

# Mathematics extended essay

## Grade boundaries

For grade boundary information, please refer to the Grade boundaries for Diploma programme coordinators document available on the PRC.

## Extended essay

### The range and suitability of the work submitted

Overall adequate, but suitability of some of the topics were questionable as they involved sophisticated mathematics and the students not being able to show understanding of the theories that were used. This is particularly disappointing when a clearly very able student does poorly because they fail to show a clear understanding of the mathematics they use.

### Student performance against each criterion

#### Criterion A: focus and method

The selection of a research question is one of the most important aspects of the extended essay process. Many of the essays that had low marks were due to the inappropriateness of the research question, mainly due to not narrowing it down to a manageable level.

It is always a good idea for students to outline the methodology to be employed and how the research will be undertaken in the introduction, as well as explaining the research question.

#### Criterion B: knowledge and understanding

Demonstrating understanding of the theory that was used in the essay is the key here. Therefore, the theoretical aspects need to be explained clearly, perhaps using examples to show how they can be used. The essays that had applications of the mathematics rather than purely theoretical work generally scored well.

Students often presented research without demonstrating their own understanding of that research.

As usual, those students trying to cover topics of a higher level of difficulty often got lower scores because they didn't demonstrate proper understanding of them.

All supervisors should recommend that students illustrate their work with numerical examples that demonstrate their understanding of the concept that is being explored and explained.

#### Criterion C: critical thinking

The analysis should demonstrate student involvement. This can be done through the application of mathematical theories that were used in the context of the research question. Evaluation is important and it should demonstrate critical thinking skills. Limitations of the mathematical procedures that were employed in the essay can be discussed here.

Students should be wary of including work that is not relevant to the research question. When they stray off topic it affects the reasoned argument they are trying to produce.

### Criterion D: presentation

This is generally done well with many students using technology efficiently and effectively. It has to be made sure that figures and tables are appropriately titled, and the formatting is done according to expected conventions.

It was nice to observe that many poor essays scored high in this criterion. This criterion helped many poor essays to pull their marks from grade E to grade D. Some of the major issues included topic missing on the title page, tables split into two pages, graphs not labelled, alignment and section/subsections missing, use of computer notation, equations presented over a line.

### Criterion E: engagement

The quality of student reflections has increased, and many students were able to demonstrate good personal engagement through these comments. Comments that include the gradual development of the essay, intellectual initiatives and the process followed to overcome challenges, score high marks in this criterion. This is again another criterion which helped poor essays to get at least a grade D.

## Recommendations for the supervision of future students

As the extended essay has a word limit of 4000 words, it is important to narrow the research question appropriately to enable the student to do a thorough analysis and evaluation within this limit. Some try to do too much, perhaps thinking that having sophisticated mathematics will be beneficial, thereby sacrificing explanations and reasoning, which brings down the quality of the essay. Supervisors have an important role here to guide the students with the wording of the research question. There is never a need for an 'extension' which simply feels like a filler and does not help students' scores. Remember that as a mathematics essay invariably includes algebra, the word count can be considerably below 4000 and still score very well.

Towards the completion of the essay, it is important for the supervisors to remind students to proofread the essay fully. This will not only help them to correct any careless errors that had crept up but also enable them to attend to important details in connection with the layout and presentation.

There were a number of essays of the type where complicated mathematics was put forward but it was not at all evident that this was written up independently by the student. It's often very obvious that material is taken from source directly when symbols are not defined, the quality of the writing varies considerably and diagrams or other aspects of the analysis are referred to without actually being present in the essay. Such essays do not score well.

## Further comments

Recommended video presentation for schools. The following video presentation was presented at the IB Mathematics Symposium in Stuttgart in November 2023 and is recommended viewing for supervisors - and for students.

(Advice for Supporting an Extended Essay in Mathematics by Paul Jackson (muse.ai))

The video is available on IB Exchange or here:

[https://pds.ibo.org/docs/ib\\_maths\\_symposium\\_programme.pdf](https://pds.ibo.org/docs/ib_maths_symposium_programme.pdf)