

# **Review of Standards in GCSE Mathematics**

2004 and 2008



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# Contents

|   |    |
|---|----|
| Executive summary .....                                       | 3  |
| Findings .....  | 3  |
| Section 1: Introduction .....                                 | 4  |
| Context.....  | 4  |
| Methodology .....   | 5  |
| Provision of assessment materials and student work .....      | 5  |
| The review team.....  | 6  |
| Analysis of the specifications and assessment materials ..... | 7  |
| Analysis of student performance .....                         | 7  |
| Section 2: Subject demand in GCSE mathematics.....            | 8  |
| Overview .....  | 8  |
| Findings .....  | 10 |
| Assessment objectives .....                                   | 10 |
| Specification content .....                                   | 10 |
| Schemes of assessment .....                                   | 10 |
| Time demand .....   | 11 |
| The effects of the increased move towards modularity.....     | 11 |
| Options.....  | 12 |
| Question papers .....   | 13 |
| Allocations of grades to questions.....                       | 14 |
| Percentage allocation of questions.....                       | 15 |
| Grade boundaries.....   | 15 |
| Tiering .....   | 16 |

|  |    |
|--|----|
| Coursework .....   | 16 |
| Section 3: Standards of performance .....  | 18 |
| Overview .....   | 18 |
| Findings.....  | 18 |
| Recommendations .....  | 18 |
| Appendix A: Provision of assessment materials and student work at GCSE and GCE levels for Ofqual’s archive (annual inclusion and standards reviews)..... | 20 |
| Section 1: Specification of requirements .....   | 20 |
| Section 2: Student work .....  | 21 |
| Appendix B: Schemes of assessment .....  | 22 |
| Appendix C: Assessment objectives.....   | 25 |
| Appendix D: GCSE specifications reviewed .....   | 27 |
| Appendix E: GCSE scripts reviewed .....  | 28 |
| Appendix F: Availability of specification materials for the purposes of this review....  | 29 |
| Appendix G: Student achievement by grade .....   | 30 |
| Appendix H: Review team .....  | 31 |

## **Executive summary**

The Office of Qualifications and Examinations Regulation (Ofqual) undertakes a rolling programme of reviews across high-profile GCSE and GCE A level subjects to monitor whether standards in assessment and student performance have been maintained over time.

This report details the findings for GCSE mathematics in the years 2004 and 2008. The previous review for this subject compared the years 1999 and 2004. The findings were published in a report in 2006, which is available on our website at [www.ofqual.gov.uk/files/qca-06-2346-mathematics-gcse-a-level.pdf](http://www.ofqual.gov.uk/files/qca-06-2346-mathematics-gcse-a-level.pdf).

The study compared subject specifications, assessment materials and student work from the five organisations awarding this qualification in the years being reviewed (AQA, CCEA, Edexcel, OCR and WJEC) by collecting the views of a number of subject specialists.

## **Findings**

- The major change that affected all GCSE mathematics examinations between 2004 and 2008 was a move from a three-tier examination system of foundation, intermediate and higher tiers to a two-tier system, comprising foundation and higher only. These changes had a significant effect on the demand of the examination by changing the balance of questions focused on each grade.
- The spread of grades to be covered in each tier increased and in some awarding organisations this resulted in a rise of structuring within questions. In addition question design showed an increasing trend towards structuring of questions. Both factors made examinations less demanding over time.
- The increasing numbers of centres entering students for specifications with modular examinations highlighted a mixed effect on demand. OCR's modular assessment design minimised the effect of the changes and allowed standards to be maintained over time, whereas AQA's modular design (also available in 2004) fragmented the assessment and increased structuring in questions, making the examinations less demanding.
- The layout of question papers, the language used and the clarity of graphs and diagrams had all improved over the time period reviewed, providing a better quality assessment in mathematics.

## **Section 1: Introduction**

### **Context**

In his Review of Qualifications for 16–19 Year Olds (1996), Lord Dearing made several recommendations to ensure that “there is a basis and accepted procedure... for monitoring and safeguarding standards over time”. In the same year, the School Curriculum and Assessment Authority (SCAA), one of our predecessors, and the Office for Standards in Education, Children’s Services and Skills (Ofsted) jointly recommended that there should be:

a rolling programme of reviews on a five-year cycle to ensure examination demands and grade standards are being maintained in all major subjects. (Standards in Public Examinations 1975 to 1995, page 4, 1996)

As a result of these recommendations we, in collaboration with the Welsh Government and the regulator in Northern Ireland (Council for the Curriculum, Examinations and Assessment (CCEA)), introduced a programme to investigate standards in GCE A level and GCSE examinations by systematically collecting and retaining assessment materials and student work to enable standards reviews to cover two or more years.

The Apprenticeships, Skills, Children and Learning Act 2009 formalised our role in undertaking such reviews by including a statutory objective “to secure that regulated qualifications indicate a consistent level of attainment (including over time)”.

We report on our work in meeting this objective. And we use our findings to inform developments in qualification and subject criteria to support meeting this objective in the future. In our reviews we:

- analyse the nature of the requirements that different assessments make on students
- compare the levels of performance required for a particular grade in different assessments
- consider how these two elements relate to each other.

In 2004 there were 743, 899 students taking the GCSE mathematics specifications being reviewed. In 2008 the number was 743,833. A detailed breakdown of student-entry numbers and cumulative percentage pass rates can be found in [Appendix G](#).

Our immediate predecessor, the Qualifications and Curriculum Authority (QCA), most recently conducted a standards review in GCSE mathematics, using materials from 1999 and 2004. The findings were published in a report in 2006, which is available on our website at [www.ofqual.gov.uk/files/qca-06-2346-mathematics-gcse-a-level.pdf](http://www.ofqual.gov.uk/files/qca-06-2346-mathematics-gcse-a-level.pdf) .

## **Methodology**

Standards reviews examine different specifications within a qualification, the associated assessment instruments and samples of student work by collating and analysing the views of a number of subject specialists. The following sections of this report detail how we collect and process this information. In these reviews, demand is measured against that of the other specifications under review and includes consideration of:

- specification-level factors such as assessment objectives, content and structure
- assessment-level factors such as what content is assessed, the weighting of each component and how the assessments are marked
- student performance-level factors, including how the students responded to the assessments and the grades they received as a result.

The demand of an assessment or qualification can be defined in a variety of ways and is linked to the purpose of the qualification. It is related to the:

- amount and type of subject knowledge required to be assimilated
- complexity or number of processes required of the students, the extent to which the students have to generate responses to questions from their own knowledge or the extent to which resources are provided
- level of abstract thinking involved
- extent to which the students must devise a strategy for responding to the questions.

## **Provision of assessment materials and student work**

Each of the five awarding organisations offering the qualifications being reviewed (AQA; CCEA; Edexcel; OCR and WJEC) was asked to provide specification materials for GCSE mathematics (from the specification with its largest entry in summer 2008).

Details of our requirements for the provision of assessment materials and student work for review are given in [Appendix A](#) and, in summary, include:

- the current specification
- all associated question papers
- final mark schemes
- the 2008 chief examiner's report and grade boundaries, overall and by unit (both raw and scaled)
- mark distributions, grade descriptors and assessment grids
- any other information that was routinely supplied to centres
- all the assessment work carried out by a sample of students whose final grade lay at or near the judgemental grade boundaries for the qualification being analysed.

The equivalent materials that were collected and retained for the previous review were retrieved from our archive of assessment materials and student work.

Full details of the materials supplied by awarding organisations can be found in [Appendix E](#) and [Appendix F](#).

### **The review team**

We contracted 13 experts in GCSE mathematics to undertake the review. These reviewers were sourced through:

- a subject-expert recruitment exercise carried out by us in November 2008, advertised via The Times Educational Supplement and our website and newsletter
- nominations made by awarding organisations involved in the review
- nominations made by subject associations and other learned bodies invited to participate in the review.

A full list of reviewers can be found in [Appendix H](#).

We contracted a lead reviewer, specification reviewers and script reviewers. (All nominees from awarding organisations and subject associations were script reviewers.)

## **Analysis of the specifications and assessment materials**

The lead reviewer and specification reviewers (specification review team) analysed the awarding organisations' materials, using a series of forms which can be found via the comparability page on our website at [www.ofqual.gov.uk/standards/research-reports/92-articles/23-%20comparability](http://www.ofqual.gov.uk/standards/research-reports/92-articles/23-%20comparability) .

These analyses are designed to describe the demand of the specification. Each reviewer analysed a subset of the specifications available, so that there were at least three different views on each specification. The lead reviewer then produced a report which brought together the views of the reviewers on each of the awarding organisations' specifications. The specification review team was given the opportunity to discuss the lead reviewer's conclusions at a follow-up meeting. These findings are presented in Section 2 of this report.

## **Analysis of student performance**

To assess student performance, all reviewers were brought together for a two-day meeting to analyse student scripts (pieces of student work supplied by the awarding organisations). This process is referred to as a script review. The meeting started with a briefing session to make sure that all the reviewers had a common understanding of the methodology and the judgement criteria.

The scripts were organised into packs for consideration during the review. Packs were organised by grade: A/B, C/D and F/G for GCSE. (Other grades are calculated arithmetically after the former grade-boundary marks have been set during the awarding process carried out by awarding organisations.) Reviewers were asked to make qualitative comments on the work they saw. For example, they were asked to comment on whether they thought the work provided by the awarding organisations had demonstrated the required level of knowledge and skill to warrant the grade that the work had received.

## Section 2: Subject demand in GCSE mathematics

### Overview

Specification reviewers considered the specification documents, chief examiner's reports and question papers with associated mark schemes from each of the awarding organisations in 2004 and 2008. Details of the specifications included in the review are given in [Appendix F](#).

The major change that affected all GCSE mathematics examinations between 2004 and 2008 was a move from a three-tier examination system of foundation, intermediate and higher tiers to a two-tier system, comprising foundation and higher only. The new GCSE criteria came into effect in October 2006, and the first two-tier examination was carried out in summer 2008. The purpose of this change was to bring mathematics in line with other subjects, which allow all students the opportunity to achieve a grade C regardless of entry tier. This was previously not possible with mathematics foundation tier.

Between 2004 and 2008 the grade ranges for each entry tier were changed. These are summarised in the table below.

| 2004         |             | 2008       |             |
|--------------|-------------|------------|-------------|
| Tier         | Grade range | Tier       | Grade range |
| Foundation   | G,F,E,D     | Foundation | G,F,E,D,C   |
| Intermediate | E,D,C,B     | N/A        | N/A         |
| Higher       | C,B,A,A*    | Higher     | D,C,B,A,A*  |

The 2006 GCSE mathematics subject criteria, also introduced a significant change in the balance of questions focused on each grade; in each tier, 50 per cent of the weighting had to be focused on the lowest two grades and 25 to 30 per cent focused on the top two grades. The purpose of this change was to make sure that all students have an opportunity to show what they know, understand and can do. This change is summarised in the table on the next page.

| 2004         |                                      | 2008       |   |
|--------------|--------------------------------------|------------|---|
| Tier         | Grade allocation                     | Tier       | Grade allocation                              |
| Foundation   | G: 33%<br>F: 22%<br>E: 22%<br>D: 22% | Foundation | G and F: 50%<br>E: 20–25%<br>D and C: 25–30%  |
| Intermediate | E: 25% D: 25%<br>C: 25% B: 25%       |            |   |
| Higher       | C: 25% B: 25%<br>A: 25% A*: 25%      | Higher     | D and C: 50%<br>B: 20–25%<br>A and A*: 25–30% |

For most awarding organisations, the 2008 GCSEs included a coursework component, comprising 20 per cent of the final assessment, with the exception of CCEA. This was removed in the 2009 examination series. Whilst the removal of coursework is beyond the scope of this review, CCEA had already implemented the change in 2008 and is, therefore, considered here.

The change from a three- to a two-tier assessment design and the alteration of the percentage allocation of questions within each grade had the following consequences:

- The C grade was now available to every student regardless of tier of entry and this must be regarded as a very positive change.
- Higher tier papers were less demanding because of the need to target 50 per cent of the questions at the lowest two grades in each tier. The positive outcome from this change, however, has been increased access for students at the lower end of each tier. It allows grade boundaries to be set especially for the C grade in the higher tier, which allowed students to show what they knew, understood and could do. This was not always the case in 2004.

- The spread of grades to be covered in each tier increased and in some awarding organisations this resulted in a rise in structuring within questions. And question design showed an increasing trend towards structuring of questions. Both factors lowered demand over time.
- The increased trend towards modular examinations had a mixed effect on demand. In OCR, the design of the assessment minimised the effect of the changes and allowed standards to be maintained over time, whereas the design of AQA's assessment caused fragmentation and increased question structuring, lowering demand.
- A further effect of the increase of modular examinations was a rapid divergence in schemes of assessment and this made it a more complex task to track coverage of specifications and standards over time and between awarding organisations. Further diversification in schemes of assessment would not be advantageous to GCSE students.

## **Findings**

### **Assessment objectives**

The assessment objectives and the weightings relating to them did not change significantly over time, and so the content of the objectives has not altered demand (see [Appendix C](#)). However, there were several changes that relate to the way in which these objectives are assessed, which are discussed in the following sections, and these changes have affected demand over time.

### **Specification content**

The overall specification content was consistent. However, what changed over time was the balance of content within the tiers. In 2008 both higher and foundation tiers covered five grades and hence examined a wider range of content than in 2004. On foundation tier, this had the effect of raising demand as there was a need to teach and assess C grade material.

By contrast, in the higher tier in 2008 there was the introduction of assessment of D grade material and this had a different effect. The wider range of material changed the nature of the demand with a greater emphasis placed on consistency and accuracy than was previously demanded in 2004.

### **Schemes of assessment**

Schemes of assessment changed significantly over the time period reviewed, including a move from a three- to a two-tier examination system; changes to the percentage allocation of questions and changes to assessment design as more

students started to take modular GCSEs. (See the summary table in [Appendix B](#) for details.)

### **Time demand**

In GCSE mathematics, marks are allocated to each part of a question with strict guidance for the awarding of each mark. The demand of the papers can be increased or decreased by giving a shorter or longer allocation of time per mark.

The reviewers judged that demand, in relation to the time available, remained consistent over time on the higher tier. The exceptions were AQA and Edexcel. AQA's time per mark increased slightly. In Edexcel's papers, it was judged that the time available per mark had fallen, marginally increasing the demand of the assessment.

The time available on foundation rose for all awarding organisations except OCR and Edexcel, where it remained constant. However, for AQA, CCEA and WJEC the amount of time per mark available rose significantly. For AQA, the reviewers judged that the 22 per cent increase in time per mark had reduced demand of the paper over time. For CCEA, the 16 per cent increase in time per mark also reduced demand over time especially when the lack of coursework assessment was taken into consideration.

### **The effects of the increased move towards modularity**

In 2004 only one awarding organisation (OCR) had a modular GCSE as its leading specification, by 2008 there were three: AQA, CCEA and OCR.

Modular specifications offer an opportunity to re-sit each non-terminal module once. Whilst this could be said to offer the students more opportunity to show what they know, understand and can do, it also has the effect of increasing the time demand of assessments. The reviewers needed more information to reach a firm conclusion on this aspect of increased modularity.

The move towards modularity affected the level of demand, but this was determined by the changes to the structure of the specification. The reviewers thought that AQA's assessment design had a negative effect on demand. The examination time became fragmented and, in the case of Module 1, much shorter, with two papers of 25 minutes each instead of one ninety minute paper. This was judged to contribute to the increased structuring of questions due to pressure to cover the content. Modules 1 and 3 were designed to test only data handling and aspects of number and algebra respectively. This structure led to a compartmentalisation of mathematics, which prevented students from being tested more synoptically and which lessened demand because the range of content being tested in each paper was much narrower.

What was a relatively consistent picture of converging practice in 2004 became a more divergent one in 2008. The trend towards modular GCSEs and the diversity of design meant that it became more difficult to appraise the standard of one awarding organisation's GCSE against that of another's and across time.

### Options

Without exception, all of the questions in the examination papers were compulsory with no optional sections. This aspect of optionality had therefore no bearing on the change of demand. While there was a choice of tasks in the coursework, the range of choices was not available to the reviewers and so was not included in this review.

In two of the GCSEs, OCR's (2004 and 2008) and CCEA's (2008), there was a choice of modules within the tiers. By selecting different module combinations students could raise or lower the demand of the assessment within each tier. In each case, the grade range for the module paper was much narrower than that in the terminal paper (in CCEA three grades and in OCR two grades, see table below). The effect of these modules was to offer students more opportunities to show what they know understand and can do at each grade within the paper. This could, potentially, offset the increased structuring seen in the terminal papers as it allowed greater access for weaker students and equally well could allow the most able students in each tier an opportunity to be tested in depth on more demanding, less structured questions.

| Awarding organisations | Modules available  |  |
|------------------------|--|--|
| CCEA 2008              | <p><b>Foundation</b></p> <p>N1: Grades available G,F,E</p> <p>N2: Grades available E,D,C</p>   | <p><b>Higher</b></p> <p>N3: Grades available D,C,B</p> <p>N4: Grades available B,A,A*</p>  |
| OCR 2004 and 2008      | <p>M1: Grades available <b>G</b> †</p> <p>M2: Grades available <b>G,F</b></p> <p>M3: Grades available <b>G,F</b></p> <p>M4: Grades available <b>F,E</b></p> <p>M5: Grades available <b>F,E</b></p> | <p>M6: Grades available <b>E,D</b></p> <p>M7: Grades available <b>D,C</b></p> <p>M8: Grades available <b>C,B</b></p> <p>M9: Grades available <b>B,A</b></p> <p>M10: Grades available</p> |

|  |  |              |
|--|--|--------------|
|  |  | A, <b>A*</b> |
|--|--|--------------|

† The grade in bold is the target grade for the module

Both of these designs were regarded as good practice in modularity and in particular OCR's design and delivery were instrumental in helping to maintain demand over time as the number of tiers decreased.

### Question papers

The two structural changes in GCSE, described in the introduction had the effect of altering the demand of the papers over time, but to a large extent this was compensated for by the changes in grade boundaries. This was true to a different extent for each awarding organisation.

Between 2004 and 2008, there was a lowering in demand due to the increased structuring of questions. This was a separate issue to the one above and related solely to the design of questions. Reviewers judged that this increase in structuring lowered demand over time.

There was a trend, over time, towards increased structuring of questions, especially on the higher tier. Although this was common to all awarding organisations it was particularly noticeable in Edexcel (Linear) and in AQA and CCEA, where the modular structure appeared to have exacerbated the problem. It was, therefore, more difficult to find the multi-step weighting of 6 per cent on foundation and 10 per cent on higher in 2008.

This trend was caused by question design and by the changes in assessment structure. With more grades and topics to cover in each tier, the 2008 papers had to reflect a wider range of topics than those of 2004. Whilst it was felt that this requirement led partially to the increased structuring seen in the papers the major factor was question design. There was a noticeable decrease in multistep questions between 2004 and 2008, where questions tended to either lack complexity or were structured into parts which led students through the problem. Reviewers judged this increase in question structure to have lowered the demand over time.

Examination papers were clear, well laid out, with a good balance of white space enabling access for students at all levels. Considerable work and thought had gone into diagrams, wording and sentence construction to ensure that students were challenged on their mathematical ability rather than their ability in literacy. This was good practice and was consistent across all awarding organisations. In the best examples further good practice was seen in the space allocated for answers, the boxing or ruling off of questions, and careful pagination to ensure whole questions fitted sensibly onto the paper and the number of blank pages minimised. In addition, the ordering of questions in the papers ensured that the incline of difficulty was

smooth. This too ensured that students were tested on their mathematical ability and had good access to the papers.

Without exception, the mark schemes were clear and easy to interpret. Where alternative answers were possible guidance was given to mark allocation and to alternative schemes. All were fit for purpose and should have resulted in consistency of marking; this was regarded as good practice. Broadly speaking, mark allocation is consistent over time and between awarding organisations, the exception to this is CCEA see Allocations of grades to questions below

### **Allocations of grades to questions**

GCSE mathematics questions were targeted at specific grades and these grades were identified in the assessment grids which accompanied the papers. Questions were distributed across the grade range as specified in the GCSE criteria (see table in the Overview above for details).

When questions were compared over time, there were some inconsistencies with similar questions being allocated different GCSE grades. These inconsistencies existed both over time and between awarding organisations with the exception of OCR which tended to be the most consistent in grade allocation.

AQA showed the highest level of inconsistency with a significant number of questions being graded higher in 2008 than in 2004, or being graded higher than similar questions from other awarding organisations in 2008. With Edexcel, the full extent of this issue was difficult to quantify as the questions in 2008 were graded on a three point scale for each tier rather than being allocated to specific grades. However, it was fair to say that some examples of grade mismatching were found. WJEC also displayed this tendency, though to a lesser extent. However their questions tended to be very similar over time and this led to higher levels of question predictability, which may be the explanation for the very high grade boundaries at the top end of the higher tier examination paper in 2008.

The A\* questions in CCEA 2008, were only just graded as A\* and tended to be simplistic at this level. The allocation of questions in 2008 was incorrect in both tiers with the 50 per cent allocation to the lower two tiers being exceeded. In addition there were several examples in 2008 of questions being awarded more marks than similar questions in other awarding organisations, for example N1 question 1(b) had two marks where other boards awarded one for this type of question (other examples included: N1, question 5(b), N5 question 9(a)). This was seen as lowering demand for the students. All of the above had the effect of lowering the demand of the 2008 CCEA higher tier examination paper.

## **Percentage allocation of questions**

Between 2004 and 2008 the percentage allocation of questions to grades was changed (see the table in the Overview above). This was a structural change determined by the 2006 criteria for GCSE mathematics and was therefore common to all awarding organisations.

The change in percentages had the effect of altering demand at the higher tier as 50 per cent of questions were targeted at grades D and C. The advantage of this change was to offer better accessibility for the C and D grade students and to ensure that they had an opportunity to show what they knew, understood and were able to do. In order to counteract this lowering of demand grade boundaries increased in 2008 and this is dealt with in greater detail in Grade boundaries below.

On foundation tier, there was an increase in demand as C grade material was included in the question papers for the first time; this too was reflected in the grade boundaries for foundation tier.

## **Grade boundaries**

There were significant differences between the 2004 and 2008 grade boundaries as the assessments responded to the structural changes in GCSE. There were changes in the nature of the demand of the qualifications and two observations were made.

Firstly, there were two very different ways of achieving C grade: impressive accuracy on foundation with some C grade questions successfully attempted or reasonable accuracy with a broader spectrum of C and D questions at higher. Whilst this was similar to the situation regarding intermediate and higher in 2004 the introduction of the D grade material at higher allowed C grade students to show what they knew, understood and could do. This should be regarded as an improvement.

Secondly, the much higher grade boundaries required for A\* reflected not only the changes in the percentages of grade allocations to questions but also the trend towards higher levels of structuring within questions. The nature of what was being tested at A\* was being changed with extremely high levels of accuracy on easier questions being required as well as the ability to tackle the harder questions. What was lost was the test of thinking skills required by more complex unstructured questions.

The F grade was comparable in demand across time and between awarding organisations and could be regarded as being of a similar standard over time once grade boundaries had been taken into account.

The A grade boundary was also comparable across time and between awarding organisations. However, the change in the nature of attainment at A\* was beginning to be seen at this grade and could have implications for transfer to A level.

The 2008, C grade boundary at higher was now a better measure of what students knew, understood and could do. In 2004, very low grades boundaries at higher made it difficult to compare the C grade across awarding organisations. In general, the C grade boundary was consistent between awarding organisations in 2008. The exception to this was CCEA; with 63 per cent of questions covering the C and D grades the C boundary was not set high enough to reflect this percentage and could not be regarded as being consistent with the other awarding organisations or across time.

The C grade on foundation was not as consistent as the C grade on higher; OCR was comparable over time and Edexcel and WJEC, although marginal, could also be broadly regarded as comparable over time. However, AQA did not reflect the changing nature of foundation in its grade boundary at this level and the C grade foundation should be regarded as declining over time. CCEA had 67 per cent of questions set at G and F as opposed to the 50 per cent required by the GCSE criteria. The grade boundary for C did not reflect these high percentages in grade allocation and reviewers did not judge it as comparable over time or compared with other awarding organisations.

### **Tiering**

The effects of the changes from three to two tiers have been discussed in detail in the previous sections and are summarised below.

The most important change was to allow access to the C grade to all students sitting GCSE mathematics, regardless of tier of entry. However, it was apparent that this change, whilst desirable, had some effects on the scheme of assessment. The wider grade range in each tier led to an increase in question structure and there were now fewer marks available at each of the top three grades to allow students to show what they knew, understood and could do. The difference in the way in which a C grade could be achieved at intermediate and higher in 2004 was less marked than the difference between a C grade on foundation and higher in 2008. In addition, the nature of demand at the A\* grade had changed. It now required high levels of accuracy on more but simpler questions rather than the ability to tackle a range of more stretching unstructured questions.

### **Coursework**

The reviewers thought that for AQA, Edexcel, OCR and WJEC the demand contributed by coursework was maintained over time.

For CCEA, in 2004, coursework contributed 20 per cent to its scheme of assessment, but in 2008 the coursework was withdrawn and the 2008 papers did not reflect the 20 per cent additional assessment subsumed into the external examination.

Furthermore, much of the coverage of AO1 was claimed by awarding organisations to lie in the two coursework tasks. In CCEA's 2008 foundation and higher tiers, the coverage of AO1 was not adequate without the coursework, and there was not enough opportunity for students to show that they could problem solve, communicate and reason within the question papers. The reviewers thought that this lack of coverage made the 2008 assessment less demanding.

## **Section 3: Standards of performance**

### **Overview**

#### **Findings**

Reviewers considered student work from all the awarding organisations in 2004 and 2008 and they made qualitative comments on the work they saw based on the performance descriptions for GCSE mathematics. There was no student work from 2004 available for review. Details of the materials used can be found in [Appendix E](#), and student performance can be found in [Appendix G](#).

#### **Recommendations**

This report has detailed our work in analysing the demand of qualifications across different years within GCSE mathematics. The findings from this report have, at the time of publication, already been fed into revisions in current versions of the qualifications.

The analysis demonstrated that changing the tiering structure of the assessment, and the increased modularisation of the assessments had impacts on the demand of the qualifications offered. These findings were considered when reviewing subject criteria.

New subject criteria for GCSE mathematics were introduced in 2011. The subject content is more specific and identifies the different key skills to be developed for each of the 3 core mathematical objectives. In 2006, 7 core objectives were given in the subject criteria but these were not broken down into key skills. The assessment objectives and weightings have changed and these are shown on the table on the next page.

| Year introduced | Assessment objective |  | Weighting   |
|-----------------|----------------------|--|-------------|
| 2000            | AO1                  | Using and applying mathematics                                       | 20%         |
| 2006            | AO1                  | Using and applying mathematics                                       | 20% minimum |
| 2011            | AO1                  | Recall and use their knowledge of prescribed content.                | 45–55%      |
| 2000            | AO2                  | Number and algebra   | 40%         |
| 2006            | AO2                  | Number and algebra   | 50–55%      |
| 2011            | AO2                  | Select and apply mathematical methods in a range of contexts         | 25–35%      |
| 2000            | AO3                  | Shape, space and measures  | 20%         |
| 2006            | AO3                  | Shape, space and measures  | 25–30%      |
| 2011            | AO3                  | Interpret and analyse problems and generate strategies to solve them | 15–25%      |
| 2000            | AO4                  | Handling data  | 20%         |
| 2006            | AO4                  | Handling data  | 18–22%      |
| 2011            | N/A                  | N/A  | N/A         |

Each scheme of assessment must allocate a minimum weighting of 25 per cent and a maximum of 50 per cent to assessment without a calculator. In 2006 a 50 per cent weighting was allocated to assessment with a calculator and a 50 per cent weighting was allocated to an assessment without. A functional element has now been introduced to the subject criteria for mathematics (20 to 30 per cent on higher tier and 30 to 40 per cent on foundation tier.)

## **Appendix A: Provision of assessment materials and student work at GCSE and GCE levels for Ofqual's archive (annual inclusion and standards reviews)**

### **Section 1: Specification of requirements**

1.1 Each awarding organisation should draw the materials for each subject from the specification with their largest entry in summer 2008, unless that selection severely limits the range of examination components available. Where there are several entry options, materials should be drawn from the largest option only, unless Ofqual were exceptionally to agree other arrangements.

1.2 (With regards to GCSE) – where there are both modular and linear (non-modular) examinations in a subject, the awarding organisation operating the modular scheme with the greatest number of students (amongst all awarding organisations) should include that modular scheme, even if it is not a specification within the awarding organisation's largest entry. Similarly, the awarding organisation operating the linear scheme with the greatest number of students should include that linear scheme. If an awarding organisation runs both the largest entry linear examination and the largest entry modular examination in a subject, it will therefore provide two sets of materials, including student work, where required.

1.3 The following materials should be supplied:

a) Current specification: all associated question papers and final mark schemes. b) The 2008 chief examiners' report (CER) and details of awarding procedures particular to the specification supplied.

c) An indication of how the specification's content and assessment criteria and objectives have been met in each question paper supplied. This may take the form of a grid. For objective tests this should include faculty values, discrimination indices and a specification grid detailing what grade each question was targeted at, as well as an indication of what percentage of students got a particular question correct when it was targeted at the grade they got overall.

d) Unit or component mark distributions (with grade boundary marks shown). It should be clear whether the marks are on the raw or uniform mark scale.

e) Grade boundaries, overall and by unit (both raw and scaled).

f) Student work as specified in Section 2.

g) Complete data record showing for each student selected the raw mark; final mark; weighted or uniform mark; grade for each component/unit (including any non-archived component/unit) and overall grade; and, where relevant, tier of entry.

Where appropriate, materials a)–e) may be supplied in electronic form.

## **Section 2: Student work**

2.1 The work submitted should include the examination scripts, the internal assessment, and any oral/ aural examinations (with examiner mark sheet) where these are routinely recorded. In addition, for modular specifications, the examination papers of module tests should be supplied.

2.2 The sample should be of the original work of the students. Photocopies of work should only be used where it is impossible to send the originals and with agreement in advance by Ofqual. Student and centre names and numbers should be removed wherever they appear in a student's work, unless they form an integral part of the work, for example, within a letter.

2.3 Where an awarding organisation's specification has a relatively small entry or where, for some other reason, it is proving difficult to find sufficient students who fulfil the criteria, the awarding organisation should contact the Ofqual officer responsible to agree how best to finalise the sample.

2.4 All internal assessment submitted should be that of the particular students selected for the sample. If, for any reason, this proves to be impossible, the awarding organisation should contact the Ofqual officer responsible to agree appropriate alternative measures.

2.5 The sample of scripts retained for each specification (option) should be taken from students whose final mark lay at or near the subject grade boundaries for A/B, C/D and F/G for GCSE and A/B and E/U for GCE A level qualifications. At each boundary, each awarding organisation will supply the externally and internally set and marked assessments of fifteen students. Students selected should be those whose performance across units is not obviously and significantly unbalanced.

2.6 In tiered subjects, where the same grade boundary may feature in two tiers, separate sets of student work for the boundary should be provided from each tier.

## Appendix B: Schemes of assessment

| Awarding organisation | 2004 assessment  | 2008 assessment  |
|-----------------------|--|--|
| AQA                   | <p><b>Linear</b></p> <p>Two terminal papers at each tier (80%) plus two coursework assessment tasks (20%):</p> <p><b>Foundation:</b> 2 x 90 mins</p> <p><b>Intermediate:</b> 2 x 120 mins</p> <p><b>Higher:</b> 2 x 120 mins</p> <p>Question paper marks 200</p> <p>Total time:</p> <p><b>Foundation</b> – 180 mins</p> <p><b>Intermediate and higher</b> – 240 mins</p> | <p><b>Modular</b></p> <p>Module 5 terminal paper (50%)</p> <p><b>Foundation and higher:</b> 2 x 75 mins module 1 (11%): A04 only</p> <p><b>Foundation and higher:</b> 2 x 25 mins module 3: (19%) A02</p> <p><b>Foundation and higher:</b> 2 x 40 mins, two coursework assignments (20%)</p> <p>Question paper marks 244</p> <p>Total time:</p> <p><b>Foundation and higher</b> – 280 mins</p> |
| CCEA                  | <p><b>Linear</b></p> <p>Two terminal papers at each tier (80%) plus two coursework assessment tasks (20%):</p> <p><b>Foundation:</b> 2 x 90 mins</p> <p><b>Intermediate:</b> 2 x 120 mins</p> <p><b>Higher:</b> 2 x 120 mins</p>   | <p><b>Modular</b></p> <p><b>Foundation:</b> terminal paper (56%) 2 x 60 mins. Choice of N1 (44%) (grade range G–E) or N2 (grade range E–C) 2 x 45 mins</p> <p><b>Higher:</b> terminal paper (56%) 2 x 75 mins. Choice of N3 (grade range) or N4 (grade range) (44%) 2 x 60 mins. No coursework</p>   |

|         |   |   |
|---------|---|---|
|         | <p>Question paper marks 200</p> <p>Total time:</p> <p><b>Foundation</b> – 180 mins</p> <p><b>Intermediate and higher</b> – 240 mins</p>   | <p>Question paper marks 200</p> <p>Total time:</p> <p><b>Foundation</b> – 210 mins</p> <p><b>Higher</b> – 270 mins</p>  |
| Edexcel | Linear  | Linear  |
|         | <p>Two terminal papers at each tier (80%) plus two coursework assessment tasks (20%):</p> <p><b>Foundation:</b> 2 x 90 mins</p> <p><b>Intermediate:</b> 2 x 120 mins</p> <p><b>Higher:</b> 2 x 120 mins</p> <p>Question paper marks 200</p> <p>Total time:</p> <p><b>Foundation</b> – 180 mins</p> <p><b>Intermediate and higher</b> – 240 mins</p> | <p>Two terminal papers at each tier (80%) plus two coursework assessment tasks (20%):</p> <p><b>Foundation:</b> 2 x 90 mins</p> <p><b>Higher:</b> 2 x 105 mins</p> <p>Question paper marks 200</p> <p>Total time:</p> <p><b>Foundation</b> – 180 mins</p> <p><b>Higher</b> – 210 mins</p> |
| OCR     | Modular   | Modular   |
|         | <p>Two terminal papers at each tier (50%)</p> <p>All tiers: 2 x 60 mins</p> <p>Two coursework assessment tasks (20%)</p> <p>Two modules from a selection of ten covering very limited grade range (30%). All modules 1 x 60 mins (120 mins for two)</p>   | <p>Two terminal papers at each tier (50%)</p> <p>All tiers: 2 x 60 mins</p> <p>Two coursework assessment tasks (20%)</p> <p>Two modules from a selection of ten covering very limited grade range (30%). All modules 1 x 60 mins (120 mins for two modules)</p>                           |

|      |   |  |
|------|---|--|
|      | <p>modules)</p> <p>Question paper marks 200</p> <p>Total time:</p> <p><b>Foundation, intermediate and higher – 240 mins</b></p>   | <p>Question paper marks 200</p> <p>Total time:</p> <p><b>Foundation, intermediate and higher – 240 mins</b></p>  |
| WJEC | Linear  | Linear   |
|      | <p>Two terminal papers at each tier (80%) plus two coursework assessment tasks (20%):</p> <p><b>Foundation:</b> 2 x 90 mins</p> <p><b>Intermediate:</b> 2 x 120 mins</p> <p><b>Higher:</b> 2 x 120 mins</p> <p>Question paper marks 200</p> <p>Total time:</p> <p><b>Foundation – 180 mins</b></p> <p><b>Intermediate and higher – 240 mins</b></p> | <p>Two terminal papers at each tier (80%) plus two coursework assessment tasks (20%):</p> <p><b>Foundation:</b> 2 x 120 mins</p> <p><b>Higher:</b> 2 x 120 mins</p> <p>Question paper marks 200</p> <p>Total time:</p> <p><b>Foundation – 240 mins</b></p> <p><b>Higher – 240 mins</b></p> |

## Appendix C: Assessment objectives

| Assessment objective               | Details  | Weightings                             |                |
|------------------------------------|--|--|----------------|
|                                    |  | 2004                                   | 2008           |
| AO1 Using and applying mathematics | <ul style="list-style-type: none"> <li>▪ Problem solving</li> <li>▪ Communicating</li> <li>▪ Reasoning</li> </ul>  | 10%<br>Internal<br><br>10%<br>External | Minimum of 20% |
| AO2 Number and algebra             | <ul style="list-style-type: none"> <li>▪ Numbers and the number system</li> <li>▪ Calculations</li> <li>▪ Solving numerical problems</li> <li>▪ Equations, formulae and identities</li> <li>▪ Sequences, functions and graphs</li> </ul> | 40%<br>External                        | 50–55%         |
| AO3 Shape, space and measures      | <ul style="list-style-type: none"> <li>▪ Geometrical reasoning</li> <li>▪ Transformation and coordinates</li> <li>▪ Measures and construction</li> </ul>   | 20%<br>External                        | 25–30%         |
| AO4 Handling Data                  | <ul style="list-style-type: none"> <li>▪ Specifying the problem and planning</li> <li>▪ Collecting data</li> <li>▪ Processing and representing data</li> <li>▪ Interpreting and discussing data</li> </ul>                               | 10%<br>Internal<br><br>10%<br>External | 18–22%         |

In 2004 the division between number and algebra in each tier had to match the relevant programme of study and manipulative algebra had to be given “appropriate” weight. By 2008 the following additional requirements had been introduced:

- The assessment of AO1 was subsumed into the other assessment objectives and represented the way in which content was assessed rather than being seen as content in its own right. The total of the assessment objectives is therefore greater than 100 per cent.
- Number and algebra should be divided according to specific ratios, foundation tier 3:2 and higher tier 2:3.
- Assessment of manipulative algebra had to have a minimum weighting of 6 per cent for foundation and 22 per cent for higher.
- The minimum weighting for questions demanding the unprompted solution of multi-step problems had to be 6 per cent for foundation and 10 per cent for higher.

## Appendix D: GCSE specifications reviewed

| GCSE 2004 and 2008 Mathematics                |                  |                 |               |                  |                    |
|---|------------------|-----------------|---------------|------------------|--------------------|
| Awarding organisation and Specification Codes |                  |                 |               |                  |                    |
|   | AQA              | CCEA            | Edexcel       | OCR              | WJEC               |
| 2004  | 3301             | G60             | 1387          | 1966 (Modular C) | 18401/2/3 (Linear) |
| 2008  | 4302 – B Modular | G2267 (Modular) | 1387 (Linear) | 1966 (Graduated) | 018501/02          |

## Appendix E: GCSE scripts reviewed

|              |      | AQA  |      | CCEA |      | Edexcel |      | OCR  |      | WJEC |      |
|--------------|------|------|------|------|------|---------|------|------|------|------|------|
| Grade        | Year | 2004 | 2008 | 2004 | 2008 | 2004    | 2008 | 2004 | 2008 | 2004 | 2008 |
|              | GCSE | A    | 8    | 8    | 8    | 8       | 8    | 8    | 3    | 10   | 8    |
| C higher     |      | 8*   | 8    | 8*   | 8    | 8*      | 8    | 3*   | 8    | 8*   | 8    |
| C foundation |      |      | 8    |      | 8    |         | 8    |      | 8    |      | 8    |
| F            |      | 8    | 8    | 8    | 8    | 8       | 8    | 3    | 8    | 8    | 8    |

\* In 2004 tiered papers were not used, therefore there are not separate higher and foundation scripts at the C grade.

The table includes the number of student scripts used in the script review

## Appendix F: Availability of specification materials for the purposes of this review

| Materials               | 2004 Materials |      |         |     |      | 2008 Materials |      |         |     |      |
|-------------------------|----------------|------|---------|-----|------|----------------|------|---------|-----|------|
|                         | AQA            | CCEA | Edexcel | OCR | WJEC | AQA            | CCEA | Edexcel | OCR | WJEC |
| Specification           | ✓              | ✓    | ✓       | ✓   | ✓    | ✓              | ✓    | ✓       | ✓   | ✓    |
| Question paper          | ✓              | ✓    | ✓       | ✓   | ✓    | ✓              | ✓    | ✓       | ✓   | ✓    |
| Mark scheme             | ✓              | ✓    | ✓       | ✓   | ✓    | ✓              | ✓    | ✓       | ✓   | ✓    |
| Chief examiner's report | ✓              | ✓    | ✓       | ✓   | ✓    | ✓              | ✓    | ✓       | ✓   | ✓    |
| Mark distribution       | ✓              | ✓    | ✓       | ✓   | ✓    | ✓              | ✓    | ✓       | ✓   | ✓    |
| Grade boundaries        | ✗              | ✗    | ✗       | ✗   | ✗    | ✓              | ✓    | ✓       | ✓   | ✗    |
| Assessment grids        | ✓              | ✓    | ✓       | ✓   | ✓    | ✗              | ✗    | ✗       | ✓   | ✓    |

✓ Material was available and was used in the review

✗ Material was not available and was not used in the review

## Appendix G: Student achievement by grade

Cumulative percentage of GCSE mathematics grades achieved in 2004 and 2008

| Awarding Organisation & Year | A*  | A   | B   | C   | D   | E   | F   | G   | U    | Total student entries |
|------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|-----------------------|
| AQA 2004                     | 3%  | 9%  | 26% | 50% | 70% | 84% | 91% | 95% | 100% | 205,704               |
| AQA 2008                     | 4%  | 12% | 25% | 52% | 71% | 83% | 91% | 97% | 100% | 232,103               |
| CCEA 2004                    | 7%  | 20% | 40% | 65% | 75% | 87% | 92% | 94% | 100% | 17,825                |
| CCEA 2008                    | 12% | 29% | 51% | 73% | 83% | 90% | 95% | 98% | 100% | 15,863                |
| Edexcel 2004                 | 5%  | 13% | 31% | 53% | 72% | 87% | 94% | 97% | 100% | 357,323               |
| Edexcel 2008                 | 11% | 16% | 34% | 59% | 78% | 89% | 96% | 98% | 100% | 357,551               |
| OCR 2004                     | 4%  | 12% | 27% | 48% | 64% | 79% | 89% | 95% | 100% | 130,192               |
| OCR 2008                     | 4%  | 15% | 30% | 56% | 72% | 83% | 92% | 97% | 100% | 105,036               |
| WJEC 2004                    | 4%  | 13% | 32% | 52% | 66% | 79% | 91% | 96% | 100% | 32,855                |
| WJEC 2008                    | 10% | 15% | 32% | 53% | 70% | 83% | 91% | 96% | 100% | 33,280                |

## Appendix H: Review team

| Review team                    |                    | Organisation                           |
|--------------------------------|--------------------|--|
| <b>Lead reviewer</b>           | Pat Morton         | Ofqual reviewer                        |
| <b>Specification Reviewers</b> | Claire Creasor     | Ofqual reviewer                        |
|                                | Andrew Rogers      | Ofqual reviewer                        |
|                                | Kevin Wallis       | Ofqual reviewer                        |
| <b>Script reviewers</b>        | Christine Davidson | Ofqual reviewer                        |
|                                | Rob Summerson      | Ofqual reviewer                        |
|                                | Peter Woods        | Ofqual reviewer                        |
|                                | Trevor Senior      | AQA                                    |
|                                | Maurice McGrath    | CCEA                                   |
|                                | Malcolm Heath      | Edexcel                                |
|                                | Jean Matthews      | OCR                                    |
|                                | Paul Metcalf       | Mathematics Association                |
|                                | Julia Croft        | Association of Teachers of Mathematics |

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