

Higher Chemistry Engagement

Introduction

Engagement Seminar events for Higher Chemistry took place between 13th November 2009 and 1st March 2010. Eight full-day seminars were held for teachers, with further half-day seminars for Higher Education and the Learned Societies. Around 300 teachers/lecturers attended the full-day seminars representing over a quarter of all Chemistry teachers in Scotland.

An online engagement hosted by SQA Academy ran from late November 2009 up to mid-February 2010.

The Qualification Design Team is extremely grateful to those who made comment on the proposals.

This document provides an overview of the key points emerging from engagement together with the action proposed by the Qualification Design Team. All comments recorded at the engagement seminars and online are available on the SQA Academy website.

Draft Outcomes and Performance Criteria

There was a very positive response to the proposed Outcomes and Performance Criteria.

- The new outcomes were reported to be more clearly defined.
- A significant number of responses indicated that these Outcomes would make the setting of examinations more straightforward.
- The proposed Outcomes were felt to place an appropriate degree of emphasis on the development of essential skills.
- It is desirable to have all science Highers share a common set of Outcomes and Performance Criteria (PC).
- Teachers/lecturers were keen to establish the division of marks between Outcome 1 and Outcome 2 in the external exam. Where responses indicated a preference, it was for Outcome 1 to carry the greater number of marks.

QDT Action: An analysis of the distribution of marks under the new Outcomes and PCs has been conducted for Higher Chemistry papers going back as far as 1973. Specimen examinations are being prepared to help the qualification design team determine the most appropriate division of marks between Outcomes and across PCs.

- Draft Outcome 1, PC(b) states “Apply knowledge in unfamiliar contexts or to solve problems”. During engagement the use of the word “unfamiliar” was a cause for concern. What is familiar to one candidate may well be unfamiliar to another.

QDT Action: Outcome 1, PC(b) has been amended to read, “Apply knowledge to solve problems”.

- Responses highlighted a degree of overlap between Outcome 2 PCs(f) and (g)

QDT Action: Outcome 2 PC(f) amended to read, “Draw valid conclusions supported by evidence or justification”.

The New Format for the Content Tables

The new three column format for the content tables was well received with a large number of responses indicating that it was preferable to the current layout.

- The notes column provides useful support for teachers, especially Newly Qualified Teachers, and was regarded as a strength of the new format.
- The suggested activities column was felt to be more useful than in the current document.
- The feedback indicated that the format of these tables should be common across all Sciences.

QDT Action: The new, three column layout will be common to all revised science Highers.

- Some entries in the notes column do not indicate clearly what may be assessed in an examination.

QDT Action: The content tables have been carefully audited to ensure that all notes now indicate clearly what candidates are expected to know and be able to do.

- Some notes column entries contain too much information.

QDT Action: The notes column has now been reviewed to ensure that it represents only examinable material. Any illustrative examples (e.g. cooking of asparagus) have been removed to the third, non-examinable column.

- More detail on the experiments mentioned in the suggested activities column should be provided.

QDT Action: All experiments mentioned in the content tables are now accompanied by a brief outline of the procedure.

- Weblinks to activities and support resources are very useful but must be kept current. There should be a mechanism for teachers to submit new activities and resources.

LTS Action: Learning Teaching Scotland are currently preparing appropriate web pages to support the new Higher course. The hyperlinks on these pages will be maintained to ensure that all content can be easily accessed.

Open-ended Questions

The use of open-ended questions within the course assessment was welcomed. Responses highlighted several advantages of this type of question.

- The questions offer a means of testing students' deeper understanding of the subject.
- These questions can illustrate the relevance of Chemistry to everyday life.
- Because candidate answers do not have to conform to a narrow marking scheme, open questions may provide a mechanism to reward weaker candidates "for what they know" rather than penalising them "for what they don't know".
- Some responses indicated that these questions were preferable to essay style questions.
- These questions could help to promote literacy.
- This style of question was felt to support the ethos of Curriculum for Excellence.

There were, however, several areas of concern.

- The marking of these questions needs to be clarified.
- Schools need a bank of example questions.
- These questions may be unsuitable for use in the Unit Assessments.
- These questions might discriminate against candidates on the basis of their cultural or socioeconomic backgrounds.

LTS Action: A CPD resource containing a bank of questions is currently in production. These questions are will be trialled with current Higher candidates in a cross-section of Scottish schools. The CPD resource will contain specimen candidate answers with marking commentaries.

With reference to the use of these questions in the course assessment, there would appear to be a preference for the inclusion of two questions, each worth three marks. Feedback also highlighted the need to give careful consideration to the placement of these questions within the exam with some responses advising that they be placed towards the end of the paper.

QDT Action: The QDT agree with the advice offered on the number of marks available for open questions and recommend that, initially, two three-mark open-ended questions are included in the specimen paper. After considerable discussion, the QDT feels that the placement of the questions within the paper is best left to the discretion of setters and the Principal Assessor. Where the open-ended question clearly relates to a certain part of the course, it is likely to assist candidates if it is placed between traditional questions coming from the same area of the course whilst, where the question is less strongly associated with a particular course area, placement at the end of the paper may be considered advantageous.

Content-based Units

Consumer Chemistry

The response to this unit was very favourable.

- The relevance of the Chemistry to everyday life was felt to be apparent.
- The unit was felt to be an improvement on “The World of Carbon”.
- There were widespread concerns that this unit contained too much content.

QDT Action: To create the time needed to ensure candidates have the opportunity to experience a range of engaging practical activities and to focus learning on the key principles of organic chemistry, the QDT has acted on the advice received during engagement and has removed Carbohydrates, Vinegars, Hydrogenated Oils, Terpenoids, Anti-aging products and the action of sunscreens from the Consumer Chemistry unit.

- It was suggested that the arrangements documents should highlight the extent to which candidates would be expected to use IUPAC nomenclature when naming straight and branched-chain compounds.

QDT Action: The QDT has inserted a section offering detailed and clear guidance on the use of nomenclature and on the drawing of formulae within the Unit Specification.

Research to Profit

There was a positive response to the way in which mastery of core chemical concepts such as the mole, equilibrium, reaction rates and thermochemistry and chemical analysis is shown to be essential for any chemical process to be taken to production.

- Whilst the mole is a central concept in this unit, the draft content tables made no explicit mention of the Avogadro number. Several responses made a case for ensuring that the Avogadro number is included in the content tables to support effective teaching and learning.

QDT Action: The Avogadro constant and its role in supporting the development of an understanding of the mole are now highlighted within the content table for this unit.

- The inclusion of analytical chemistry was welcomed with a number of responses supporting the inclusion of chromatographic techniques. A significant number of responses suggested that the overly-detailed section on Gas-Liquid Chromatography was inappropriate at this level.

QDT Action: The content section on Gas-Liquid Chromatography has been replaced with a more general statement to the effect that, “In chromatography, differences in the polarity and/or size of molecules are exploited to separate the components present within a mixture.” Candidates are not required to know the details of any specific chromatographic method or experiment and, in assessments, are expected to encounter chromatography within the context of problem solving exercises.

Periodicity, Polarity and Properties

The content of the Periodicity, Polarity and Properties was seen to contain key concepts central to building an understanding of Chemistry at this level. However, a significant number of responses expressed a concern that this unit may prove “dry” in comparison to the others, offering little by way of experimental work.

QDT Action: The QDT wishes to thank all of the teachers and lecturers who took time to send in suggestions for engaging activities for this unit. Thanks to their support, the redrafted content tables for this twenty hour unit now contain a total of 55 activities, 33 of which involve experimental work.

Researching Chemistry Unit

The skills-based Researching Chemistry unit generated considerable invaluable feedback and advice.

Outcomes and Performance Criteria

- The proposed outcomes and performance criteria were generally felt to be appropriate.
- Responses indicated that this unit helps to emphasise the relevance of Chemistry to everyday life.
- The Unit was expected to provide a better preparation for AH Chemistry or for further study or employment.
- The feedback indicates a clear desire to see Prescribed Practical Abilities no longer employed as an assessment mechanism within Higher Chemistry.
- Outcome 2, Performance Criteria (a) refers to candidates being involved in “designing” an experiment. Several responses suggested that, at Higher level, it is more appropriate for candidates to be “adapting” or “modifying” a procedure.

QDT Action: The Chemistry QDT are currently working in parallel with the Physics QDT to reword this Performance Criterion in a manner more appropriate to this level.

Experimental Techniques, Data Analysis Techniques and Apparatus

- The apparatus, experimental techniques and data analysis strategies specified were felt, in general to be appropriate.
- A number of responses indicate that centres may not have access to all of the named apparatus.

QDT Action: Hotplates have been removed from the apparatus list provided in the unit.

- A number of responses indicated concern over any quantitative treatment of uncertainties.

*QDT Action: The unit specification will make clear that candidates are **not** expected to: undertake any formal error analysis; calculate percentage errors; know the uncertainties associated with specific laboratory apparatus.*

The Investigative Activity

- The responses gave a clear indication that centres would require a number of topical investigation support packs to be available at any time to permit choice.

LTS Action: A number of Investigation support packs are currently being prepared spanning a range of chemical topics currently in the media.

- A number of centres are interested in producing their own topical investigation packs.

QDT Action: The draft unit specification will allow centres to develop their own investigation topics.

- Centres were concerned about the potential cost of undertaking the practical work associated with this unit.

QDT Action: Great care is being taken over the selection of topics for development into Investigation support packs to ensure that minimal costs are incurred to centres.

- Two responses were concerned that the exemplar “Biodiesel” topic may not appeal to female candidates.

QDT Action: It is highly desirable that the topics for Investigative work be selected to appeal to candidates and teachers / lecturers.

LTS Action: A range of Investigation packs are currently being developed by LTS to ensure that centre’s will be able to choose from a diverse range of contexts.

- Some responses indicate concerns about the time required for the Investigative activity proposed for the end of the unit.

QDT Action: Trials indicate that practical work associated with the Biodiesel exemplar investigation can comfortably be completed in less than an hour. Schools who have attempted the proposed investigative activities provide reassuring evidence that they can be completed within the time available.

- A small number of responses indicate concerns over any possibility that the Higher investigative work would follow the same model currently in use in the Advanced Higher course. If each candidate were

required to undertake a unique, twenty-hour investigation, the logistical problems would be overwhelming.

QDT Action: The QDT agree entirely and there is no intention to move towards such a model. The investigative activities associated with this unit should come at the end of a unit where the majority of the twenty hours available has been dedicated to teaching and learning activities associated with the development of chemistry skills. One possible model would be that a class base their investigative work on a single Investigation pack, with pupils working in groups to address one of the investigative challenges provided within the pack. In this way, there would never be more than five activities in use at any time, and all of the activities would be based upon a single theme. Centres are free to use their professional judgement in determining number of support packs, the most appropriate group size and in selecting which of the investigative challenges within the support packs will be used with a particular class.

Assessment

- A significant number of responses indicate that this form of assessment is appropriate and practical.
- Many responses comment that it is appropriate that this unit is ungraded.
- To avoid plagiarism, it was suggested that there should be individual “focus questions” provided for all candidates in the assessment of Outcome One.

QDT Action: The QDT agree and the exemplar pack now contains a bank of 30 focus questions to ensure that every candidate may be assigned a unique focus question in even the largest of Higher Chemistry classes.

- The unit specification taken to engagement requires candidates to identify at least three sources of information. Is this the most appropriate number?

QDT Action: The QDT agree that there should be a clear rationale to support any minimum number of sources specified for this activity. This unit seeks to equip candidates with the skills to be able to research a chemical topic. Information retrieved from a single source may be unreliable, so students should follow best practice in seeking corroboration from another source. For this reason, the QDT recommend that the unit specification be altered to require candidates to identify a minimum of two sources.

- Support was given for the approach which allowed candidates to record their sources in a wide-range of formats.
- Many responses welcomed a team-working approach during the practical phase of the investigation.
- For Outcome 2, the planning and carrying-out of practical work, while some gave unqualified support to the proposed assessment by teacher observation, others highlighted potential difficulties for assessors in deciding whether a candidate has “made an *effective* contribution”.

QDT Action: The QDT share this concern. The Chemistry QDT are working closely with the Physics QDT to reword this Performance Criterion.

- Some responses warned against the time required to allow every pupil in a large class to make an individual oral presentation.

QDT Action: The unit specification allows for a wide range of formats to be adopted for the scientific communication of which the oral presentation is only one. The Guidance on Assessment will advise centres take into account the number of candidates and availability of resources before arriving at the selection of a format.

- A significant number of responses called for clarification on the verification strategy likely to be adopted for this unit.

QDT Action: The SQA are currently considering alternate verification strategies. One option being considered is the newer style of visiting verification recently introduced for Advanced Higher Chemistry.

- A significant number of responses asked for clarification on the procedures to be followed in the event of pupil absence during all or part of the assessment process.

QDT Action: The QDT would anticipate that the absence of at least one candidate during the investigative work is likely to occur in many centres. For this reason the unit specification will allow all three outcomes to be assessed independently. For example, where a candidate has been absent during the experimental phase of the investigative activity, on their return to school it would be permissible for them to demonstrate their communication skills by preparing a laboratory report using the results obtained in their absence. If they complete this task to the required standard they will achieve a pass for Outcome 3. They can then, at a later date, participate in any investigative practical work in order to achieve Outcome 2.