UNIVERSITY OF CAMBRIDGE

REPORT COVERSHEET FOR EXTERNAL EXAMINERS

Name and Title: Professor John Plane
Email: j.m.c.plane@leeds.ac.uk
Home institution: University of Leeds
Award or subject area examined: Part II and Part III Chemistry
Associated University of Cambridge Faculty/Department: Chemistry

Please tick the statement which most closely reflects your views of the examinations. TICK HERE

The standards set for the award(s) or subject area(s) above were appropriate. The processes for assessment, examination and the determination of awards were sound and fairly conducted. **Any recommendations made are for the purposes of enhancement to the course and its assessment.**	x
The standards set for the award(s) or subject area(s) above were appropriate. The processes for assessment, examination and the determination of awards were sound and fairly conducted. **HOWEVER, there are some risks to the future assurance of the course and its assessment, as outlined in my recommendations.**	☐
There are immediate concerns or risks relating to the standards set for the awards or subject areas above and/or the processes for assessment, examination and the determination of awards. **These require immediate action on behalf of the University to prevent reoccurrence in the next set of examinations.**	☐

Please tick as appropriate:	Yes	No	N/A
Are you satisfied that you received sufficient programme materials (programme handbooks, regulations, and marking criteria)?	x	☐	☐
Are you satisfied that you were consulted adequately on draft examination papers, and that the level of questions was appropriate?	x	☐	☐
Were you given sufficient opportunity to scrutinise the general standard and consistency of marking of examination scripts and coursework?	x	☐	☐
Have issues raised in previous report(s) been addressed to your satisfaction?	x	☐	☐

Please return this form, with your full report, to: vcexternalexaminers@admin.cam.ac.uk by July 31st for undergraduate examinations, 1st October for Masters Degrees, and 12th October for resits.

Or: The Vice-Chancellor, University of Cambridge, The Old Schools, Cambridge, CB2 1TN.

Please also forward copies to your Chair of Examiners.

This form can be downloaded from:
http://www.admin.cam.ac.uk/offices/education/examiners/eecoversheet.pdf

NOTES FOR EXTERNAL EXAMINERS

Submitting reports to the University

1. All External Examiners are required to submit a written report at the conclusion of their involvement with the examination, and may comment on any aspect of the examination, including the fairness of the assessment and the standards of the candidates for the part of the examination that they are involved with.

2. Reports should be addressed to **the Vice-Chancellor of the University**; payment of the fee and expenses is conditional on receipt of the report.

3. Full guidance on the roles and responsibilities of External Examiners is provided on appointment. It can also be found at: www.admin.cam.ac.uk/offices/education/examiners/external.html for undergraduates and http://www.admin.cam.ac.uk/students/studentregistry/staff/exams/examiners/index.html for graduates. All External Examiners will receive feedback on their full report in line with University policy.

Report structure and content

4. The written report is made available for discussion by the appropriate Faculty or Department concerned with the examination and by the General Board's Education Committee. Reports are usually considered by the senior committees of the relevant Faculties and Departments. These committees include student representatives and reports should therefore be written in a form that avoids discussion of individual candidates by name or candidate number.

5. There is no University standard reporting template, but reports are expected to cover four main areas:

   - the extent to which standards are appropriate for the examination and the qualification;
   - the extent to which standards are comparable with similar programmes in other UK institutions with which you are familiar;
   - the extent to which processes for assessment, and the determination of awards were sound and fairly conducted;
   - any good practice which you feel could be usefully identified for further dissemination.

6. Reports may also include commentary on the following topics, at the discretion of the individual External Examiner:

   the examination

   - the design, structure and marking of the examination;
   - the procedures for assessment, including the basis and rationale for any comparisons of standards made;
   - the strengths and weaknesses of the students as a cohort;
   - whether your role is appropriate for the examination to which you were appointed, including whether or not you had sufficient access to any material needed to make the required judgements;

   the course

   - the curriculum, its aims, content and development;
   - resources as they impact upon student performance;
   - the quality of teaching and learning, which may be indicated by student performance.

General points

7. Submitted reports will only be used in accordance with General Board policy (for the monitoring of academic standards within the institution) and in line with current legislation.
8. In line with UUK recommendations, all External Examiners' reports will be made available, in full, to all students, with the sole exception of any confidential report which may be made to the Vice-Chancellor.
9. The University shall own the copyright in the reports made to them by External Examiners; in accepting the appointment, External Examiners assign all present and future rights relating to the reports and any other materials created in relation to their appointment. External Examiners will also waive any rights including moral rights in connection with those materials.
10. The University will take reasonable endeavours to ensure the accurate reproduction of material and information provided by External Examiners; all other warranties and undertakings are excluded, including liability for direct or indirect loss to an External Examiner.
11. External Examiners are advised that, under the Data Protection Act 1998, the University will process personal information on its External Examiners.
12. External Examiners are also advised that, under the Freedom of Information Act, the University may be obliged to disclose details of their report on request.

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The Vice-Chancellor,
University of Cambridge,
The Old Schools,
Cambridge CB2 1TN.

25th July 2014.

Subject: External examiner's report for Chemistry, Parts II and III

Dear Vice Chancellor

This has been my second year as an external examiner for the Department of Chemistry. Once again, my overall impression is very positive - both Parts II and III are rigorous, challenging parts of the Natural Sciences Tripos which were appropriately assessed and where the student cohort performed strongly. This report is now broken down into sections following the suggested guidelines.

The extent to which standards are appropriate for the examination and the qualification

Candidates for Part II and III are required to answer questions with significant problem-solving components. In the majority of exam questions, around 30% of the marks are awarded for problems that go beyond material covered in lectures and supervision exercises. A large degree of choice is permitted on most of the exam papers, which allows candidates to focus (though not exclusively) on sub-disciplines of the subject. It was quite striking in the Part III exams that students were three times more likely to choose an organic chemistry question than a theoretical one, though the theoretical questions were usually answered very well by a motivated minority of students. The physical, inorganic and biological chemistry questions were in between in popularity. The exam structure is not modular, so that accumulated knowledge is tested in both years. The indicative mark scheme for each question allows particularly good answers to parts of questions to be given additional credit. The 3-hour exam format also allows longer, more testing questions to be set. These are all positive aspects to the examination process.

The extent to which standards are comparable with similar programmes in other UK institutions with which you are familiar

During the last 8 years I have been an examiner at four other Russell Group universities. I think that the absence of modularity and the degree of mathematical problem-solving in the Cambridge course makes it particularly challenging to achieve 1st Class marks. One concern that the externals had this

year was that the course content is over-specialised, so that students acquire deep knowledge in narrow areas, without enough breadth in between. This impression was borne out to some extent during the *viva voce* exams. For instance, in my area of physical chemistry - atmospheric chemistry - most students did well on questions that were pretty testing. However, two of the students who were given *vivas* had little idea of the kinetics - the role of the third body, temperature dependence and so on - of the central atmospheric reaction which produces ozone, and claimed they had not heard of the Lindemann-Hinshelwood mechanism (which should be standard knowledge for Part III students). Of course, this was a small sample of students and may not be representative.

The fraction of students achieving 1st Class results at Part III (51% of the cohort) is higher than in most other research-intensive universities, where a typical figure would be around 40%. In fact, the fraction of Firsts has jumped from 36% in 2012-13, though it was somewhat higher in earlier years (going back to 2005). In my view these results were fairly earned, and this high proportion is a credit to the Department. It is also clear that marks from practical work and projects are not off-setting lower theory marks to produce high overall results.

The extent to which processes for assessment, and the determination of awards were sound and fairly conducted

Dr James Keeler, Director of Teaching, sent out the examination papers and model answers in plenty of time to scrutinise them properly. I had commented last year about the rather mixed standard of the model answers, so I am happy to report that this year the standard of model answers was much higher. In particular, this made it possible to comment sensibly on the mark allocations for parts of questions. The exam papers were once again produced to an exceptionally high standard, with few typographical errors. The comments I made on the papers were responded to in depth by Dr Keeler and satisfactorily addressed by the setters of the exam questions.

At the final assessment meeting, Dr Keeler provided a briefing to accompany the extensive notes that he prepared for the examiners. These notes contain very useful data and statistical analysis on both Part III and Part II. There were a small number of errors on the papers that came to light near the start of the exams and were communicated quickly to all candidates. The mean marks on the Part III papers were close enough to the desired 65% not to require further adjustment. The Part III notes also explained in some detail the assessment of the projects, which contribute 25% to the final mark. The average project mark of 71% seemed fair, based on our reading of a selection of project reports. Importantly, the justification of marks - for competence, achievement etc - is clearly laid out, as well as an explanation of how a final mark is arrived at in the event of a disagreement between the two markers. This level of detail allowed the externals to identify one candidate for a *viva* where there appeared to be discrepancies between marks awarded and the accompanying narrative. The average project mark is 2% lower than in 2012-13 i.e. there is no evidence for mark inflation.

At Part II, the average paper scores were close to the desired 65% (ranging from 63 to 66%), and the average practical mark was 70% - again, a balanced outcome.

The exam questions seemed to be fairly marked. As I stated in my report last year, it would be useful if there was more uniformity in the way markers annotate the scripts to indicate how marks were arrived at in certain circumstances. For instance, how credit is awarded when a small mistake in an early part of the question leads to the rest of the question being wrong because of error carry-through. Only some markers annotated the answers to show that this was being done.

. One point we felt strongly about is the timing of the final exam meeting during May Week. It was pretty clear that 4 of the 5 students that we interviewed had been at May Balls the night before, and were not in an optimal condition for a *viva*.

This clash is unavoidable because *viva* candidates are only selected on the Monday afternoon. If it were possible to move the exam meeting to the end of the previous week, that would be fairer on the candidates selected for *vivas.*

The final meeting between the external and internal examiners within the Department of Chemistry proceeded efficiently and our advice on borderline cases was accepted without further discussion.

Any good practice which you feel could be usefully identified for further dissemination

Adopting more uniform annotation of exam scripts to show where credit is being given would be desirable (see above).

I mentioned in my report last year about the possibility of getting to meet some of the students informally, as opposed to the formal *viva voce* exam setting. I have experienced this at the University of York, where around 25 students are invited to spend an hour or so talking to the external examiners over coffee and cakes. The students quickly open up with pretty frank views on what is both good and bad about their course - lectures, assessment, laboratory work etc. - providing a lot of valuable information which can be fed back to the internal examiners.

In conclusion, I would like to thank Dr Keeler and the other internal examiners for enabling the work of the external examiners to run so smoothly.

Yours sincerely,

UNIVERSITY OF CAMBRIDGE

REPORT COVERSHEET FOR EXTERNAL EXAMINERS

Name and Title: Professor Patrick Steel
Email: p.g.steel@durham.ac.uk
Home institution: Durham University
Award or subject area examined:Chemistry
Associated University of Cambridge Faculty/Department: Science / Chemistry

Please tick the statement which most closely reflects your views of the examinations. TICK HERE

The standards set for the award(s) or subject area(s) above were appropriate. The processes for assessment, examination and the determination of awards were sound and fairly conducted. **Any recommendations made are for the purposes of enhancement to the course and its assessment.**	X
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Please tick as appropriate:	Yes	No	N/A
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Have issues raised in previous report(s) been addressed to your satisfaction?	☐	☐	☒

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1st July 2014

The Vice-Chancellor
University of Cambridge
The Old Schools
Cambridge
CB2 1TN.

Dear Vice-Chancellor,

RE: External examiner's report for Chemistry, Parts II and III, 2014

This represents the conclusion of my first year as an external examiner for the Department of Chemistry. As such I am still learning of all the nuances of the Tripos system. This has been facilitated by the superb organisation of the whole examination process (papers, marks and meetings) by James Keeler and his team.

We are asked to cover the following points:

- *the extent to which standards are appropriate for the examination and the qualification*

and

- *the extent to which standards are comparable with similar programmes in other UK institutions*;

I found that the questions I reviewed to be challenging and require the students to display considerable depth of knowledge. Importantly most of these appear to have a synoptic element requiring students to demonstrate knowledge accrued over previous courses years and thus avoiding the pitfalls of some more modular courses. The course produces a relatively large proportion of first class degrees. However the statistics monitoring performance year on year combined with the rigour of these exam papers would suggest that this is not inappropriate. Importantly whilst the final year research project plays a significant contribution to the final mark this does not seem to be distorting the result such as to mask a substandard performance in the theory papers. Overall I am confident that a Cambridge student is comparable in standard to the equivalent student at other leading UK chemistry Departments.

- *the extent to which processes for assessment, and the determination of awards were sound and fairly conducted;*

I was impressed by the process of setting of exams. Each question was supplied with a proforma which confirmed that it had been internally peer reviewed, indicated the level of effort required by the student to answer the question and was accompanied with a model answer. The quality of the question setting was good and I only had to make a small number of relatively minor suggestions / comments. However each one of these was considered in the response I received so I am very happy with the setting process.

At the examiners meeting we were presented with the ranked marked list and given a detailed briefing on the conduct of the exams and the outcome of the internal board meeting.

All questions and papers had marked to the appropriate averages (Part III 65-67% with the project 71%; Part II 62-66% with Practical 69%) although this can mask class distributions (see below). Certainly the students at the top of the class had performed exceptionally well across the board. Marking seem to be robust and I did not

detect any significant errors. However there seems to be a universal policy of not commenting on the answer or showing how marks are awarded. In many cases it appears to be common practice to simply provide a total mark at the bottom of a page / end of a section. This does make it difficult –particularly when looking lower down the class list where students have struggled – to identify where or why these students have gained or lost marks. This could be addressed by the universal inclusion of a provisional marking scheme within the model answer at the setting stage and a suitably amended version, if necessary, to show that which was used when the marking was done. The marking system used for the projects appears to be very robust – two independent reviewers and a supervisor report. If there was a discrepancy between these and then the moderated mark was clearly identified along with a rationale for this revision. Having read several of the reports I am confident that the systems in place provide a fair measure of student effort and performance suitably balanced to their theory marks. After reviewing the class lists we focused on the boundary conditions and ultimately held *viva voce* exams for five students

Overall this gave a clear impression that the borderlines as presented in the ranked list are appropriately placed.

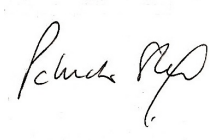
- *any good practice which you feel could be usefully identified for further dissemination.*

The chemistry course at Cambridge is obviously very challenging and whilst I did not have time to review their work in great depth the top students are obviously very bright, very capable and very well-prepared (taught). Part III is a selective cohort and performs appropriately but Part II does contain a hidden tail. If one looks at the overall mark distribution then one notices a bimodal distribution (24% 2ii and III) which is somewhat masked by the mean and large number of first class marks (41%). Many of the questions in the papers that I reviewed are problem based (neither uncommon or inappropriate), moreover relatively few of these are level 1 standard requiring recall of notes. Moreover, there there is little in the way of discussion type answers. All of these factors are more challenging for the student who is not so proficient in theoretical aspects. Perhaps questions could be designed to account for both extremes of the class – some level 1 but also more level 3 material. Apart from the comment about marking schemes made in the section above, I have little to suggest about the examination process.

One other observation relates to specialisation / breadth. As is appropriate Part II provides a relatively broad range of courses and the question options in papers 1 & 4 means that students cannot opt out of complete elements of the syllabus too early in their education. There is a range of choice in the remaining papers and certainly in Part III students appear to be able to focus on just one of the main branches of chemistry in respect of the questions they answer. Whilst at this stage specialisation is acceptable and the course does reflect research strengths of the department it is surprising that students who have interests in other aspects of chemistry are not able to follow them at an advanced level. For example in organic chemistry the courses at level three this year were either synthesis (four courses - I include the medicinal chemistry option here as it appears to be essentially a synthesis course in all but name) and courses on protein folding and biosynthesis. No options for students with interests in polymers/softmatter/supramolecular chemistry/ physical organic chemistry. I understand that the staff who normally provide these options are on research leave this year but it is a little surprising that such significant elements of the course cannot be taught every year.

To conclude, I would like to reiterate my thanks to James Keeler and the other examiners for their efforts in making this such an efficient process.

Yours sincerely,



Patrick Steel
Professor of Chemistry

Mjr/jr/mydocs/correspondence/Camexamining14

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9th September 2014

Vice Chancellor
Cambridge University

Dear Vice-Chancellor

External Examining – Part II and III Chemistry Examinations 2014

The examination and associated paperwork and information for the external examiners was organised in an exemplary manner by Dr. Keeler. The papers are demanding and the students of high quality, clearly justifying the distribution of degree classifications.

The changes in assessment of the project in Part III in response to comments in the previous two years have produced a more rigorous protocol which gives confidence in the marks.

I feel that more attention could be focussed on examining the students in comparative inorganic chemistry – few of the questions probe understanding of e.g. which oxidation states are adopted by the transition elements and why. This would be of considerable benefit to the students. It is perhaps more important to know that Cr, Mo and W are in the same group than to be able to construct elaborate molecular orbital schemes for their compounds.

It would make the external examiners task much easier if a homogeneous marking scheme was adopted throughout in terms of using raw marks or percentages. The broad spread of schemes used by different examiners is challenging to assimilate in the limited time available to the externals to evaluate scripts, and I feel this is an unnecessary obstacle.

Yours sincerely

Matthew Rosseinsky

Response to the External Examiners' reports for Part II and Part III Chemistry 2014

We would like to start by thanking the External Examiners for the time and effort that they put into their role. The advice and assistance of such experienced colleagues is invaluable in maintaining the integrity of the examinations, and in the continuing improvement of our procedures. We are also pleased to see that the External Examiners have explicitly acknowledged the improvements made as a result of their earlier suggestions which have been acted upon.

Annotation of scripts

All three Examiners suggest that it would be helpful to the External Examiners if scripts were annotated/marked in a consistent way, and in particular if there were more detail given as to how marks had been awarded.

We agree in principle with this, but note that with a large number of scripts to mark in a short time it will not be possible for a marker to make detailed comments on each script. However, in our instructions to markers for the coming examinations we will ask that the level of annotation be increased. The model answers, along with the division of marks indicated on the question paper, give an indication of how the marks are split between sections; again, we will ask for question setters to give as much detail as they can in the model answer about how the marks will be awarded.

As we did last year, we will instruct markers to use a simple scheme in which the part marks add up to the final mark in a straightforward way.

Timing of the orals and the final meeting; informal meeting with students

Professor Plane comments that the current timetable results in orals being scheduled for the morning after a number of May Balls, and that this leaves the students who have been up all night at a disadvantage if they are called for an oral. He also mentions that an informal meeting between a group of students and the External Examiners is not uncommon at other universities, and he would welcome the adoption of this practice in Cambridge.

Following up on this we have already agreed with the External Examiners for 2014/15 the following revised timetable

Monday 15th June: arrive in Cambridge by 11:00; scrutiny of scripts;
decision on who to call for orals by 18:00

Tuesday 16th June: 10:00-11:30 informal meeting with students; orals from 11:30;
final meeting from 15:00

This will delay the publication of the class list by at most half a day, which we think is an acceptable compromise to enable us to accommodate the requests.

Mark distributions and style of questions

Professor Steel points to a 'hidden tail' in the Part II class of students who perform rather poorly in the examination, and that these are balanced out by another group who do very well. He comments that for the weaker students it is important that the questions contain some relatively straightforward material ('level 1', as we term it) which they are able to tackle. He also comments

that there are few questions requiring a discussion (as opposed to solving a problem), and this creates further difficulties for weak students.

We agree that it is important that all questions have within them some straightforward parts which related directly to the lectures and which are accessible to the weakest students. We are, however, not so keen on having 'discussion' or 'recall' questions: our preference is for problem-based questions throughout, and this is reflected in the preparation that students undergo. We will remind question setters of the need always to include some 'level 1' material at the start of the question, and for the subsequent parts of the question to have a graded level of difficulty, rather than a sudden jump in level.

Balance between specialised and general knowledge

We recognise that there is a tension inherent within our course in that in Part III, and to some extent in Part II, many students develop a specialised focus to their studies, possibly to the detriment of their knowledge of the breadth of chemistry. It is indeed embarrassing for it to be discovered that one of the students given an oral did not know that Cr, Mo and W were all in the same Group, and that another student had a deficient knowledge of elementary kinetics.

Notwithstanding these particular cases, we are confident that our students do receive a good grounding in a wide range of chemistry in their first and second years (and in part of the third year); they are assessed on this knowledge and understanding in the end of year exams. That they do not have this chemistry at their fingertips at the very end of the course is disappointing, but it is perhaps not realistic to expect this, given the way the course is structured. Certainly from the students point of view the ability to specialise is regarded as a great strength of the course.

Courses available

Professor Steel comments on the range of organic courses available to the students. Looking across Part II and Part III all of the topics he mentions are in fact covered with the exception of polymer chemistry which, due to a key member of staff being on leave, was not covered. We did in fact look into various ways of providing a polymer chemistry course in the absence of the member of staff, but it turned out not to be feasible. In general we agree that maintaining coverage, despite colleagues being on leave, is very desirable and something we aim to do.

Draft by the Teaching and Outreach Committee 23/10/2014; approved by SMT 10/11/2014