



Qualifications and
Curriculum Authority

Review of standards in chemistry

GCSE 1998 and 2003; A level 1999 and 2003

2005

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Introduction

QCA conducted enquiries into standards over time in 1998 and 1999 in GCSE and in A level chemistry respectively. The results were published in reports that are available on the Qualifications and Curriculum Authority (QCA) website: www.qca.org.uk. Where relevant the key issues identified by these enquiries were considered as part of the work of this review. However as will be clear from this report, the tendency of awarding bodies to follow the national subject criteria very closely during the period covered in this review has meant that many of the major differences noted previously were not found in the current exercise.

By reviewing GCSE and A level syllabuses at the same time, this study also provided the opportunity to consider the issue of progression between GCSE and A level in terms of coverage of topics and the development of skills.

Between them the GCSE syllabuses in this study attracted about 80 per cent of the 49,000 candidates who took GCSE chemistry in 2003. The 2003 A level syllabuses included in this review attracted about 76 per cent of the 35,000 candidates who took A level chemistry.

GCSE chemistry 1998–2003: summary

In general reviewers found relatively little difference in overall demand or any of the individual aspects between 1998 and 2003.

Reviewers felt that:

- the excellent clarity of all specifications and transparency of the assessment processes ensured that centres could be confident of knowing what was expected of teachers and candidates. However this also had the effect of reducing opportunity for the use of everyday examples of chemistry which might be topical news items and thus make the study of chemistry more relevant
- the rationalisation of syllabus material between the foundation and higher tiers made both more appropriate for their target groups
- advice to centres on the use of information and communication technology (ICT) was limited
- the only optional route available (OCR option B) was less challenging than OCR's option A and the other awarding bodies
- examination papers were generally very clear and well structured and written in a language that was accessible to the range of candidates
- the amount of overall examination time across awarding bodies could be further standardised
- the use of just one examination by some awarding bodies to assess candidates at this level may disadvantage some candidates
- although the expectation of mathematical performance had not been changed, candidates' performance was lower in this area in 2003 than in 1998, particularly at grade A
- the opportunity for foundation tier grade C candidates to display mathematical ability or a grasp of real scientific concepts was very limited
- coursework assessment had the potential to overcompensate low examination marks for lower attaining candidates.

A level chemistry 1999–2003: summary

The team concluded that despite major changes to the A level system between 1999 and 2003, there was little difference overall in the demand of chemistry specifications over this period or between awarding bodies. Reviewers judged that in general the standard of candidates' performance had improved at grade A and declined at grade E between 1999 and 2003.

Reviewers felt that:

- the assessment objectives as defined in the specifications were appropriate
- the exceptionally high level of detail of syllabuses and other materials coupled with the transparency of information about examinations and marking of scripts was very helpful to teachers, although they were also likely to reduce flexibility and innovative approaches to teaching
- the reduction in the level of choice available across all awarding bodies meant that there was much less variation in overall demand between and within awarding bodies by 2003
- the use of synoptic assessments made the overall demand of some awarding bodies slightly greater than previously. However many questions in the synoptic papers failed to require candidates to synthesise information, knowledge and skills from across the syllabus
- the requirements for mathematics and use of English did not significantly change over the period of the review
- the complexity of the criteria for the delivery and assessment of coursework were not fully understood and applied by all centres, based on the sample of coursework seen from 1999 and 2003
- the potential for candidates with low examination marks to be compensated by higher coursework marks could mean that CCEA and AQA with their lower coursework weightings were slightly more demanding.

GCSE chemistry 1998–2003

Key issues identified in 1998 review of standards

Issues raised in the previous report included:

- With the exception of CCEA (which omitted earth science), all awarding bodies in 1998 had common core content and assessment objectives, although there were variations in the extension materials.
- Changes in the assessment weighting of the extension material in 1998 from the previous 35 per cent to 25 per cent was seen as a lowering of demand in the more difficult aspects of chemistry such as quantitative work (calculations) and balancing of chemical equations.
- A reduction in the number of tiers from three in 1995 to two in 1998 was judged to have reduced the capacity to match the demand of the papers to candidates' abilities.
- In 1998 the higher tier papers from all awarding bodies had a similar proportion of calculations but the assessment of understanding of chemical equations was variable and in some cases considered rather low.
- Targeting of foundation tier questions was not always sufficiently precise to allow candidates to demonstrate the range of knowledge and skills expected at grade C.
- Reviewers noted some variation and generosity in the marking of coursework.

Key changes 1998–2003

Changes between 1998 and 2003 included the following:

- All awarding bodies further clarified their specifications, including the criteria for delivery and assessment of coursework.
- Assessment objectives were more clearly delineated between knowledge/understanding and application/evaluation.
- All awarding bodies except CCEA reduced the weighting for coursework from 25 per cent to 20 per cent.
- The subject content across all awarding bodies was very similar, the only exception being OCR that offered a distinctive optional route.
- Opportunities for the use of English, ICT skills and mathematics were more clearly stated.
- Some examiners' reports in 2003 commented on gaps in the mathematical ability of candidates.
- Even the limited amount of choice of examination questions in 1998 had disappeared in 2003.

Examination demand

Materials available

Reviewers considered the syllabus documents, examiners' reports and question papers with associated mark schemes from each of the five awarding bodies in 1998 and 2003. Details of the syllabuses included in the review are given in appendix A.

Assessment objectives

In 1998 assessment objectives were very similar across awarding bodies and by 2003 they were identical, in line with the revised GCSE criteria and more clearly specified. In 2003 all awarding bodies reduced the weighting for practical work to 20 per cent (the minimum required by the GCSE criteria for science), except CCEA that continued to allocate 25 per cent.

The major change in assessment objectives for 2003 was the clearer separation between knowledge and understanding and aspects of application and evaluation. In 1998 experimental and investigative work was weighted at 25 per cent, knowledge, understanding and application at 60 per cent and communication and evaluation at 15 per cent (the latter usually split evenly between communication and evaluation). By 2003 knowledge and understanding was weighted between 45 to 55 per cent and application and evaluation weighted between 25 to 35 per cent.

There was some attempt to broaden the scope of the coursework in 2003 by including more non-laboratory-based activities, though the effect of this on the candidates' overall experience could not be judged from the documentation.

Reviewers did not consider that the slight differences in assessment objectives between awarding bodies in 1998 or the changes between 1998 and 2003 significantly altered the demand of the individual assessments.

Syllabus content

In 1998 there was slight variation in content between the awarding bodies at foundation tier and also in the extension materials. By 2003 all awarding bodies had formally removed key stage 3 material and further refined their specifications. As a result of this, and through the effect of the GCSE criteria for science, both the

breadth and depth of content were very similar across the awarding bodies by 2003 and the variation in extension materials had become negligible.

All awarding bodies produced clearer, more detailed specifications in 2003, though even in 1998 most syllabuses read much like a textbook or a set of teaching or briefing notes. Reviewers felt that this had the advantage of ensuring that centres were fully aware of the syllabus coverage required but it left very little or no flexibility for them to include issues of the day that become important news/media stories and could give more relevance to the subject. It was also felt that the detail contained in the teaching notes should make the curriculum easier to deliver by non-specialist teachers.

Between 1998 and 2003 most awarding bodies made some minor changes to the content of extension materials, for example removing some aspects of geology (AQA), adding some biotechnology (for example AQA and WJEC), organic chemistry (Edexcel), social or environmental issues (for example CCEA and WJEC inclusion of the social effects of alcoholic beverages) and reducing the content of the foundation tier (WJEC). Overall the changes, including those relating to economic, social and environmental aspects of chemistry, were considered by reviewers to be relatively minor. There was one exception in that OCR had introduced an alternative to their second paper, which covered significantly different material from the mainstream content. (See the “Options” section, below.)

Where material in the 2003 specification had been re-assigned between the foundation and higher tiers, reviewers believed it had made the content of both tiers more appropriate than had been the case in 1998.

English, ICT, mathematics

All 1998 specifications contained minor references to the use of English, ICT and other key skills. In 2003 these were expanded in the form of ‘opportunities for teaching’. For ICT this meant that the 2003 specifications explicitly outlined areas in which the use of ICT might be appropriate, instead of a common statement of the expectation that judgement should be applied as to when to use ICT. Such advice appeared to reviewers to be relatively limiting and mainly directed to candidates accessing information and using ICT in the composition and presentation of their coursework.

In both years all awarding bodies gave clear information on the mathematical requirements of candidates. The description in the specifications suggested that there was little difference between awarding bodies and no significant change between 1998 and 2003.

Scheme of assessment

All awarding bodies examined the foundation and higher tiers by separate examination papers. Papers generally consisted of structured, short-answer questions with very little use of multiple-choice/multiple-response questions in 1998 and even less in 2003. The papers were normally well thought out with clear rubrics so that candidates should have been well aware of what was expected of them.

The number and length of examinations are summarised in table 1.

In both years AQA and WJEC used just one examination paper for each tier. At higher tier the highest total time for the examinations was more than 50 per cent greater than those with the lowest time allocation. There were only very small changes to the times allowed between 1998 and 2003. No awarding body changed the number of question papers over the period. The slight changes to the time allocations were not thought by reviewers to have affected the demand over time.

However there were concerns about the different schemes of assessment used by AQA and WJEC compared to the other three awarding bodies. The use of a single paper by AQA and WJEC was considered to create a particular challenge to candidates especially at foundation tier. The issue was not whether the single long paper was more or less demanding than the shorter paper totalling more time overall. Rather it was that the single assessment opportunity was felt to be inherently less reliable. In particular candidates would not have the opportunity to compensate for a poor performance in one paper by a better one in the second. It was noted that awareness of this would put added pressure on candidates.

Table 1: number of GCSE examination papers and time allocated

	AQA		CCEA		Edexcel		OCR		WJEC	
	FT	HT	FT	HT	FT	HT	FT	HT	FT	HT
1998 no. of papers	1	1	2	2	2	2	2	2	1	1
2003 no. of papers	1	1	2	2	2	2	2	2	1	1
1998 time/mins	120	135	60+90 =150	90+120 =210	90+60 =150	90+60 =150	90+45 =135	105+60 =165	120	150
2003 time/mins	135	135	60+90 =150	90+120 =210	90+60 =150	90+60 =150	90+45 =135	90+45 =135	120	150

Use of English, ICT, mathematics

In 2003 all awarding bodies included questions in the written papers that incorporated marks for the assessment of the quality of written communication, but the mark allocation was very small and variable. Thus in 2003 the CCEA foundation tier paper 1 allocated two marks out of 76 and paper 2 allocated two marks out of 110. The higher tier paper 1 had two marks out of 114 and paper 2, two marks out of 160. WJEC allocated even fewer marks, with one mark out of 120 on the foundation tier paper and one mark out of 150 at higher tier.

The number of marks allocated to calculations varied across awarding bodies, years and tiers. In 1998, apart from WJEC, where no calculations were required of candidates, foundation tier papers generally had about 4 to 5 per cent of their marks allocated to such questions. In 2003 about 10 per cent of marks were allocated to calculations at foundation tier. There were more significant variations at higher tier with for example, the CCEA weighting reducing from 16 per cent in 1998 to 12 per cent in 2003, WJEC increasing from 6 to 8 per cent and AQA from 13 to 19 per cent.

Some examiners' reports commented upon candidates' poor mathematical skills in 2003. However reviewers judged that foundation tier papers were very limited in testing numeracy and devoid of any real application of mathematics and so offered candidates limited opportunities to demonstrate mathematical ability. In fact it was considered that the nature of the examination for the foundation tier was such that candidates at the grade C boundary had almost no opportunity to display their mathematical ability.

This was supported by evidence seen when reviewing candidates' work. Reviewers noted some obvious differences between the assessments and assessed work of candidates between the grade C boundary for foundation and higher tiers. In both cases candidates demonstrated some ability to select, organise and present

information and displayed some developing skills in the application of scientific principles. However the nature of the foundation tier papers meant that candidates who achieved relatively high marks were only required to display very limited mathematical skills and little evidence of any engagement with 'real' science. For example only at higher tier was there a test of the ability to write chemical equations. Reviewers also noted that at higher tier the proportion of marks allocated to certain important aspects of chemistry varied significantly between awarding bodies. For example CCEA allocated 28 marks out of 160 for equations, WJEC only seven out of 150.

There were no assessments that related directly to the use or application of ICT.

Options

The only awarding body to make a major change in the availability of options in the period under review was OCR whose 2003 syllabus offered candidates a choice of two routes – option A and option B. The latter was oriented towards the more environmental and social aspects of chemistry. The syllabus for this option was superficially more sophisticated, having the potential to include some very challenging chemistry. However in the opinion of the reviewers the content of the assessment instruments available suggested that this was not being achieved and there was doubt as to whether the candidates taking option B were being given as good a grounding in chemistry as those in option A.

Question papers

Apart from the choice of tiers and the alternative 2003 OCR paper there was very little choice available to candidates. In 1998 WJEC had one question in which three parts out of four had to be answered. Other forms of 'choice' existed where alternative answers could be given. For example a question about the preparation of alcohol gave candidates a choice of describing a route from ethene or by fermentation. The only other sense in which candidates had any element of 'choice' occurred where the number of possible responses was more than the number required in a question. Question papers had several examples of this, the most extreme being in the 1998 Edexcel paper which asked for two statements to describe what happens when sodium is added to water. There were six possible and not particularly 'chemical' answers of which candidates only needed to supply two. Such a wide set of possible responses inevitably eases the demand of such a question.

Tiering

All awarding bodies covered common material in the foundation and higher tier examination papers, usually by use of common questions. In terms of making questions accessible to the full range of candidates the best of these made a point of altering the language used in questions testing common content to ensure they were fully accessible to foundation tier candidates. However reviewers felt that as a method of providing a transparent comparison of difficulty between tiers and between awards (for example single chemistry and the content of the double award) it might be more appropriate to use identical wording in the common questions even if this meant using some foundation tier language in higher tier examination papers.

Coursework

The criteria for coursework assessment were detailed, making the tasks required by centres very clear, if rather onerous. Reviewers expressed some concern about the potential effect of these very structured requirements on the range of experiments carried out in centres. The repetition of the same limited number of experiments and the instruction that centres report on a candidate's best performance in coursework in

each assessed skill are likely to have the effect of ensuring relatively high marks for many candidates in this element of assessment.

The review of candidates' performance confirmed this effect at grade C, with candidates receiving higher marks in coursework than in the written papers. The evidence suggested that marks achieved in coursework sometimes overestimated candidates' understanding of the subject as evidenced by their performance on the written papers.

Standards of performance

Materials available

Reviewers considered GCSE candidate work from all the awarding bodies from 1998 and 2003. Details of the materials used are provided in appendix B. It should be noted that coursework from 1998 was unavailable, which might have affected reviewers' judgements of candidate performance.

Performance descriptors

Reviewers were asked to identify key features of candidates' performance based on the work seen at each key grade boundary. Performance descriptors for each grade boundary were drawn up, focusing on the assessment objectives, as well as allowing for additional features of performance.

Standards of performance at GCSE grade A

GCSE grade A performance descriptor

Candidates could:

- recall and show understanding across much, but not all, of the specification content
- apply knowledge and understanding to explain some phenomena (not always using rigorous scientific terminology)
- interpret and translate data and handle calculations
- apply principles and concepts in some unfamiliar situations
- often handle formulae, graphs and balance equations (including ionic equations)
- usually sequence their ideas in a question requiring the use of prose.

Performance at the GCSE grade A boundary

Generally reviewers judged that performance was slightly better in 1998 than in 2003, particularly in the area of mathematical skills. The exception was CCEA where candidates were better on atomic structure and calculations.

Across awarding bodies there were few differences although OCR candidates seemed less secure on the application of knowledge and understanding and analysis and evaluation than those from the other awarding bodies.

Standards of performance at GCSE grade C

GCSE grade C performance descriptor

Candidates could:

- recall and show understanding of some of the course specification
- apply some knowledge and understanding to explain some phenomena (without necessarily using rigorous scientific terminology)
- interpret and translate some data and carry out some calculations correctly (although foundation tier papers often did not provide sufficient opportunity for candidates to demonstrate this)

- apply principles and concepts in a few unfamiliar situations
- make attempts to outline a plan for an investigation
- interpret and explain some experimental data and make some measurements.

Performance at the GCSE grade C boundary

Standards appeared to be very similar in 1998 and 2003 at both higher and foundation tier.

Standards across awarding bodies were very similar with the exception of Edexcel at higher tier where knowledge and understanding of key chemical concepts was sometimes weak.

Reviewers were concerned that question papers did not provide foundation tier candidates with sufficient opportunity to demonstrate appropriate mathematical skills at this grade boundary or to show proper evidence of engagement with 'real' science.

Standards of performance at GCSE grade F

GCSE grade F performance descriptor

Candidates could:

- recall some simple facts (such as the basic structure of the atom)
- display a shallow understanding of science
- occasionally apply some knowledge to explain phenomena and interpret or translate some concepts (for example by processing some simple data given to them or extracting basic information from a given passage or list of possible answers)
- follow instructions, carry out some practical work and make some measurements.

Performance at the GCSE grade F boundary

There was little evidence upon which to base judgements of standards over time although the WJEC candidates from 2003 seemed a little more secure.

There were no clear differences in performance between the awarding bodies at this grade boundary.

A level chemistry 1999–2003

Key issues identified in 1999 review of standards

Issues raised in the previous report included:

- an increase in the number of papers between 1995–99, though because the syllabus was being examined in smaller sections this was not believed to have increased the overall difficulty
- variation in subject content, (for example the requirement in one awarding body to study only one group in the periodic table)
- a significant variation in types of questions in 1999 compared with 1995 as awarding bodies adjusted to the consequences of modularisation of the syllabus but with a marked reduction in the choice of questions. While this was considered to have had no effect on demand, the increase in the structuring of questions was believed to be more than balanced by a reduction in choice, increasing overall demand slightly in 1999 compared with 1995

- variation in the balance of skills being assessed (for example one awarding body over-emphasising recall and variations in the approach to synoptic assessment) leading to real differences in demand between awarding bodies.

Key changes 1999–2003

One major issue that affected all A level specifications between 1999 and 2003 was the move to unitised assessment based on a six-unit structure, in line with the Curriculum 2000 A level criteria. The overall assessment of the A level qualification was split into the first half, advanced subsidiary (AS) and the second half, A2. The AS and A2 sections of the course were each assessed by three units, making six units for the A level overall. The level of demand of the AS qualification was reduced from the former advanced supplementary qualification, to allow a smoother transition for students moving from GCSE to A level and to allow the new AS to stand as a 'broadening' qualification in its own right.

Chemistry specifications in 2003 conformed to the Curriculum 2000 criteria. Those from 1999 were based on existing subject cores that tended to cover content but not structure. This adherence to national criteria meant that over the period covered by this study awarding bodies moved towards very similar expectations in terms of assessment as well as content.

Changes between 1999 and 2003 included:

- By 2003 all awarding bodies had six examinations (excluding optional examinations in place of coursework), this being an increase for CCEA, OCR and WJEC.
- There was some transfer of the more demanding material from AS to A2.
- All awarding bodies moved to having synoptic examinations in line with the Curriculum 2000 criteria.
- Awarding bodies moved to having very similar percentage allocations for the assessment objectives (though the weighting for coursework was 12.5 per cent for AQA and 6.7 per cent for CCEA, compared with 20 per cent for other awarding bodies).
- All syllabuses and other documents were revised and made even clearer and definitive. There was also a significant increase in the amount of support materials, such as CD-ROMs, online support and linked textbooks.
- Examination papers were even more carefully written and detailed.
- Such curriculum choice as existed in 1999 disappeared by 2003 except for a small option in one awarding body (OCR) amounting to only 7.5 per cent of the syllabus.
- Any choice within examination papers was eliminated by 2003.

Examination demand

Materials available

Reviewers considered the syllabus documents, question papers and associated mark schemes from each of the awarding bodies in 1999 and 2003. Details of the syllabuses included in this review are given in appendix A.

Assessment objectives

In 1999 awarding bodies presented assessment objectives in slightly different ways, although the overall weightings, which separated knowledge and understanding from application, fell within very similar ranges. For example 'knowledge and understanding/application' and 'analysis, evaluation' were also presented as 'knowledge/comprehension/analysis, evaluation and synthesis'. In 1999 all awarding

bodies allocated 20 per cent for experimental and investigative skills measured by coursework, except OCR (16.7 per cent). By 2003 assessment objectives were the same across awarding bodies, in line with the Curriculum 2000 criteria. In 2003 coursework weightings varied from 6.7 per cent (CCEA) and 12.5 per cent (AQA) to 20 per cent for the other awarding bodies. Given the tendency for lower examination achievers to obtain quite high marks in coursework, reviewers judged that this could have meant that CCEA and AQA were marginally harder at least for lower ability candidates.

A notable change between 1999 and 2003 was the additional emphasis given by all awarding bodies to a synoptic element. This required candidates to bring together knowledge, principles and concepts (including those from experimental and investigative exercises) and apply them in particular contexts. Reviewers considered that in most cases the synoptic papers did not require candidates to synthesise information, knowledge and skills from the whole syllabus to answer individual questions. Some of the better examples of individual questions, which at least demanded knowledge from a range of different modules, were found in multiple-choice/multiple-response questions. Reviewers judged that the lack of synthesis did not necessarily detract significantly from the level of challenge of such papers, as the fact that they could cover the full range of the syllabus content was in itself demanding of candidates.

Reviewers were broadly satisfied that the assessment objectives for both AS and A2 were appropriate. The inclusion of the synoptic assessment meant a marginal increase in demand for some awarding bodies between 1999 and 2003.

Syllabus content

Changes in the overall content of syllabuses for each awarding body between 1999 and 2003 were relatively limited but all awarding bodies made some adjustments to remove some of the more demanding aspects from the AS syllabus, in line with the Curriculum 2000 criteria.

Most syllabuses, which were already very detailed in 1999, were further revised by 2003. This ensured that there could hardly be any misinterpretation of the expectations of each awarding body. Indeed there was a description of what did *not* need to be covered (for example Edexcel). While such attention to detail is in one sense good practice, it means that syllabuses come close to defining the content of teaching notes, reducing the flexibility of teachers to develop innovative approaches or engage candidates in those aspects of chemistry that may from time to time occur in topical news items. Since the syllabus sets the boundary for the assessment instruments, and mark schemes are now available to teachers and candidates, and marked scripts can be seen by centres, reviewers judged that the expectations of examiners had become clearer over time which is very helpful for informing teaching.

A further element of detail that increased noticeably in 2003 was the listing of linked textbooks, CD-ROMs and online support. Reviewers found that these, combined with other aspects mentioned above, increase the potential to ensure that teaching becomes ever more focused upon the very tightly defined curriculum and assessment expectations that could increase candidates' likelihood of success in examinations.

Scheme of assessment

The number of examinations and time allocated to them are summarised in table 2.

Table 2: number of papers and time allocation AS/A2

	AQA	CCEA	Edexcel	OCR	WJEC
1999 no. of papers	6	4	6	5 + either coursework or practical examination	5
1999 time/mins	540	360	520	450 or 600 for practical option	400
2003 no. of papers	6 + either coursework or practical x 2	5 + compulsory practical exam + compulsory coursework	6 + either coursework or practical x 2	6 + either coursework or practical x 2	6 + either coursework or practical x 2
2003 time/mins	*450 or 570 or 690	570	450 or 555 or 660	390 or 480 or 570	*495

*First figure is for candidates who opt for two coursework options, second for candidates doing one practical and one coursework option and third figure for candidates choosing two practical options. WJEC did not specify a time limit for the two practical options. This time should be compared with the first figure supplied for AQA, Edexcel and OCR.

CCEA did not offer the optional routes provided by the other awarding bodies. All candidates had to do a 150-minute practical exam and coursework. Candidates therefore did one fewer written paper than for the other awarding bodies.

The table shows that by 2003 all awarding bodies had the same total number of examinations for AS and A2. The total time allocated for examinations varied in 1999 from 360 minutes for CCEA to 540 minutes for AQA. In 2003 the figures ranged from 390 minutes for OCR to 570 minutes for CCEA. However CCEA was the only awarding body with a compulsory practical examination lasting 150 minutes. Reviewers considered the difference of three hours excessive in terms of the additional strain it may put on candidates.

The varied structures adopted by the awarding bodies in 2003 make it difficult to draw firm conclusions as to the comparability of the schemes of assessment. It seems likely that the differences created by the optional routes within an awarding body are as great as those across them. What is clear however is that the figures for 2003 are much more similar than in 1999, with CCEA and WJEC having come more into line by significantly increasing examining time.

In 1999 only two awarding bodies (Edexcel and WJEC) had papers that were defined as synoptic but by 2003 all awarding bodies required candidates to sit an A2 synoptic unit, in line with the Curriculum 2000 criteria.

Options

In 1999 while all syllabuses covered a common core of material, the choice available beyond the core for some awarding bodies meant that there was some potential variation in the overall content. For example in addition to compulsory cores AQA gave a choice of three from six modules, CCEA one from 10 potential options and OCR two from eight. By 2003 the only awarding body offering any choice of content

was OCR and this amounted to only 7.5 per cent of the whole A level syllabus. Reviewers were concerned by the variation in demand of the different optional modules in the 1999 AQA syllabus and so the reduction in options was seen as ensuring a much greater consistency of demand both within and across awarding bodies, making the examinations fairer to all candidates.

Reviewers considered that the reduction in the extent of options between 1999 and 2003 reduced the depth of demand previously achieved within the options offered by AQA and CCEA. However this was balanced by the fact that the breadth of the core syllabus had increased.

In 1999 some of the examination papers still allowed candidates a small element of choice of questions (for example AQA in the third and last section of the second paper set for the linear A level route; Edexcel in the equivalent of the synoptic paper and within one section of OCR papers). By 2003 none of the awarding bodies offered any choice of questions on any paper.

In 2003 all awarding bodies except CCEA offered a choice between a practical examination and coursework on one AS and one A2 unit – a choice made usually by teachers rather than candidates. Candidates taking coursework would have had a degree of choice over the content.

Question papers

Generally all papers and marking schemes in 1999 were clear and detailed but had been made even more explicit by 2003. Reviewers felt that questions had been written in ways that made them accessible to all candidates. Marking schemes for centre-based activities were considered to be helpful, though their detail and complexity demanded considerable attention from staff in centres. Although there is a need to have clear criteria for the centre-based assessment of coursework, reviewers questioned whether the level of detail was fully understood and applied by all those involved in the delivery and internal marking of coursework, based on evidence seen at the script review.

Reviewers judged that the extent to which all awarding bodies now follow the national subject criteria and have created such detailed specifications, and examination papers, with substantial supporting materials and detailed published marking schemes means that there can be no area where centres can be unclear about what needs to be included in the course to prepare candidates for assessment. Reviewers considered that this means that the assessment instruments have tended to become narrower which, combined with the very full specifications, may mean that centres will concentrate on delivery of the specification, relating it heavily to the anticipated assessment and giving candidates a narrower learning experience.

AS level examinations in 2003 were considered by reviewers to be, as intended, more accessible in their style and construction than the former (1999) A level papers. Many aspects of A2 examination papers were considered similar in accessibility to the 1999 A level papers but there were some aspects deliberately of a higher demand, to balance with the lower demand of the AS papers. Reviewers considered the expectations of the 2003 AS papers to be appropriate for their intended level and candidature.

Awarding bodies had a variety of approaches to synoptic assessment in 2003. Some tended to set individual questions from different parts of the whole specification thus requiring students to know something from a wide range of material to obtain a high grade. Others tried to pull together chemistry from at least two units. At the extreme,

this type of question can be highly demanding (and also very difficult to set at an appropriate level). Reviewers felt that the synoptic papers did create a different and greater demand on candidates than the other papers, which perhaps helps to balance out the issue of teaching to the syllabus and assessment instruments mentioned earlier. Nevertheless reviewers were satisfied that there was a clear incline of difficulty from AS to A2 with AS questions being more obviously structured and requiring more straightforward answers while A2 expected some strategy to be applied by candidates to some answers.

Reviewers felt that mathematical demand and requirements for the use of English had not changed significantly between 1999 and 2003.

Coursework

In 1999 only Edexcel offered an externally set and marked practical test as an alternative to centre-based coursework. By 2003 all awarding bodies were doing so except CCEA, which required all candidates to do coursework (worth just 6.7 per cent of the overall A level marks) as well as a compulsory practical examination.

Standards of performance

Materials available

A2 scripts from 2003 were compared with A level scripts from 1999. AS scripts from 2003 were compared across awarding bodies but not with 1999 A level scripts as the advanced subsidiary is a new qualification. No materials were available for WJEC at A level grade E in 1999.

Further details of the materials used are provided in appendix B.

Performance descriptors

Reviewers were asked to identify key features of candidates' performance based on the work seen at each key grade boundary. Performance descriptors for each grade boundary were drawn up, focusing on the assessment objectives, as well as allowing for additional features of performance.

Standards of performance at GCE AS level grade A

GCE AS level grade A performance descriptor

Candidates could:

- recall and show understanding of the specification with relatively few omissions
- apply knowledge and understanding to explain phenomena
- interpret and translate data and carry out calculations even when minimal guidance or structure was given
- apply chemical principles and concepts in unfamiliar situations
- devise and plan experimental work with some level of logic and interpret and evaluate the results clearly
- demonstrate practical skills in a safe and competent manner
- make correct observations and measurements with appropriate precision
- often handle, for example formulae, balance equations (including ionic equations), graphs
- usually use technical language correctly.

Performance at GCE AS level grade A boundary

The standard of performance was broadly comparable across awarding bodies at this grade boundary.

Standards of performance at GCE AS level grade E

GCE AS level grade E performance descriptor

Candidates could:

- recall and show understanding of some of the specification content
- apply knowledge and understanding to explain some phenomena
- interpret and translate some data and carry out some calculations when guidance or structure was given
- occasionally apply some chemical principles and concepts in unfamiliar situations
- make some attempt to outline a plan for an experiment and attempt to interpret and explain some experimental results
- demonstrate some practical skills safely
- use correct technical language only in a limited way.

Performance at GCE AS level grade E boundary

The standard of performance was broadly comparable across awarding bodies at this grade boundary. Reviewers noted that the quality of work seen in coursework components was rather higher than that shown by candidates under examination conditions.

Standards of performance at GCE A level grade A

GCE A level grade A performance descriptor

Candidates demonstrated the following in the context of more demanding and wide-ranging subject content than at AS.

Candidates could:

- recall and show understanding of the specification with relatively few omissions
- apply knowledge and understanding to explain phenomena
- interpret and translate data and carry out calculations even when minimal guidance or structure was given
- apply chemical principles and concepts in unfamiliar situations
- devise and plan experimental work with some level of logic and interpret and evaluate the results clearly
- demonstrate practical skills in a safe and competent manner
- make correct observations and measurements with appropriate precision
- often handle formulae, balance equations (including ionic equations) and graphs
- demonstrate an ability to bring together knowledge including that required by synoptic questions where this was tested
- usually use technical language correctly.

Performance at GCE A level grade A boundary

With the exception of CCEA, performance was judged to have improved slightly between 1999 and 2003. This was especially true for AQA and OCR, whose candidates demonstrated stronger performance in particular on AO2 and AO4 in 2003. Reviewers judged that the greater emphasis on the synoptic element had produced better performance in 2003. The CCEA work from 2003 was felt to be weaker than that from 1999. Reviewers found that CCEA candidates in 2003 were less secure on AO4, the synthesis of knowledge, understanding and skills. They also

demonstrated weaker chemical knowledge, less depth of understanding and were less competent at equations.

Across awarding bodies, performance in 2003 was judged to be broadly similar, with the exception of CCEA, whose candidates demonstrated some fairly basic weaknesses in terms of chemical knowledge and understanding and their ability to apply these. Reviewers also commented on weaker performance on calculations and equations by CCEA candidates at this grade boundary in 2003.

Standards of performance at GCE A level grade E

GCE A level grade E performance descriptor

Candidates could:

- recall and show understanding of some of the specification content
- apply knowledge and understanding to explain some phenomena
- interpret and translate some data and carry out some calculations when guidance or structure was given
- occasionally apply some chemical principles and concepts in unfamiliar situations
- make some attempt to outline a plan for an experiment and attempt to interpret and explain some experimental results
- demonstrate some practical skills safely
- make some attempts to bring together some knowledge and concepts from different areas of the specification and apply these in some given contexts
- use correct technical language only in a limited way.

Performance at GCE A level grade E boundary

Performance in 1999 was generally found to be better than in 2003 at this grade boundary. This was particularly marked for AQA, where reviewers commented that 1999 candidates demonstrated better performance in all areas except experiment and investigation.

Across awarding bodies, Edexcel candidates were judged to demonstrate a higher standard of performance in all areas. Reviewers commented that the accessibility of the Edexcel question papers meant that candidates at this grade boundary had sufficient opportunity to demonstrate their knowledge, understanding and skills.

The work of only one CCEA candidate for 2003 was available. This candidate was generally judged to be below the standard expected at grade E.

Relationship between GCSE and A level chemistry

Reviewers felt that the knowledge and skills that candidates developed in coursework at GCSE would not be very helpful in preparing students for advanced level experiment and investigation. There were also grave doubts as to whether a grade C overall was sufficient preparation for AS chemistry. The recognition that many candidates taking the foundation tier also had limited mathematical and communication abilities added to this concern. Notwithstanding these reservations almost all GCSE material was seen as useful for progression, particularly atomic theory, structure and bonding, the periodic table, writing equations and appreciating chemical change.

Within the AS syllabus areas not considered to be helpful in promoting progression to A2 included various extension material and specific examples such as Brownian motion, colloids, structures of carbohydrate and the description of rust. Reviewers also questioned whether sufficient attention was paid to calculations and the

opportunity for exercises in balancing equations in the AS specification for it to act as a foundation for A2 study.

Overall in spite of these reservations reviewers agreed that the way in which the specifications are set out, where basic issues (for example structure and bonding) are presented at GCSE, then presented and extended at both AS and A2, form an appropriate linear progression and is supportive of candidates who move through the three phases of study to A2.

Appendix A: specifications used in the syllabus review**GCSE**

Year	Awarding body and specification code				
	AQA	CCEA	Edexcel	OCR	WJEC
1998	4174	G14	1036	1781	0125
2003	3421	G14	1530	1981	0125

AS/A level

Year	Awarding body and specification code				
	AQA	CCEA	Edexcel	OCR	WJEC
1999	4174	A14	9081	9535	0009
2003	6421	1110	9080	7882	6090

Appendix B: number of scripts used for review**GCSE 1998/2003**

	AQA 98 03		CCEA 98 03		Edexcel 98 03		OCR 98 03		WJEC 98 03	
A	13	15	5	15	15	12	12	12	15	15
C (Higher tier)	12	11	5	7	14	15	12	14	10	15
C (Foundation tier)	12	15	5	6	15	13	12	11	10	15
F		12		1		2			3	4

A level 1999/2003

	Unit 1 99 03		Unit 2 99 03		Unit 3 99 03		Unit 4 99 03		Unit 5 99 03		Unit 6 99 03	
AQA												
A	15	15	15	15	15	15	15	15	15	15	15	15
E	15	15	15	15	15	15	15	15	15	15	15	15
CCEA												
A	15	11	15	11	15	11	15	10	15	10	15	10
E	11	5	11	5	11	5	11	1	11	1	11	1
Edexcel												
A	15	13	15	13	15	13	15	15	15	15	15	15
E	15	11	15	11	15	11	15	12	15	12	15	12
OCR												
A	15	14	15	14	15	14	15	10	15	10	15	10
E	15	7	15	7	15	7	15	4	15	4	15	4
WJEC												
A	9	15	9	15	9	15	9	15	9	15	9	15
E		15		15		15		15		15		15

Appendix C: list of reviewers

Review team	
Coordinator	Ian Haines
Syllabus reviewers	Sheila Carroll Stewart Chambers Ian Hotchkiss Valerie Simpson Ray Vincent Yvonne Walls
Script reviewers	Lucy Boulton Smith David Cox Margaret Cross Marilyn Gould Ian Lodge Colin Chambers David Nicholls Barrie Crowther John Apsey David Swann David Berrington Philip J Hills Phil Barratt David Ward John Payne