

## MATHEMATICS

This is a supplementary report following the May 2010 session and should be read in conjunction with the May 2009 extended essay report.

### Overall grade boundaries

<b>Grade:</b>	E	D	C	B	A
<b>Mark range:</b>	0 - 7	8 - 15	16 - 22	23 - 28	29 - 36

### The range and suitability of the work submitted

As always the range of topics was quite wide (and sometimes quite imaginative), which is a good thing. However many were not suitable. Most of the time a subject may not be inappropriate per se but unfortunately leads the candidate to an inappropriate essay.

For example, a subject in statistics can be quite adequate but most of the candidates who chose a subject in statistics spend all their efforts in circulating poorly conceived questionnaires to their entourage and then apply merely elementary (and often unjustified) tests with little mathematical content.

Similarly a subject in the history of mathematics may be quite adequate but most candidates limit themselves to listing results obtained by one or more mathematicians without explaining (or even understanding) them resulting again in EEs with negligible mathematical activity.

Some subjects are unsuitable because they are too difficult (or too advanced) so that most candidates end up reproducing material from various sources (mostly from the web) which they do not understand (sometimes they do not even realize that they do not understand). In that category we find subjects like fractals, transfinite cardinals and applications of game theory (even though, occasionally, some particularly brilliant candidates manage to deal meaningfully with these subjects).

Some subjects are adequate but lead to essays loaded with paragraphs emoting on “the beauty and ‘magic’ of mathematics” while in most cases, in fact, having a negligible mathematical content; in that category we find among others the Golden number and the Fibonacci sequence.

Some subjects are completely inadequate and are to be avoided such as those trying to deal with mathematics in sports, in music or in gambling (essentially because the actual mathematical content is trivial).

Finally supervisors should also realize that Mathematical Olympiads (most countries hold them now in one form or another) are often good potential sources for subjects.

## Candidate performance against each criterion

### **A: research question**

This has been dealt with in the previous question. One should add here that supervisors should exert a better control on the choice of the research question and reject those that appear inadequate.

### **B: introduction**

Most introductions were fairly adequate but some candidates were too anecdotal and personal, failing to contextualize the subject or showing its potential interest.

### **C: investigation**

Candidates, for the most part, did locate sources (when relevant) but not always critically. Too many (see above) quoted these sources without understanding them. When the investigation was original (in the rare cases when it was feasible by a secondary school student) it was usually adequate.

### **D: knowledge and understanding of the topic studied**

Candidates who took subjects within their range of ability usually displayed good knowledge and understanding. This was almost never the case when the subject chosen was too difficult.

### **E: reasoned argument**

Same remarks as for the previous criterion.

### **F: application of analytical and evaluative skills appropriate to the subject**

Same remarks as for criterion D.

### **G: use of language appropriate to the subject**

Mathematical language (even in otherwise reasonably adequate EEs) was often poorly used (terms used without definition, inappropriately, and without clear understanding).

### **H: conclusion**

The quality of conclusions generally matched the overall quality of the EE. When the subject was too difficult, conclusions were usually meaningless and/or completely unjustified.

**I: formal presentation**

In an EE in mathematics a good presentation implies in particular adopting a mathematical approach i.e. identifying definitions, theorems, proofs, and this was very rarely the case. Some EEs by non-native speakers were on the verge of complete confusion (supervisors should provide help to these candidates rather than merely stating in their remarks that “the candidate is a not a native speaker” which is obvious anyway).

**J: abstract**

Most abstracts were adequate but some were totally uninformative about the content of the EE and quite a few omitted mentioning the conclusion.

**K: holistic judgment**

It is impossible to make a meaningful remark on the performance of the candidates against this criterion.

**Recommendations for the supervision of future candidates**

Supervisors should err on the side of providing too much guidance rather than being too passive: too many candidates derive no benefit from having spent a significant amount of time writing a worthless essay. It must never be forgotten that before being an instrument of assessment, EEs are meant to provide a learning opportunity, an active hands-on experience with the subject as opposed to the passive classroom situation of listening to a teacher. This opportunity for learning must be carefully monitored by the supervisor who must try to make it as positive an experience as possible.

Too many supervisors ignore the requirement of writing appropriate comments on the cover sheet: often the supervisor states that he/she spent a significant number of hours with the candidate and yet offers no comments. This can only affect negatively the candidates.

Finally supervisors should not hesitate to reject subjects which are obviously or potentially inappropriate: they know (or should know) what their candidates are capable of doing and should accordingly steer them away from subjects which will lead to a sterile, negative experience.