Assessment criteria

Each exploration should be assessed against the following five criteria.

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

The descriptions of the achievement levels for each of these five assessment criteria follow and it is important to note that each achievement level represents the **minimum** requirement for that level to be awarded. The final mark for each exploration is obtained by adding together the achievement levels awarded for each criterion A–E. It should be noted that the descriptors for criterion E are different for mathematics SL and mathematics HL.

The maximum possible mark is 20.

Applying the assessment criteria

The method of assessment used is criterion referenced, not norm referenced. That is, the method of assessing each exploration judges students by their performance in relation to identified assessment criteria and not in relation to the work of other students.

Each exploration submitted for mathematics SL or mathematics HL is assessed against the five criteria A to E. For each assessment criterion, different levels of achievement are described that concentrate on positive achievement. The description of each achievement level represents the minimum requirement for that level to be achieved.

The aim is to find, for each criterion, the level descriptor that conveys most adequately the achievement level attained by the student.

Teachers should read the description of each achievement level, starting with level 0, until one is reached 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.

For example, when considering successive achievement levels for a particular criterion, if the description for level 3 does not apply, then level 2 should be recorded.

For each criterion, whole numbers only may be recorded; fractions and decimals are not acceptable.

The highest achievement levels do not imply faultless performance, and teachers should not hesitate to use the extremes, including 0, 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 available to students at all times. Descriptors of the achievement levels for each assessment criterion are given in the tables in the following section. Within the tables, for each achievement level, there is a link to an exploration within this TSM that achieved that level for that particular criterion.

Students should be made aware that they will not receive a grade for mathematics SL or mathematics HL if they have not submitted an exploration.

Achievement levels

Criterion A: Communication

This criterion assesses the organization and coherence of the exploration. A well-organized exploration contains 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. **Example 11**
2	The exploration has some coherence and shows some organization. **Example 14**
3	The exploration is coherent and well organized. **Example 10**
4	The exploration is coherent, well organized, concise and complete. **Example 18**

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. **Example 17**
2	The mathematical presentation is mostly appropriate. **Example 20**
3	The mathematical presentation is appropriate throughout. **Example 15**

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. **Example 19**
2	There is evidence of some personal engagement.
3	There is evidence of significant personal engagement. **Example 13**
4	There is abundant evidence of outstanding personal engagement. **Example 12**

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. **Example 19**
2	There is evidence of meaningful reflection.

	Example 16
3	There is substantial evidence of critical reflection. **Example 10**

Criterion E: Use of mathematics

The achievement levels and descriptors for criterion E are different for mathematics SL and mathematics HL.

SL only

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.

A piece of 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. **Example 11**
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. **Example 19**
5	Relevant mathematics commensurate with the level of the course is used. The mathematics explored is mostly correct. Good knowledge and understanding are demonstrated. **Example 21**
6	Relevant mathematics commensurate with the level of the course is used. The mathematics explored is correct. Thorough knowledge and understanding are demonstrated. **Example 20**

HL only

This criterion assesses to what extent and how well 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. Sophistication in mathematics may include understanding and use of challenging mathematical concepts, looking at a problem from different perspectives and seeing underlying structures to link different areas of mathematics. Rigour involves clarity of logic and language when making mathematical arguments and calculations. Precise mathematics is error-free and uses an appropriate level of accuracy at all times.

Achievement level	Descriptor
0	The exploration does not reach the standard described by the descriptors below.
1	Some relevant mathematics is used. Limited understanding is demonstrated. **Example 11**
2	Some relevant mathematics is used. The mathematics explored is partially correct. Some knowledge and understanding are demonstrated. **Example 12**
3	Relevant mathematics commensurate with the level of the course is used. The mathematics explored is correct. Good knowledge and understanding are demonstrated. **Example 13**
4	Relevant mathematics commensurate with the level of the course is used. The mathematics explored is correct and reflects the sophistication expected. Good knowledge and understanding are demonstrated. **Example 14**
5	Relevant mathematics commensurate with the level of the course is used. The mathematics explored is correct and reflects the sophistication and rigour expected. Thorough knowledge and understanding are demonstrated.
6	Relevant mathematics commensurate with the level of the course is used. The mathematics explored is precise and reflects the sophistication and rigour expected. Thorough knowledge and understanding are demonstrated. **Example 10**

Skills and strategies required by students

The exploration is a significant part of the course. It is useful to think of it as a developing piece of work, which requires particular skills and strategies. As a general rule, it is unrealistic to expect all students to have these specific skills and to follow particular strategies before commencing the course.

Many of the skills and strategies identified below can be integrated into the course of study by applying them to a variety of different situations both inside and outside the classroom. In this way, students can practise certain skills and learn to follow appropriate strategies in a more structured environment before moving on to working independently on their explorations.

Choosing a topic

- Identifying an appropriate topic
- Developing a topic
- Devising a focus that is well defined and appropriate
- Ensuring that the topic lends itself to a concise exploration

Communication

- Expressing ideas clearly
- Identifying a clear aim for the exploration
- Focusing on the aim and avoiding irrelevance
- Structuring ideas in a logical manner
- Including graphs, tables and diagrams at appropriate places
- Editing the exploration so that it is easy to follow
- Citing references where appropriate

Mathematical presentation

- Using appropriate mathematical language and representation
- Defining key terms, where required
- Selecting appropriate mathematical tools (including information and communication technology)
- Expressing results to an appropriate degree of accuracy

Personal engagement

- Working independently
- Asking questions, making conjectures and investigating mathematical ideas
- Reading about mathematics and researching areas of interest
- Looking for and creating mathematical models for real-world situations

- Considering historical and global perspectives
- Exploring unfamiliar mathematics

Reflection

- Discussing the implications of results
- Considering the significance of the exploration
- Looking at possible limitations and/or extensions
- Making links to different fields and/or areas of mathematics

Use of mathematics

- Demonstrating knowledge and understanding
- Applying mathematics in different contexts
- Applying problem-solving techniques
- Recognizing and explaining patterns, where appropriate
- Generalizing and justifying conclusions