	Weighting
<p>External assessment (3 hours)</p> <p>Paper 1 (1 hour 30 minutes) No calculator allowed. (90 marks)</p> <p>Section A Compulsory short-response questions based on the whole syllabus.</p> <p>Section B Compulsory extended-response questions based on the whole syllabus.</p> <p>Paper 2 (1 hour 30 minutes) Graphic display calculator required. (90 marks)</p> <p>Section A Compulsory short-response questions based on the whole syllabus.</p> <p>Section B Compulsory extended-response questions based on the whole syllabus.</p>	<p>80%</p> <p>40%</p> <p>40%</p>
<p>Internal assessment</p> <p>This component is internally assessed by the teacher and externally moderated by the IB at the end of the course.</p> <p>Mathematical exploration Internal assessment in mathematics SL is an individual exploration. This is a piece of written work that involves investigating an area of mathematics. (20 marks)</p>	<p>20%</p>

External assessment

General

Markschemes are used to assess students in both papers. The markschemes are specific to each examination.

External assessment details

Paper 1 and paper 2

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.

Calculators

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*.

Mathematics SL formula booklet

Each student must have access to a clean copy of the formula booklet during the examination. It is the responsibility of the school to download a copy from IBIS or the OCC and to ensure that there are sufficient copies available for all students.

Awarding of marks

Marks may be awarded for method, accuracy, answers and reasoning, including interpretation.

In paper 1 and paper 2, full marks are not necessarily awarded for a correct answer with no working. Answers must be supported by working and/or explanations (in the form of, for example, diagrams, graphs or calculations). Where an answer is incorrect, some marks may be given for correct method, provided this is shown by written working. All students should therefore be advised to show their working.

Paper 1

Duration: 1 hour 30 minutes

Weighting: 40%

- This paper consists of section A, short-response questions, and section B, extended-response questions.
- Students are not permitted access to any calculator on this paper.

Syllabus coverage

- Knowledge of **all** topics is required for this paper. However, not all topics are necessarily assessed in every examination session.

Mark allocation

- This paper is worth **90** marks, representing **40%** of the final mark.
- Questions of varying levels of difficulty and length are set. Therefore, individual questions may not necessarily each be worth the same number of marks. The exact number of marks allocated to each question is indicated at the start of the question.

Section A

This section consists of compulsory short-response questions based on the whole syllabus. It is worth approximately 45 marks.

The intention of this section is to test students' knowledge and understanding across the breadth of the syllabus. However, it should not be assumed that the separate topics are given equal emphasis.

Question type

- A small number of steps is needed to solve each question.
- Questions may be presented in the form of words, symbols, diagrams or tables, or combinations of these.

Section B

This section consists of a small number of compulsory extended-response questions based on the whole syllabus. It is worth approximately 45 marks. Individual questions may require knowledge of more than one topic.

The intention of this section is to test students' knowledge and understanding of the syllabus in depth. The range of syllabus topics tested in this section may be narrower than that tested in section A.

Question type

- Questions require extended responses involving sustained reasoning.
- Individual questions will develop a single theme.
- Questions may be presented in the form of words, symbols, diagrams or tables, or combinations of these.
- Normally, each question reflects an incline of difficulty, from relatively easy tasks at the start of a question to relatively difficult tasks at the end of a question. The emphasis is on problem-solving.

Paper 2

Duration: 1 hour 30 minutes

Weighting: 40%

This paper consists of section A, short-response questions, and section B, extended-response questions. A GDC is required for this paper, but not every question will necessarily require its use.

Syllabus coverage

- Knowledge of **all** topics is required for this paper. However, not all topics are necessarily assessed in every examination session.

Mark allocation

- This paper is worth **90** marks, representing **40%** of the final mark.
- Questions of varying levels of difficulty and length are set. Therefore, individual questions may not necessarily each be worth the same number of marks. The exact number of marks allocated to each question is indicated at the start of the question.

Section A

This section consists of compulsory short-response questions based on the whole syllabus. It is worth approximately 45 marks.

The intention of this section is to test students' knowledge and understanding across the breadth of the syllabus. However, it should not be assumed that the separate topics are given equal emphasis.

Question type

- A small number of steps is needed to solve each question.
- Questions may be presented in the form of words, symbols, diagrams or tables, or combinations of these.

Section B

This section consists of a small number of compulsory extended-response questions based on the whole syllabus. It is worth approximately 45 marks. Individual questions may require knowledge of more than one topic.

The intention of this section is to test students' knowledge and understanding of the syllabus in depth. The range of syllabus topics tested in this section may be narrower than that tested in section A.

Question type

- Questions require extended responses involving sustained reasoning.
- Individual questions will develop a single theme.
- Questions may be presented in the form of words, symbols, diagrams or tables, or combinations of these.
- Normally, each question reflects an incline of difficulty, from relatively easy tasks at the start of a question to relatively difficult tasks at the end of a question. The emphasis is on problem-solving.

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 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.

Guidance and authenticity

The exploration 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 exploration 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 exploration. 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 exploration. 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 exploration 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 exploration must be entirely their own.

As part of the learning process, teachers can give advice to students on a **first draft** of the exploration. 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.

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 explorations. Each exploration is an individual piece of work.

It should be made clear to students that all work connected with the exploration, including the writing of the exploration, 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 mathematics 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 10 teaching hours should be allocated to the work. This should include:

- time for the teacher to explain to students the requirements of the exploration
- class time for students to work on the exploration
- 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

Mathematical exploration

Duration: 10 teaching hours

Weighting: 20%

Introduction

The internally assessed component in this course is a mathematical exploration. This is a short report written by the student based on a topic chosen by him or her, and it should focus on the mathematics of that particular area. The emphasis is on mathematical communication (including formulae, diagrams, graphs and so on), with accompanying commentary, good mathematical writing and thoughtful reflection. A student should develop his or her own focus, with the teacher providing feedback via, for example, discussion and interview. This will allow the students to develop area(s) of interest to them without a time constraint as in an examination, and allow all students to experience a feeling of success.

The final report should be approximately 6 to 12 pages long. It can be either word processed or handwritten. Students should be able to explain all stages of their work in such a way that demonstrates clear understanding. While there is no requirement that students present their work in class, it should be written in such a way that their peers would be able to follow it fairly easily. The report should include a detailed bibliography, and sources need to be referenced in line with the IB academic honesty policy. Direct quotes must be acknowledged.

The purpose of the exploration

The aims of the mathematics SL course are carried through into the objectives that are formally assessed as part of the course, through either written examination papers, or the exploration, or both. In addition to testing the objectives of the course, the exploration is intended to provide students with opportunities to increase their understanding of mathematical concepts and processes, and to develop a wider appreciation of mathematics. These are noted in the aims of the course, **in particular, aims 6–9 (applications, technology, moral, social**

and ethical implications, and the international dimension). It is intended that, by doing the exploration, students benefit from the mathematical activities undertaken and find them both stimulating and rewarding. It will enable students to acquire the attributes of the IB learner profile.

The specific purposes of the exploration are to:

- develop students' personal insight into the nature of mathematics and to develop their ability to ask their own questions about mathematics
- provide opportunities for students to complete a piece of mathematical work over an extended period of time
- enable students to experience the satisfaction of applying mathematical processes independently
- provide students with the opportunity to experience for themselves the beauty, power and usefulness of mathematics
- encourage students, where appropriate, to discover, use and appreciate the power of technology as a mathematical tool
- enable students to develop the qualities of patience and persistence, and to reflect on the significance of their work
- provide opportunities for students to show, with confidence, how they have developed mathematically.

Management of the exploration

Work for the exploration should be incorporated into the course so that students are given the opportunity to learn the skills needed. Time in class can therefore be used for general discussion of areas of study, as well as familiarizing students with the criteria.

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

Requirements and recommendations

Students can choose from a wide variety of activities, for example, modelling, investigations and applications of mathematics. To assist teachers and students in the choice of a topic, a list of stimuli is available in the teacher support material. However, students are not restricted to this list.

The exploration should not normally exceed 12 pages, including diagrams and graphs, but excluding the bibliography. However, it is the quality of the mathematical writing that is important, not the length.

The teacher is expected to give appropriate guidance at all stages of the exploration by, for example, directing students into more productive routes of inquiry, making suggestions for suitable sources of information, and providing advice on the content and clarity of the exploration 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 exploration and the criteria by which it is assessed. Students need to start planning their explorations as early as possible in the course. Deadlines should be firmly established. There should be a date for submission of the exploration topic and a brief outline description, a date for the submission of the first draft and, of course, a date for completion.

In developing their explorations, students should aim to make use of mathematics learned as part of the course. The mathematics used should be commensurate with the level of the course, that is, it should be similar to that suggested by the syllabus. It is not expected that students produce work that is outside the mathematics SL syllabus—however, this is not penalized.

Internal assessment criteria

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

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

Students will not receive a grade for mathematics SL if they have not submitted an exploration.

Criterion A	Communication
Criterion B	Mathematical presentation
Criterion C	Personal engagement
Criterion D	Reflection
Criterion E	Use of mathematics

Criterion 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.

Graphs, tables and diagrams should accompany the work in the appropriate place and not be attached as appendices to the document.

Achievement level	Descriptor
0	The exploration does not reach the standard described by the descriptors below.
1	The exploration has some coherence.
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, concise and complete.

Criterion B: Mathematical presentation

This criterion assesses to what extent the student is able to:

- use appropriate mathematical language (notation, symbols, terminology)
- define key terms, where required
- use multiple forms of mathematical representation, such as formulae, diagrams, tables, charts, graphs and models, where appropriate.

Students are expected to use mathematical language when communicating mathematical ideas, reasoning and findings.

Students are encouraged to choose and use appropriate ICT tools such as graphic display calculators, screenshots, graphing, spreadsheets, databases, drawing and word-processing software, as appropriate, to enhance mathematical communication.

Achievement level	Descriptor
0	The exploration does not reach the standard described by the descriptors below.
1	There is some appropriate mathematical presentation.
2	The mathematical presentation is mostly appropriate.
3	The mathematical presentation is appropriate throughout.

Criterion 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.

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

Criterion 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.

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

Criterion E: Use of mathematics

This criterion assesses to what extent students use mathematics in the exploration.

Students are expected to produce work that is commensurate with the level of the course. The mathematics explored should either be part of the syllabus, or at a similar level or beyond. It should not be completely based on mathematics listed in the prior learning. If the level of mathematics is not commensurate with the level of the course, a maximum of two marks can be awarded for this criterion.

The mathematics can be regarded as correct even if there are occasional minor errors as long as they do not detract from the flow of the mathematics or lead to an unreasonable outcome.

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.