

Teaching Committee report to the Faculty Board

Examinations for Parts IA, IB and II of the Tripos, 2010

1 Introduction

The Committee met three times, for two hours each time, to consider the examinations. We looked, for each part of the Tripos, at:

- the Examiners' report;
- the External Examiners' reports;
- the Examiners' comments on their questions;
- the examination statistics;
- the examination papers;
- the analysis of the paper lecture questionnaires;
- the responses to the on-line questionnaires;
- the report from the CATAM assessors (Parts IB and II).

We also looked at letters sent each year by the Chair of the Faculty Board to Chairs of the Examiners.

We note with pleasure that the External Examiners, without exception, commented favourably both on the examination process and also on the performance of the candidates. The six External Examiners' reports include comments such as:

Generally, the quality of the candidates' scripts is very high. The very best candidates wrote exemplary papers and seven obtained a full set of alphas. The level of questions is appropriately challenging and Cambridge maintains its very high standard. (Part IA)

My conclusion about the exams process is that it is rigorous, and has been conducted with great care by a thorough and committed group of examiners. The great majority of candidates showed considerable achievement, and those at the top end showed impressive ability. (Part IB)

The questions set in applied mathematics are similar to those in my institution [Newcastle], but many of these subjects would be taught and examined in the final year rather than the second year. I am therefore satisfied that just over 30% of the students were awarded first class honours. (Part IB)

The Part II course covers a wide range of topics to a high level. The standard of the examination is challenging but fair. The overall quality of the work produced by many of the top students is at a very high level, and that of many others is also of a very good standard. (Part II)

Part II of the mathematical Tripos is an excellent course, offering candidates a wide choice in a variety of mathematical subjects. The assessment is mostly based on a challenging final year exam which provides ample possibilities for the candidates to show their abilities. Examinations were well-organised and offered a very good basis for a fair and robust classification of the students. (Part II)

Mathematics examinations in Cambridge are unusual in that candidates are permitted to submit very variable amounts of work. The best candidates are enabled to present a large amount of high quality, and this must be a rewarding experience for them. The least able candidates can present rather a small quantity of work. On the whole, the process enables the examiners to discriminate well between the candidates, but there are special problems of fairness. They are generally tackled conscientiously and with care. (Part II)

There follows a summary of the points raised in the Examiners' reports which the Committee believe need the attention of the Faculty Board. We have not generally highlighted points of a purely administrative nature: that is for the Chairs of this year's Examiners to pick up from the previous year's Examiners' reports. This year, we were pleased that the annual meeting of the Directors of Studies has requested a copy of this report in time to be able to contribute to the Faculty Board discussion.

2 General Matters

2.1 Errors

This year the following errors were reported, out of a total of about 280 questions: no errors in Part IA; no errors in Part IB; and nine errors in Part II.

We note that the Part II Examiners have not included a list of errors, despite being requested to do so by the Chair of the Faculty Board in his letter to Chairs of Examiners.

Professor Kerr (Part II External) comments that the examination papers were sent out later than expected this year and surmises that the rather rushed later stages of the process meant that the errors had less chance of being spotted.

2.2 Cover sheets

This year, as last, individual examiner cover sheets were pre-printed with question numbers, so that the candidates needed only to circle the questions attempted. Further, machine-readable cover sheets were used. This practice was again welcomed by examiners and so should be continued.

However, the colours of the cover sheets and the master cover sheets were, with no warning, changed (exchanged, in fact) this year by (we believe) the Board of Examinations. This meant that the information given in the rubric of the examination paper (which refers to ‘gold cover sheets’ and ‘green master cover sheets’) was incorrect, as was the e-mail sent to all candidates by the Teaching Committee a week before the examinations. Furthermore, it appears that the scanner had more difficulty dealing with the new colours. We **recommend** that the Board of Examinations be asked to revert to the colours used previously.

2.3 ‘Short’ questions

The agreed and advertised description for ‘short’ questions is:

Short questions should be accessible to any student who has studied the material conscientiously. They should not contain any significant ‘problem’ element.

Last year, we raised a concern about the take-up of short questions, which had declined very significantly. The take-up rate has again declined, though it is encouraging that the average mark and the number of betas per attempt have increased as shown in the following tables. The percentage take-up rate is the number of attempts as a percentage of the theoretical maximum number of attempts; in Part IA, there are four short questions on each of the four papers, and there were N candidates, so the maximum is approximately $N \times 16$. In Part IB and (particularly) in Part II, a much lower take-up rate is expected because of the different structure of the examinations.

	year	take-up rate (%)	average mark	average beta
Part IA	2010	1970 (50.9%)	6.7	0.48
	2009	2047 (51.8%)	6.1	0.38
	2008	2445 (65.0%)	6.5	0.44
	2007	2916 (74.4%)	7.1	0.56
	2006	2677 (71.2%)	6.5	0.44
	2005	2623 (71.0%)	7.2	0.56
	Part IB	2010	1543 (19.9%)	6.9
2009		1592 (21.8%)	6.7	0.43
2008		2378 (29.2%)	6.6	0.44
2007		2232 (29.7%)	6.9	0.55
2006		2369 (31.3%)	7.0	0.54
2005		2408 (30.0%)	6.6	0.45

	year	take-up rate (%)	average mark	average beta
Part II	2010	900 (10.8%)	6.9	0.54
	2009	1105 (12.2%)	6.5	0.43
	2008	1156 (14.0%)	6.3	0.46
	2007	1353 (15.5%)	6.7	0.49
	2006	1425 (16.3%)	7.0	0.54
	2005	1334 (15.8%)	6.9	0.54

As can be seen, the take-up rates of the short questions decrease in Part IA from nearly three-quarters to just over a half in five years, and in Part IB there is a further reduction after the huge fall in take-up from last year.

We did not have sufficient data to determine the cause. Is it because the stronger students no longer think it worthwhile to tackle short questions? If so, what could have triggered this change? There has been a significant decrease since last year, so the new (last year) merit mark formula could have played a role. But there was also a significant decrease between 2007 and 2008.

We did not investigate who was tackling the short questions; was it the weaker students, as is intended, or was it the stronger students (which may account for the increasing average mark). Such an investigation might provide a basis for greater confidence in the classification system at the lower boundaries, doubts about which were expressed by Professor Greenlees (Part IB External). We **recommend** that a computer officer be asked to furnish the Teaching Committee with an appropriate analysis of the data.

Last year, we recommended that the chairs of Examiners for 2010 were asked to consider the above data and ensure that short questions are accessible to any student who has studied the material conscientiously and do not contain any significant ‘problem’ element. From the data, it does appear that this happened to some extent, but the take-up rate still fell. We **recommend** that this year’s examiners again be asked to ensure that short questions are accessible to any student who has studied the material conscientiously and do not contain any significant ‘problem’ element.

2.4 Classification criteria

The new quantitative classification criteria came into force in 2008/9. There was general approval for the scheme.

The Teaching Committee has discussed merit mark formulae almost every year for the last 10 years. We think that the subject has been aired thoroughly and, as a result, robust and fair classification criteria have emerged.

However, we are not persuaded that the significance of the Faculty Board’s description of quantitative primary criteria in the Schedules has been fully grasped by all examiners.

For example, Professor Mansfield (Part IA External) states that ‘some candidates were taken out of merit mark order and moved across borderlines depending largely on the number of alphas they obtained’.

Of course, the discussion may have been more complex than this statement suggests.

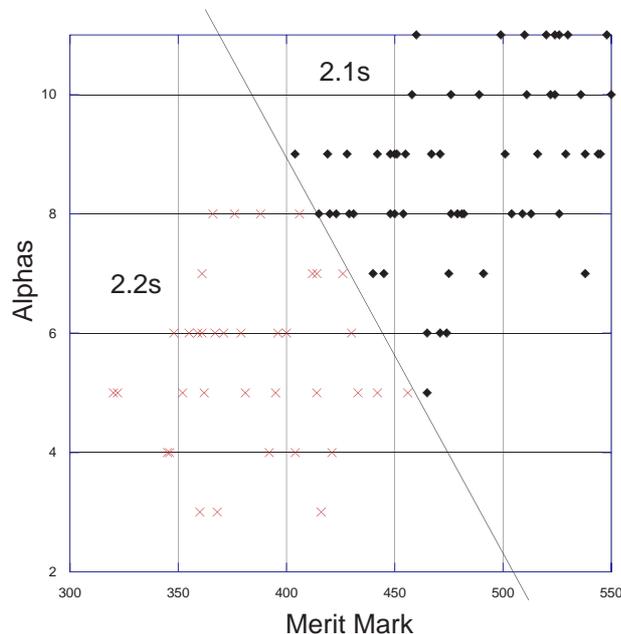
The scatter plot overleaf shows the 2.1/2.2 borderline in Part IB. Candidates awarded a 2.2 are denoted by a cross and candidates with a 2.1 are denoted by a dot. Strict classification by the Faculty Board’s primary criterion would have resulted in a vertical line separating the crosses and dots. The sloping line shows the effect of classification by a merit mark with weight 30α instead of the weight 15α that Faculty Board recommends for this border.

We note that the merit mark already assigns to alphas the (large) weight that the Faculty Board has decided is appropriate at each border. Moreover, publication of classification criteria in the Schedules booklet is intended to provide candidates with explicit and reliable guidance on the criteria by which they will be assessed (as required by the General Board and external bodies). Hence it would be inappropriate if alphas were given greater (or lesser) weight by examiners than in the published criteria.

Of course, very near borderlines examiners can take into account factors other than the number of marks and quality marks. For example, they might take into account a candidate’s good attempt at a particularly difficult question. So the borderline need not be exactly vertical.

Professor Mansfield emphasises the importance of stating clearly the classification criteria and sticking to them. As explained above, we agree with the thrust of this remark. He feels uneasy about the statement in the Schedules booklet that ‘other factors besides marks and quality marks may be taken into account’. We do not share this unease (provided of course the primary criteria are adhered to and remain primary), since it would be unwise to be prescriptive about the secondary factors that may influence decisions about

genuinely borderline candidates. However, these factors should not be allowed to undermine the reliability of the published primary criteria as a guide to candidates.



The Faculty Board's recent decision to specify the relative weighting that should be attached to alphas, betas and marks at each borderline represented a considerable change from the previous practices to which many examiners had been accustomed. We therefore **recommend** that the letter from the Chairman of the Faculty Board to Chairs of Examiners be reworded to give even clearer advice on this point.¹ In particular, the request that 'the examiners report should include ... and also what criteria had been used at each boundary' could be replaced by a request for information about the class boundaries in the form required by the Faculty Board for publication in the Schedules Booklet.

We note that the General Board's Education Committee *requires* Faculty Boards to issue guidelines for determining class-lists.²

2.5 Differences in difficulty between courses

This issue arose in Part IB last year and previously in Part II. It appears not to have been an issue this year.

2.6 Transferable skills

Professor Steiner (Part II External) comments, as last year, on the lack of transferable skills in the curriculum. He believes that this is not a matter for concern, but could perhaps become one in the future.

¹We note that the Chairman's letter, sent out after consultation with the Teaching Committee this week, has in fact been reworded to take into account this recommendation.

²The following is an extract from a Education Committee policy document which can be found at www.admin.cam.ac.uk/offices/education/curricula/markings.pdf.

Ownership of marking standards and classing conventions

Under the general regulations governing the form and conduct of examinations (2008 Statutes & Ordinances p 226), Faculty Boards and comparable authorities are empowered to issue to Examiners details of the conventions and criteria that must be applied in marking written papers and other work and in determining class-lists. Such details and any changes to them should be issued before the end of the Full Michaelmas term preceding the examination. The Education Committee requires Faculty Boards and comparable bodies to issue such guidelines for examiners and strongly recommends that this same information should also be published on the web for the information of students and their advisors. This guidance should normally be in two parts: 1. marking standards for individual essays, questions or other assessed work 2. classing criteria for determining the class of a candidate based on their overall performance in the examination

He recognises that it is a consequence of Cambridge concentrating on its strengths. We note that the comparative lack of transferable skills is compensated for by the extra mathematical skills acquired by our students. It would be difficult to build more transferable skills into the curriculum without compromising the mathematical excellence of the course. We also note that the University and Colleges afford many opportunities for students to acquire transferable skills.

2.7 Rubric and excess questions

The Part IA examiners commented, as in previous years, on the number of rubric violations.

There were 125 excess questions this year, which is lower than last year but not atypical of the last 10 years.

The advice in the e-mail sent to candidates for Part IA by e-mail a week before the examination was strengthened this year as follows: ‘Past examiners have been of the opinion that some candidates have put themselves at a disadvantage by tackling excess questions.’

We note that 125 extra questions is not a very large number when compared with the total of 6000 or so attempts and believe that any attempt to tamper with the marking or classification schemes would be a disproportionate response.

2.8 Marks processing programme

There were various comments about the efficacy of the marks processing programme and the process through which it is updated. We **recommend** that the Chairs of Examiners liaise as soon as possible with Mike Rose on these matters.

2.9 Marking

The Part IB External Examiners comment on the fact that some examiners did not use sub-totals or red lines on marked pages. We note that the Chairman’s letter to Chairs of Examiners gives explicit instructions on this point. We wondered whether all examiners see this letter, which is at present only sent to the Chairs. We **recommend** that it be sent to all examiners directly.

2.10 Availability of secure computers

The Part II Examiners strongly recommend that, because of congestion, separate computers be used to enter Part III questions and Parts IA, IB and II questions. We **endorse** this recommendation.

2.11 Faculty Secretary and Computer Officer

All the Examiners’ reports remarked on the excellent support given by the staff of the Faculty Office, in particular Amy Moir and Maya Hagemann. We **recommend** that the Chair of the Faculty Board expresses the appreciation of the Board for their work.

The Examiners in all Parts of the Tripos found the expertise of Mike Rose, Chris Mortimer and John Sutton invaluable. We **recommend** that the Chair of the Faculty Board expresses the appreciation of the Board for their work.

The Part IB Examiners specifically draw attention to the work of Gareth Taylor in mark-checking. We **recommend** that the Chair of the Faculty Board expresses the appreciation of the Board for his work.

3 Part IA

3.1 Education Tripos

The Examiners commented again on the generally extremely poor standard of the candidates for the Education Tripos.

This was the last year in which candidates for the Education Tripos are permitted to offer papers from the Mathematical Tripos.

3.2 Number of External Examiners

The Examiners suggest that the Faculty Board consider appointing two External Examiners (instead of one) in future; one in pure and one in applied. Although much of the material in Part IA will be accessible to either a pure or an applied External, we did feel that having two examiners (not in phase) would bring a greater degree of continuity to the process. We **recommend** that the Faculty Board considers the appointment of an additional External Examiner.

3.3 Examination structure

Professor Mansfield (External Examiner) raises the possibility of having one paper per course (i.e. eight papers in total), to avoid specialisation if this is an issue. Our feeling was that specialisation is not an issue since nearly all students follow all courses throughout the year; and we were not keen on an increase in the number of hours of examination or on a decrease in the length of examination papers. We note that that question of modularisation was discussed at great length recently by the Faculty, mainly in connection with Part II though many of the arguments apply to other parts of the Tripos. This resulted in the Faculty reaffirming its commitment to the existing non-modular system.

4 Part IB

4.1 Examination structure

Professor Moss (External Examiner) comments that some candidates would not have obtained honours at his institution because there was evidence of ability in only a few areas of mathematics. This is a consequence of the non-modular examination structure (see the comment above), the educational advantages of which we would not recommend sacrificing for the sake of the classification of a small number of candidates at the bottom of the list. We note that lack of evidence of ability is not evidence of lack of ability, and it is entirely possible that the candidates in question could have answered questions on a wide range of courses (and probably had done so over the course of the year), but chose to answer questions on only a few courses in the examination.

4.2 Curriculum

Professor Moss (External Examiner) comments that there might be some scope for updating the syllabuses for Electromagnetism and Quantum Mechanics to reflect some of the developments over the last half century. We note that the courses in Part IB (which are at the level of final year courses at some universities) are intended as foundation courses for the courses in Part II which tackle the subject matter in more depth and (possibly) more modernity.

4.3 Use of merit mark in ordering candidates

The External Examiners mention that there was some difficulty in classifying candidates at certain borderlines because of the use of the merit mark in ordering candidates for the final examination meeting. This difficulty arises because the merit mark formula changes at 8 alphas and, if the resulting kink occurs near a borderline, the merit mark ordering may not provide an ordering with respect to the primary classification criterion.

We discussed this at length but did not see an easy way of avoiding this problem, so we do not suggest a move away from the status quo. Professor Lister, who is Chair of Part IA Examiners for this coming year will discuss with the computer officers a way of flagging up the few candidates in the merit-mark ordered list where the merit mark may not coincide with the relevant primary criterion, and will liaise with the other Chairs.

5 Part II

5.1 Number of pure examiners

The examiners point out that the marking load of the pure Examiners was very large and some of the examiners were not able to meet the deadline. According to the examiners, there were (on average and

