



The Vice-Chancellor
University Registry
The Old Schools
Cambridge CB2 1TN

19 June 2012

Dear Vice-Chancellor

External Examiner's Report for Part II and Part III Chemistry 2010 (Physical and Theoretical)

This was my third and final year as moderating external examiner in Chemistry Part II and III with particular responsibility for Physical and Theoretical Chemistry.

General procedures

As in previous years, the examination process was organised extremely efficiently by the Senior Examiner, Dr Keeler. The examination questions and model answers were sent in March and we were given plenty of time to read them and prepare comments. We were also sent copies of the instructions that had been provided for the internal examiners and question setters, as well as minutes of examination meetings, all of which were useful.

The model answers were accompanied by a sheet indicating whether the different parts of the question were based on lecture notes or whether they were new, unseen problems. This was particularly helpful and is a practice that I have suggested we introduce at UCL. The model answers were mostly sufficiently detailed that they were useful in determining whether or not a question was appropriate.

I received a copy of the responses to my comments on the examination questions, and those of the other external examiners, in April. The internal examiners and question setters had considered all our comments carefully and responded in detail.

Post-examination meeting in Cambridge

The external examiners' meeting commenced at 11 am on the day prior to the final examiners' meeting. The senior examiner provided us with detailed written reports and a very clear oral summary of the examinations. The scripts were all laid out carefully so it was easy to find those belonging to candidates whose marks we chose to look at more carefully.

We paid particular attention to the candidates at the borderlines and a candidate whose mark distribution had been drawn to our attention, both in terms of their written papers and, where appropriate, their practical work or project dissertations.

Decisions at borderlines

Part III

Part II

General comments

The examination process runs very smoothly and I was reassured again to note that the two candidates we interviewed at the 1st/2.1 boundary were of a similar standard to those who would be found at this boundary at UCL.

I remain impressed with the clear qualitative descriptors used in the marking scheme for the Part III research projects. The comments and the marks were very consistent and I noted that, in the projects I sampled, most of the examiners had also written helpful comments on the dissertations. However, to improve the system further, perhaps the teaching committee might consider establishing project panel(s) to oversee oral examinations and to discuss and agree overall project marks. This would reduce the uncertainty in the mark and also bring the project assessment into line with other chemistry departments.

The examinations are of a very high standard. There are a large number of 1st and 2.1 degrees; however, the marking seems fair and this distribution simply reflects the high quality of the Cambridge Chemistry students. The Part II exams cover a wide range of physical and theoretical chemistry. There is less breadth in Part III, and I appreciate that this reflects the research interests of the physical and theoretical chemists. However, it is noticeable that

although a lot of physical and theoretical chemistry exam questions are set, the uptake is relatively low. This is not effective in terms of academic staff time, but perhaps more importantly, it is a shame that these very bright undergraduates are not being attracted to physical chemistry. Perhaps increasing the breadth of material taught in Part III to include cutting-edge physical chemistry-based measurement methods focusing on applications in biology might be more attractive to final year chemistry students.

Finally, I have enjoyed my three years as an External Examiner and would like to thank once again the senior examiner, Dr James Keeler, and his colleagues for their outstanding organisation and administration of the examination process and the support and hospitality they offer to their external examiners.

Yours sincerely,

Helen Fielding

The Vice-Chancellor
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18th July 2012

Dear Vice-Chancellor,

External Examiners Report – Part II and Part III Chemistry (Organic Chemistry)

This was my second year serving as External Examiner with expertise in the area the organic chemistry. In general, the examination process ran smoothly from start to finish and Dr Keeler and his colleagues did a very good job with the preparation of the papers and model answers. The presentation of the examination results and the various analyses performed on the examinations data were very informative. As was the case last year, it was very helpful to be provided with detailed information concerning averages, mark ranges and standard deviations for each question along with the number of candidates who had attempted each question.

Examination Papers and Model Answers

The draft examination papers were sent to me in late March which allowed me sufficient time to read through everything thoroughly and return my comments. The detailed instructions and formatting of the papers and model answers meant that it was a relatively straightforward task to appreciate what information was required in the answer to each question.

The Part II and Part III the papers covered a wide range of topics and there was sufficient choice to allow candidates to play to their strengths. The balance between questions based on core knowledge and those testing problem-solving skills was appropriate. Inevitably, there were some discrepancies with regard to what individual examiners expected candidates to write for a given number of marks, but these were minor and less obvious than last year.

The inclusion of a cover sheet giving details of who set and checked the question, plus an indication of whether the question was addressing basic core material or required additional knowledge and/or an ability to extrapolate what has been learned to solve an unfamiliar problem, was very helpful. The provision of detailed model answers along with marking schemes was also extremely helpful.

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Part II Examination

All four papers generated marks with sufficient ranges to indicate that exceptional students were being differentiated from the less able candidates. The average marks for the Papers 1–3 were very consistent, falling in the range 63–66%, but that of Paper 4 was somewhat lower at 58%. This outcome probably reflects the fact that candidates are slightly less comfortable dealing with shorter more tightly bounded questions than longer questions in which they can be more expansive in their answers. Nevertheless, I feel that the questions in Paper 4 were entirely fair and that this paper adds an important extra dimension to the examination process. The mean practical mark was just above 69% which is 6% higher than the corresponding average theory mark. This difference in marks is consistent with last year and is typical of chemistry degree courses in other institutions where I have worked or examined.

1st/2i Borderline

2i/2ii Borderline

2ii/3rd Borderline

Part III Examination

The examination questions were of a very high standard and covered a wide range of topics in chemistry. Candidates were given considerable choice in what they answered and so were able to play to their strengths. In my opinion, it is perfectly acceptable for students to have some degree of choice at this stage of their university education but this approach does lead to some questions being answered by very few students and a gravitation away from questions covering topics that are perceived as being difficult. This year, as last, candidates gravitated towards questions dealing with organic chemistry and away from those dealing with physical chemistry. The situation is particularly stark when one analyses the data: of the 15

questions answered by fewer than 10 candidates, 14 dealt with topics in physical chemistry, whereas of the 12 questions answered by more than 30 candidates, 10 dealt with topics in organic chemistry or had a significant organic component. As I stated in my report last year, I think there is probably a good case for structuring the examination papers in such a way that candidates are forced to answer at least some questions in all three major branches of chemistry. In most other universities it is considered undesirable for students to be given freedom to deselect a major area of chemistry. This is an issue that should be discussed further by members of the Department of Chemistry at their Teaching Committee.

Research Project

The research project has a relatively high weighting (25%) in the final overall mark, but this is consistent with other chemistry departments in the UK. Last year, we were concerned that the supervisor had a relatively large input into the final mark for the project and I am glad that this has been reduced somewhat, with independent assessors being used to judge the oral performance and to mark the project report. A clearly defined set of criteria is being used in the project assessment which should ensure objective assessment and consistency, as far as this is possible. However, it is evident that very high project marks are being given to some candidates whose performance in the examinations is rather less impressive. This is particularly true at the bottom end of the 1st and 2i categories and in some cases a high project mark has resulted in a candidate who was in the mid-2i bracket, based on Part III examination performance, ending up with a 1st or appearing at the 1st/2i borderline. For example, of the bottom seven candidates in the 1st Class category, five had Part III theory marks of less than 70% and one candidate had an average of just 65.72%.

1st/2i Borderline

2i/2ii Borderline

General Observations

- The candidates called for *viva voce* examinations were of the standard expected of students at the 1st/2i boundary in a top UK university.
- There have been substantial improvements in the assessment of research projects with a down-weighting of the input from the supervisor. I feel this has helped bring the project marks more into line with the theory marks.



- High project marks are being given to some candidates whose performance in the examinations is substantially weaker (see particularly candidates and where there is a ca. 16% discrepancy). This is generally observed at the bottom end of the 1st and 2i categories and in some cases has meant that a candidate who was in the mid-2i bracket, based on Part III examination performance, has ended up with a 1st Class degree or appeared at the 1st-2i borderline.
- Candidates are tending to gravitate towards questions dealing with organic chemistry and away from those dealing with physical chemistry. I think there is probably a reasonable argument for structuring the examination papers in such a way that candidates are forced to answer at least some questions in all three major branches of chemistry. This is an issue that should be discussed further by members of the Department of Chemistry at their Teaching Committee
- The examination papers are of a high standard and the distribution of marks is impressive with a large proportion of students (>80%) gaining a 1st or 2i classification at Part III level. I am sure that the planned changes to the entry requirements to Part III will mean that even fewer 2ii and 3rd Class degrees will be awarded after Part III in future.

In summary, I believe the examinations were of a high standard this year and that they reflect the high quality of the chemistry courses at Cambridge and the high standard of teaching. I can also confirm that the examinations were conducted in a fair and impartial manner.

I would also like to pay tribute to Dr Keeler and his colleagues for their excellent level of organisation and also thank them for the helpfulness and hospitality when I visited the Department of Chemistry.

Yours sincerely,

J. Stephen Clark

Mjr/jr/mydocs/correspondence/Camexamining

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External Examining - Chemistry examination Cambridge University

This was my first year as external examiner at Cambridge. The information regarding the marks and performance on the papers provided by Dr Keeler was extremely well-organised and informative.

The questions in inorganic/materials/physical chemistry are extremely demanding and in general discriminate well between the students. You may wish to consider some more breadth in questions in areas where the mean mark is consistently high, as this will reduce direct overlap with previously seen lecture examples, but this is not a concern.

It would be useful to have a process to ensure that the project marking is as comparable as possible across the cohort. This could be done by a small group or an individual tasked with ensuring orals are performed consistently and supervisor-provided marks are given on an equivalent basis. This would provide both you and the externals with reassurance that these marks are given on an equal basis.

Yours sincerely



Matthew Rosseinsky

Response to the reports of the External Examiners:

Part II and Part III Chemistry 2011/2012

We are grateful to the External Examiners for their help with, and careful oversight of, the examination process. Having the benefit of the advice of experienced colleagues from other universities is helpful when it comes to making some of the more difficult decisions and also in making sure that our processes are transparent, defensible and as good as they can be.

Assessment of Part III projects

Making a consistent assessment of a very diverse range of projects represents quite a challenge, and over recent years the majority of comments and suggestions from the External Examiners have been aimed at improving this process. The set of changes that were introduced last year have, we believe, led to further improvement and this is acknowledged by the External Examiners.

The issues highlighted by all three Externals this year relates to the conduct of the oral examination (worth 20 marks out of 100) and the moderation of the project marks. Our present practice is that the oral is conducted by one of the Part III Examiners together with another member of staff who is familiar with the area of research, but who is not the project supervisor. These two are also responsible for agreeing the mark for the written project.

In setting up this scheme our intention was that the Part III Examiner would ensure that the proper procedures were followed and would also be able to take on a moderating role across the fifteen or so related projects that he or she would be involved in assessing. We believe that to a great extent the examiners fulfilled this expectation.

Professor Fielding has suggested that one option would be for a third person to be present in the oral, but not involved in the assessment, so as to ensure that the oral is conducted properly and also to exert a moderating influence on the marks. We see the merit of this suggestion, but feel that we simply do not have the staff time available to implement it. With over 70 orals to conduct in a just one week, and with most of the staff already heavily committed to examining duties, it is difficult to see how we could resource such a scheme.

As an alternative we suggest the following enhancements to our existing arrangements:

- The role of the Part III Examiner who is involved in the oral will be re-emphasized, in particular that it is his or her responsibility to ensure the proper conduct of the oral, and that the assessment of both the oral and the written project has been carried out according to the guidance issued by the Examiners. It will be made clear to all involved that the Part III Examiner is the senior party in this process, and will be in control of it.
- Collectively, the Part III Examiners will increase their scrutiny of the project marks overall. In particular they will continue to challenge unusually high or low marks, or marks where there is inconsistency between the assessors, or marks which are out of line with those on the written papers. To allow for this an extra Examiners meeting will be timetabled shortly after the completion of the orals.

We hope that these changes will go a significant way in meeting the concerns that have been raised.

Low take-up of physical and theoretical courses, especially at Part III

Both Professor Fielding and Professor Clark comment on the low take-up of physical and theoretical courses, especially at Part III, and it is certainly the cases that such courses are much less popular than those covering biological, inorganic and organic chemistry.

In part we believe that this bias is an inevitable consequence of the cohort of students who take Part II and Part III Chemistry. These have all been recruited as Natural Scientists and experience is that many of them will have come to Cambridge with the idea that they would most probably end up specializing in physics. However, the challenging mathematical content of this course means that only those who are strong in this area tend to persist in the study of physics. Those who find the mathematics just too difficult tend to change focus to chemistry, earth sciences or materials science. Our cohort simply does not contain large number of students who are strong in mathematics, and indeed the students we have might best be characterized as having deliberately turned their backs on courses which require strong mathematics. In addition, at Part II we also pick up a significant number of students who originally saw themselves as biologists, but who are attracted by the concept-based learning in chemistry and our strong offering in chemical biology. The result of all this is a Part II and Part III class with a bias away from physical and theoretical topics. It is not that we do not have some students who are strong in mathematics and who are attracted by such courses – it is just that there are few of them.

Lecturing to a small group is, on the face of it, not an efficient use of resources. However, our theoretical colleagues are content to continue in this way, recognizing that they are providing teaching for a small, but committed, group. In addition, these lectures are also used as part of the taught component of research degrees.

Nevertheless we do recognize that it would be desirable to increase the number of students taking physical and theoretical courses. To this end the physical staff are reviewing the courses they offer with a view to adding additional courses which would be attractive to a wider range of students and/or refreshing the existing courses. The theoretical staff have been asked to review the level of mathematical competence required by their courses to see if this can be toned down (especially at Part II) so as to make the courses more accessible to a wider range of students.

Connected to the issue of the low up-take of physical or theoretical courses is whether or not students should be required to take a wider range of topics. At present the first- and second-year material is all compulsory and covers the full range of chemistry topics. Of the ten courses in Part II which the students are required to take, four are compulsory and cover the full range. There is a free choice at Part III. It has long been the Department's policy to allow progressive specialization in Part II and in Part III, not least as this fits in with the Natural Sciences philosophy. We would be reluctant to introduce more compulsory material.

Style of questions

Professor Rosseinsky expresses concerns about whether or not some of the questions are too closely related to material in the lecture courses and/or exercises that the students have completed as part of supervisions. We agree that it is important that each question should contain a significant part which involves the students applying their knowledge in a genuinely new situation. The Examiners will remind question setters of this requirement and monitor compliance.

In addition, where there are two alternative questions offered for a particular course (as is typically the case), we agree that it is important that the level of difficulty of these two questions is balanced so that they will be equally popular as choices in the exam. Again, the Examiners will remind question setters of this requirement and monitor compliance.

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