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.
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.

Additional notes

A complete exploration will have all steps clearly explained, and will meet its aim.

Key ideas and concepts should be clearly explained. **Mathematical** definitions and terminology should be considered under criterion B.

The use of technology is not required (although encouraged where appropriate). Therefore the use of analytic approaches rather than technological ones does not necessarily mean lack of conciseness, and should not be penalised. This does not mean that repetitive calculations are condoned.

An exploration which shows some organisation but does not have some coherence can achieve level 1.

The aim, introduction, rationale and conclusion do not have to be formally identified by the student and may be in the main body of the exploration.

Organisation refers to the overall structure or framework, including the introduction, body, conclusion etc.

Coherence refers to how well different parts of the exploration link to each other. It can also refer to the overall flow, including between different parts, or from text to mathematical presentation etc.

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.

Additional notes

Mathematical presentation is not the same as communication. However, when there appears to be an overlap, care has to be taken **not** to penalise a student for the same shortcoming in criteria A and B.

There are multiple facets to criterion B, including using correct notation and terminology, and selecting the **appropriate** mathematical tool(s) and representation(s).

Level 3 can be achieved by using only one form of mathematical representation as long as this is appropriate.

Consistency in presentation is expected, but if there are inconsistencies which do not adversely affect the use of mathematics, they can be condoned.

Calculator and computer notation should not be penalized if it is software generated. It is expected that students use appropriate mathematical notation in their own work.

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.

Additional notes

There must be evidence of personal engagement seen in the exploration. It is not sufficient that a teacher comments that a student was highly engaged.

There are many ways of demonstrating personal engagement, not just those mentioned in the guide and TSM.

A common "investigation/textbook problem" is unlikely to achieve the higher levels on criterion C unless there is clear evidence that the student has considered the problem from their own viewpoint or other contexts. This could be demonstrated by the students considering **and** *applying new mathematics.*

"Abundant evidence" refers to what is reasonable for a DP student (rather than an experienced teacher) to demonstrate in an exploration.

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.

Additional notes

Simply describing results represents limited or superficial reflection. Further consideration is required to achieve the higher levels.

Some ways of showing meaningful reflection are: linking to the aims, commenting on what they have learnt, considering some limitations or comparing different mathematical approaches.

Some ways of showing critical reflection are: considering what next, discussing implications of results, discussing strengths and weaknesses of approaches, and considering different perspectives.

Substantial evidence is likely to mean that reflection is present throughout the exploration. Potentially it may be seen only at the end; however this will need to be of a high quality in order to achieve a level 3.

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.

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.
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.

Additional notes

A key word in the descriptors is "demonstrated". Obtaining a correct answer is not sufficient to demonstrate understanding. Students must **demonstrate** their understanding (even limited understanding) in order to achieve level 2 or higher.

The mathematics used need only be what is required to support the development of the exploration. This could be a few small topics or even a single topic from the syllabus. It is better to do a few things well, rather than a lot of things not so well. If the mathematics used is relevant to the topic being explored, commensurate with the course, and understood by the student, then it can achieve a high level in this criterion.

If only a very minimal amount of mathematics commensurate with the course is used, but this mathematics is central to the development of the exploration, the exploration may achieve level 3 or more.

Regression using technology is commensurate with the level of the course, but understanding must be demonstrated in order for the candidate to achieve higher than level 1.

For knowledge and understanding to be thorough it must be demonstrated **throughout** the work.

While topics specifically listed in the "Prior Learning" are not considered commensurate with the course, other topics not listed in the syllabus may be commensurate.

Commentary to support marking

SAMPLE B FIBONACCI

Mathematics SL

IA

English

May 2014

Criterion	Mark	Out of	Justification
A	2	4	Lack of coherence as jumps from section to section without clear links
B	2	3	Appropriate presentation although some key variables are not defined (r, fn etc) Inappropriate use of images – not clear what pictures are for on p5
C	1	4	Superficial PE and little independent thinking Presentation merely uses article researched
D	1	3	Does not reflect on results/final equation (p3 etc) Superficial reflection (p4) – " …sequence is pretty cool.."
E	3	6	The use of induction is beyond syllabus and therefore only limited understanding is demonstrated. Majority of work clearly not at student's level of understanding
Total:	9	20	

Commentary to support marking

SAMPLE E FOOTBALL

Mathematics SL

IA May 2014

English

Criterion	Mark	Out of	Justification
A	2	4	Some organisation and coherence Incomplete and hard to follow in parts
B	1	3	'plugged in' is inappropriate poor notation in physics formula (p2 and throughout)
C	2	4	Personal interest as a kicker in his team Considers real-life situation
D	1	3	Superficial reflection Results contradict each other but no discussion on this (see degrees v radians in E)
E	2	6	Understanding of formulas used not demonstrated – only substitutes in values (p2) Confusion between radians and degrees – **every** single result is incorrect.
Total:	8	20	

Commentary to support marking

SAMPLE H CAVALIERI'S PRINCIPLE

Mathematics SL

IA

English

May 2014

Criterion	Mark	Out of	Justification
A	4	4	Very easy to read and follow Aim and rationale at end of introduction and addressed by end of exploration Consistent and concise. Explanations are complete
B	2	3	Appropriate and varies representation throughout the exploration A couple of notational errors (penalised here rather than E) on p9 and p10 confusing dy, dx, dr etc Helpful diagrams
C	3	4	Her first look at integral calculus Includes moments of wonder especially in the projects results!! It is worth noting that the candadite was initially worried about being capable of the level of mathematics required which is not seen in the ways the ideas are disseminated (NOTE how important it is to include background information) Uses multiple methods
D	3	3	Misconceptions were observed, researched and eventually solved Final observations in the conclusion lead to considering possible extensions Reflects on results by checking answers using various methods
E	6	6	Commensurate (eventually) when considering volumes of revolution Explanations demonstrate full understanding of the Mathematics (notational errors on p9/10 penalised in B)
Total:	18	20	