

## Awarding GCE Mathematics – 3-6-9-12 awarding system

### 0 Summary

- 0.0 This is an urgent response to the proposal for a 3-6-9-12 awarding system received on 4 May 2007 which was a modification of a similar proposal of which we became aware on 3 April 2007.
- 0.1 These proposals are radical in nature and highly controversial. Unless they are withdrawn altogether, it is important that there is full public consultation on them with the mathematics and user communities. **Reports are circulating that there will be sign-off on these proposals on or before 11 May. I should be grateful to receive your immediate and total assurance that these reports are untrue** and that, if these or similar proposals continue to be considered, there will be a full public consultation which will last at least twelve weeks and no decision will be made until after that consultation.
- 0.2 These proposals are intended for implementation in January 2008 so students already in the middle of their courses would find their target qualifications changed; this is unacceptable. Also on the basis of existing qualifications, many students due to start GCE courses in September 2007 have already chosen their courses and institutions have entered into commitments on that basis. Regardless of the merits of these proposals, it would be wrong to implement them before the summer of 2010 and doing so would be likely to undermine public confidence in the examination system.
- 0.3 The proposals received do not constitute a fully workable model and leave many practical questions unanswered.
- 0.4 The proposals largely come from consideration of technical issues relating to awarding and show little appreciation for the impact such proposals may have on mathematics education and more widely. Educational considerations should be paramount and awarding procedures should be developed in conformity with them.
- 0.5 **It is our belief that these proposals would be highly damaging to mathematics education and should be withdrawn.**
- 0.6 The comments made below are supplementary to the earlier paper which is appended to this response. Given the timescale within which this response has been drafted, it is quite likely that further consideration will bring to light additional concerns.

### 1 Unanswered practical issues

- 1.0 The language of three-unit awards, six-unit awards and so on is not free from confusion as we move into a situation where we shall have 1-2, 2-4 and 3-6 patterns in use in other subjects, and 2-4-6-8 and 2-4-7-10 patterns being piloted in mathematics alongside the existing 3-6-9-12-15-18 pattern. Titles have been proposed for the awards containing 3, 6, 9 and 12 units but not for those with 15 and 18 units.
- 1.1 There are contradictory indications in the examples contained in the modified proposals whether the existing rules of combination would apply.
- 1.2 Following the withdrawal of the facility to decline certifications, candidates will be free to re-use existing unit results towards re-certifications in the same, and only the same, qualification titles. These proposals implicitly modify that rule but do not make clear what form the modified rule would take. (Some modification will be needed to

provide a sensible solution for mathematics but we need to be clear of the extent of that modification.)

- 1.3 The proposals provide for two six-unit awards yet do not make clear which would be awarded where a candidate is eligible for both when automatic smaller awards are being made.
- 1.4 It is estimated that at present of the order of 600 candidates a year sit GCE Mathematics in one specification and GCE Further Mathematics in a different specification, and it is expected that over the next three years that this number could well rise to over 2000 a year. (This phenomenon is common in the Further Mathematics Network but not confined to it.) No provision is made in these proposals for such candidates. Indeed, the proposals seem to exclude the possibility.

## **2 Impact**

- 2.0 The proposals make much of the interests of candidates who receive offers from universities (some of which are overseas) specifying minimum UMS scores, yet no estimate is made of the number of candidates involved or the impact of the availability of unit grades to universities on the prevalence of such offers. (It is known that at least one UK university that makes an offer requiring 540+ in AGCE Mathematics expects to switch to requiring a grades in the four core units.)

It is very likely that any scheme produced will have some who gain more from it than others and it is important to know the numbers involved.

- 2.1 The impacts of the proposals on learners, those who support them and users of the qualifications receive little consideration in the proposals. No research is produced or cited to indicate that the proposals will have a positive (or at least neutral) impact. Such issues of perception and behaviour can be very difficult to predict (the experience of Key Skills gives a salutary warning in this regard), and constitute a very high level of risk around the proposals.

Early indications are that there would be a strongly negative impact. This was the view when the proposals were overwhelmingly rejected three years ago. If anything, feeling is stronger now. We have begun to see substantial growth in numbers studying Mathematics and Further Mathematics, following measures to tackle the Curriculum 2000 debacle and through the work of the government-funded Further Mathematics Network. It is estimated (and this is by no means the most extreme estimate heard) that there would be a drop by at least half in the numbers studying Further Mathematics, and that there would also be a substantial backwash effect on Mathematics numbers.

The proposals would make mathematics (especially Further Mathematics) less attractive to learners. The unfamiliarity and complexity of the awarding system will lower confidence in awards in mathematics and in the prestige attached to them. There is a grave danger that learners (with the advice of their advisers) will be more inclined to opt for 'safe' subjects where they feel they understand the system. We still have not fully overcome the perception of GCE mathematics being relatively inaccessible; proposals such as these will only make matters worse.

Similarly, higher education selectors will be faced by unfamiliar and complicated offerings. This will be a particular problem in subject areas where mathematics is not central and the subtleties of GCE mathematics awarding less well known. There is a grave danger that either performance in mathematics will be discounted or selectors will just pick out the results with which they feel more familiar or comfortable.

As an example of the issues of perception and behaviour which would need careful study but do not appear to have received it we draw attention to the following. The revised proposals provide that every twelve-unit award should be accompanied by a simultaneous nested six-unit award; yet what relative weight will be given to those two results? Would the presence of a six-unit grade A be taken into account when faced with a headline twelve-unit grade of BB? (At present, smaller awards tend to be discounted in the presence of larger awards.)

There is a danger that, for institutional reasons, schools and colleges will enter candidates for certification early and often, perhaps with units taken at times that would not otherwise be the case. The result could be that student ends up with a wide variety of qualifications and titles built on overlapping units, for example:

January of Y12	AS Mathematics
June of Y12	Double Award AS Mathematics and AS Further Mathematics AS Mathematics
January of Y13	A Level Mathematics and AS Further Mathematics A Level Pure Mathematics AS Pure Mathematics
June of Y13	Double Award A Level Mathematics and A Level Further Maths A Level Mathematics and AS Further Mathematics A Level Mathematics AS Pure Mathematics

What does a higher education selector or employer make of this collection of results? What will be used in Performance Tables? What does that learner put on her or his UCAS form? The last point (which has its mirror image in what form might university offers be made) is exacerbated by candidates not knowing what qualification titles will be used in awards made to them, as these will depend on their unit scores and the possible aggregation totals resulting from them.

- 2.2 Anecdotal evidence exists that in the present arrangements for GCE Mathematics some learners do not give the C4 unit (which many see as the most challenging) as much attention as other units if their early results suggest that they can safely obtain their desired grades with this reduced effort. The proposals would allow a far greater degree of compensation between units in qualifications. It is quite likely that substantial numbers could gain awards (with high grades) involving Further Mathematics in their titles with very little contribution from material which was distinctively Further Mathematics. The report presents maximal compensation as desirable (and it is understandable that this could seem attractive to a candidate with an offer to meet) but it is not clear that unrestricted compensation is educationally desirable or would maintain the standing and value of the GCE mathematics qualifications with the user communities.
- 2.3 The revisions to the proposals do not alter our assessment of them, so you are asked to consider the fuller analysis of the earlier proposals, given in the appendix. That analysis together with the remarks above lead me to urge strongly that these proposals, or anything like them, be rejected and proceeded with no further, now or at a later date. Instead, I ask that consideration be given to the suggestions in the appendix which give some relief to some of the 'hard cases'.

## APPENDIX

### Proposed Changes to GCE Mathematics and GCE Further Mathematics

## 0 Executive Summary

QCA is considering a proposal from the awarding bodies to replace existing awards in GCE mathematics by three-unit, six-unit, nine-unit, twelve-unit, fifteen-unit and eighteen-unit awards analogous to those used for Applied GCE subjects. A very similar proposal in 2004 evoked the overwhelming opposition of the mathematics community and was rejected. The reasons for that decision hold good today and are indeed stronger now. (See Section 1.)

The government has recognised the key importance of mathematics to this country and its economy. It wants to see more students doing more mathematics. To that end it has provided funding for several initiatives, including the Further Mathematics Network. (See Section 2.)

Changes such as those proposed would inevitably cause confusion in the user community and undermine confidence in GCE mathematics qualifications. The proposals have neither been requested nor welcomed by higher education. (See Section 3.)

Further Mathematics now has a much higher profile and a growing uptake. The investment of money and effort that has gone into achieving this could be set at nought by these proposals which would make Further Mathematics much less attractive to many students by placing their AGCE Mathematics grades in jeopardy if they take Further Mathematics. Indeed, it is likely that numbers taking the subject would sink, below the recent nadir, to a level that would place the viability of the subject in question. (See Section 4.)

The proposal in seeking to address some existing hard cases would create fresh hard cases which would be likely to affect a larger number of students. (See Section 5.)

There is a simple way other than that proposed for coping with the situation once the facility to decline certification is withdrawn this autumn. (See Section 6.1.)

There are weaknesses in the current model for allocating units to qualifications. These can be addressed by adapting the existing model or reverting to the previous model. (See Section 6.2.)

## 1 The Present Situation

### 1.1 Qualifications Available

At present, ASGCE and AGCE qualifications with titles *Mathematics* and *Further Mathematics* are available for all six specifications; with the additional title *Further Mathematics (Additional Award)* available for two of the specifications. The least-best principle is used when making awards for all these qualifications. ASGCE and AGCE qualifications in *Pure Mathematics* are also available, which make use of the same units, but those qualifications are not discussed in this paper.

A proposal is being put to QCA by some of the awarding bodies that would treat mathematics as an Applied GCE subject rather than a GCE subject. The qualification titles available would be *AS Mathematics* (3 units), *A Level Mathematics* (6 units), *A Level Mathematics and AS Further Mathematics* (9 units) and *Double A Level in Mathematics and Further Mathematics* (12 units); there would also be 15-unit and 18-units awards to replace *Further Mathematics (Additional Award)*. The best-best principle would be used when making awards for all these qualifications. These proposals are similar to ones put forward and rejected in 2004.

### 1.2 Reasons for Change

The present provision for candidates to decline awards after they have been made will be withdrawn in the autumn of 2007, this provision allowed candidates who were re-sitting some units to also make use of their previous results; in future, candidates will automatically be able to make use of previous results when re-sitting, but only for the same qualification title as the one they were used for before. From this summer, universities are to receive the grades achieved in the units making up the GCE qualifications of their applicants. Also, some universities, in the UK and overseas, are now asking candidates to obtain particular UMS scores (such as at least 540) as part of their offers. These developments have been put forward in support of the proposal outlined above.

Following the first large-scale award on the current specifications in the summer of 2006, some weaknesses have become apparent in the present least-best procedure, in that the least-best principle is being applied even when a candidate is not seeking a simultaneous award in a 'higher' qualification. This could result, where students had spare units, in the worst rather than the best set of unit grades being reported to universities. It also could lead to a candidate appearing, on her or his result slip, to have scraped a grade rather than being nearly at the next grade, this could mislead the candidate when considering whether to make use of post-result services. (Examples of these situations appear later in this paper.) Previous practice had applied least-best only if a 'higher' qualification was being awarded, otherwise best-best was applied.

## **2 The National Context**

The government has recognised the importance to the country of developing the mathematical talent of our young people and has provided substantial funding to establish a national Further Mathematics Network to support the teaching of GCE Further Mathematics and to increase the uptake of the subject. That network, along with the revisions to GCE mathematics specifications in 2004, has already led to a significant increase in uptake, although there government's long-term targets have yet to be achieved.

Following the Smith Report on mathematics education the DfES has remitted QCA to conduct research into Pathways in 14–19 Mathematics which could lead to changes in the landscape of mathematics qualifications. Trials and pilots, at considerable public expense, have begun and are continuing. The proposals made seem to pre-empt the outcome of some of that work.

The Smith Report on mathematics education called for a double GCSE in Mathematics. This proposal was rejected by ministers who have instead decided on two separate GCSEs in Mathematics. It would seem very strange for us to move GCE mathematics in the opposite direction from having two separate awards for GCE Mathematics and Further Mathematics to a double award.

Although different, these proposals have much in common with those almost universally opposed by the mathematics and mathematics education communities when they were made a few years ago. Indeed, at a meeting convened by QCA of representatives of member organisations of the Joint Mathematical Council, only one representative spoke in support of the proposals made then (and that representative was from an organisation outside England, Wales and Northern Ireland).

The changes currently proposed seem motivated by the desire to simplify arrangements for awarding bodies – they address the technical considerations the awarding bodies must manage and circumvent some potential hard cases. What has not been assessed is the impact of the proposals, which would affect a large and growing number of

students and have the potential to have a highly damaging effect on the uptake of Further Mathematics, a subject which the government has decided to promote.

### **3 Impact in Higher Education**

Soundings taken among some higher education tutors were, with one exception, opposed to the proposed change. (The one exception was not opposed in principle, if by the time of the introduction of the proposed changes there should be a fully post-qualification admission system for undergraduate courses and so be available full access to unit grades throughout the admissions process, which will not be the case.) The comments received in those soundings have informed many of the points made in this section. Loss of confidence in the GCE system as providing adequate discrimination for admissions purposes has seen the re-emergence of university admissions tests; it would be regrettable if changes to certifications for GCE mathematics were to accelerate that trend.

Unit grades will not be available until after certification; so as long as we have an element of pre-qualifying application, subject grades (and predictions of them) will play an important part in assessing applications. Even with all unit grades available, subject grades act as a shorthand and summary (it is much easier to think about four subject grades than twenty-four unit grades). Unit grades will represent a second-tier of detail which is unlikely to be examined until after subject grades (or, for the present, more often subject-grade predictions) have been considered.

Awarding a Double A Level in Mathematics and Further Mathematics will deprive higher education selectors of the information they currently gain from there being two separate awards and deprive them of the ability to treat performance in the two subjects differently. Schools and colleges will continue to make subject, rather than unit, predictions but almost certainly they will be based on the grading system then in use. What is a university admissions tutor to make of a prediction of BB in the proposed scale? At present candidates getting A + C and B + B tend to be quite different and to be seen as such. Also performance in Further Pure units (some of which are compulsory for GCE Further Mathematics) will be lost more deeply in the mix.

The proposals require higher education selectors (for few of whom is admissions work their primary duty) to make considerable changes to their perceptions of different grades. Where previously a candidate not predicted A in AGCE Mathematics might have been subject to immediate rejection (if no special circumstances were evident), a candidate predicted BB or even BC should be seen as possibly carrying within a less glamorous prediction equal merit (which will only be revealed to the university once certification has taken place). It is just possible (but by no means prudent to assume) that with vigorous publicity such a change of perception might be achieved in most university departments of mathematics and immediately kindred subjects. It is certainly not realistic to expect that other subjects will be as well informed and able to ensure that any applicants offering GCE Further Mathematics are treated fairly. The inevitable consequence will be that fewer will take GCE Further Mathematics and the country's need for more highly numerate graduates, across a wide range of disciplines, will not be met.

In some quarters, most notoriously of late in some medical schools, GCE Further Mathematics has not been considered as a full subject to be treated equally with other subjects. Replacing the separate award with being part of a double award is likely to reinforce that perception and, in the case of medicine, to undo the work done of late which has led several medical schools to change positively their attitudes towards GCE Further Mathematics.

The paper containing the proposals mentions the practice of the University of Cambridge of collecting unit scores (rather than just unit grades) from applicants. As all units taken have to be recorded (and this is done at the time of application), issues of how units are aggregated do not arise. Also mentioned in the paper is the use by other universities of 540+ UMS offers; with the availability of unit grades at least one institution making use of such offers (only for those offering just AGCE Mathematics) expects to change to making offers demanding A grades in all of the core units.

#### **4 Impact in Schools and Colleges**

The least-best system has provided incentives for young people, and those who teach and advise them, to behave in ways that are consistent with public policy objectives. The proposals would do the opposite.

A double award for a GCE is something unfamiliar and likely to be treated with suspicion. As in higher education, it will reinforce the perception that exists among some that GCE Further Mathematics is not to be valued as much as other GCE subjects; this can lead to lower levels of resourcing and less readiness to offer the subject. Further, as we move from a system where all subjects, except a few small-entry ones, have six units to a mixture of four-unit and six-unit subjects, any system which distinguishes qualifications by the number of units used is likely to lead to considerable confusion. (In addition, it should be noted that candidates involved in the Pathways Pilots would be awarded (if the proposal was implemented) a two-unit *ASGCE Mathematics*, a four-unit *AGCE Mathematics*, six-unit or seven-unit *A Level Mathematics and AS Further Mathematics* or an eight-unit or ten-unit *Double A Level in Mathematics and Further Mathematics*.

It would be very difficult to persuade learners, let alone their carers that BB is to be valued as much as a combination of grades involving A. (The selecting universities place greater emphasis on subject-specific requirements than UCAS-point totals and it is with aspirations to such universities that these issues will bite most.) Many learners will not take GCE Further Mathematics as a consequence; the 'A or bust' phenomenon is well known. This issue will become worse once the A\* grade is introduced. Indeed, it is inevitable that the introduction of the A\* grade will reduce grades in GCE Further Mathematics and have a negative impact on uptake. In such circumstances GCE Further Mathematics needs support whilst the proposals will only serve to inflict further damage.

Some centres, including ones commended as having good practice in recruitment for GCE Further Mathematics, have been able to use the line that 'taking Further Maths will boost your Maths grade' as an argument to boost participation. It is going to be very hard to convince a student who needs an A grade in GCE Mathematics for her or his desired institution that her or his cause is helped by taking GCE Further Mathematics. In the eyes of many (and there is very little prospect of achieving substantial change in this perception), taking GCE Further Mathematics will put you at strong risk of getting a lower grade for your mathematics and cost university offers. This can have only one consequence, a decline in the uptake of GCE Further Mathematics and this could well be accompanied (past statistics would suggest this) by a decline in GCE Mathematics numbers.

An immediate effect of using best-best would be to depress GCE Further Mathematics results. This will reduce entries. Some students who are otherwise 'straight-A students' will withdraw from GCE Further Mathematics if they are not confident of an A grade in it. This already happens to some degree but making it harder to get an A grade will cause more to drop out for this reason. (This is a real issue as some admissions tutors considered AAA to be stronger than AAAB.)

## **5 Hard Cases**

### **5.1 Hard cases the proposal seeks to address**

**5.1.1** A motivation given is that of the position of a candidate who has an offer requiring 540 or more UMS. The proposals will not provide a cure within themselves, only grade information is being conveyed to universities so anything based on UMS score would need to be dealt with individually. The moment such communication takes place, an opportunity arises for the centre (which in practice will be the institution which will make the communication) to point out any high-performing units which have been allocated to GCE Further Mathematics under least-best. Changing the system for this purpose is quite disproportionate to the problem.

It is presumed that the proposals are for use from January 2008 (which means, for the vast bulk of certifications, from summer 2008). From summer 2010 the A\* grade will be available which will be likely to supersede 540+ UMS requirements. So this proposal would only address this issue (which affects only a small number of students) for two cohorts.

**5.1.2** A second motivation given is that of dealing with the candidate who has certified prematurely. Awarding bodies advise against certification before the end of study but some candidates do not take the advice and one suspects that not all are made aware of the advice and informed consent is not always obtained from candidates by centres before making certification entries, so this category cannot be dismissed. The strength of the argument that something needs to be done here seems to be about the permanent locking of applied units to GCE Mathematics so that repeated certifications of GCE Mathematics could attach more and more units to GCE Mathematics forcing the learner to take supernumerary units in order to obtain GCE Further Mathematics qualifications.

In any case, if the premature certification is the result of failure by the centre to obtain informed consent from the candidate before making the entry then it is repugnant that a rule should be interpreted in a way which injures the interests of the candidate. On a practical level, no awarding body would relish investigating just what took place between candidate and centre in the matter of transmitting information and gaining consent, in order to decide a claim on this point. Yet treating the attachment of applied units to GCE Mathematics in the way proposed could force awarding bodies down that path. If some flexibility could be found in the attachment of units then this problem need not be insurmountable.

### **5.2 Hard cases the proposals create**

**5.2.1** The paper draws a veil over the grades to be reported for 9 units (and the very few candidates offering 15 units). If only one grade is reported, then it going to be very hard to persuade learners and others to value ASGCE Further Mathematics equally with other ASGCE subjects. Also it would have the perverse effect of tending to depress candidates' single grade if they do extra mathematics. If two grades are reported then it will make AGCE Further Mathematics appear to have little added value over the ASGCE, and also act as factor to reduce take-up. There seems just one way out: report one grade for AGCE Mathematics and a separate grade for ASGCE Further Mathematics.

**5.2.2** Provision exists at present (and is much used within the Further Mathematics Network's provision) for candidates to sit GCE Mathematics on one specification and GCE Further Mathematics on another specification (often the OCR(MEI) specification). It is difficult to see how in practice this could be made to work with a double award, especially where two awarding bodies were involved.

- 5.2.3** At present it is possible for a candidate to be awarded ASGCE Mathematics and ASGCE Further Mathematics but in the new system any six-unit award would be subject to the rules of combination for AGCE Mathematics, so the candidate could receive only the ASGCE Mathematics.

## 6 Possible Ways Forward

In what follows, the word *proposal* and its cognates refers to the proposal made by the awarding bodies and the word *suggestion* and its cognates refers to suggestions put forward in this paper.

### 6.1 Re-certification

In order to avoid unfair practice by candidates, once the facility to decline has been abolished, it is intended that units, once cashed-in, will be locked to qualification titles. The proposal implicitly overrides this to the extent that it allows that a certification for the six-unit *A Level Mathematics* will not preclude subsequent use of the units for certification for the twelve-unit *Double A Level in Mathematics and Further Mathematics*.

It does not seem unreasonable that a similar flexibility should be extended to awards made using the current titles. The following is suggested.

- 6.1.1 Where a candidate seeks certification in just one of the titles *Mathematics*, *Further Mathematics* and *Further Mathematics (Additional Award)* the standard rule locking units to titles applies.
- 6.1.2 Where a candidate seeks certification in more than one of the titles *Mathematics*, *Further Mathematics* and *Further Mathematics (Additional Award)* all the units locked to the titles for which the candidate is seeking certification would be available for use across all the titles being certified.

A candidate who had certificated *AGCE Mathematics* at the end of the first year of study could then seek certification for *AGCE Mathematics* and *AGCE Further Mathematics* at the end of the second year (in order to benefit from optimisation). The ability to seek certification in just *AGCE Further Mathematics* would also provide for those candidates who changed specification between *AGCE Mathematics* and *AGCE Further Mathematics*.

### 6.2 Optimisation

- 6.2.1** If it is accepted that the double award of the proposal is not acceptable then a way forward must be found with two separate awards. Four models are defined here for discussion.

**Model M** The least-best model which applies the least-best principle in all circumstances, as at present.

**Model N** The previous least-best model where the least-best principle was applied only if there was a 'higher' certification, otherwise best-best was applied. Best-best was always applied to *AGCE Mathematics*.

**Model O** Where only one title is to be certified, the best-best principle is applied. Where more than one title is to be certified, the least-best principle is applied to establish the best possible subject grades, then among the grade combinations that yield those grades the best-best principle is applied. This model is a fresh suggestion.

**Model P** This applies the best-best principle of the proposal in all circumstances.

**6.2.2** Where a candidate seeks to cash-in just six units then all models give the same answer for *AGCE Mathematics*; differences arise when two titles are being awarded simultaneously or there are spare units. The application of these models (observing the current rules of combination) is illustrated below. (The data used here has not been artificially created to demonstrate particular points but relates to real candidates who were certificated in the summer of 2006 using the AQA specification.)

**Candidate I**

model	qualif-ication	C1	C2	C3	C4	FP1	FP2	FP3	FP4	D1	M1	M2	S1	S2	Total
	units	97	100	93	80	100	79	39	89	97	100	65	91	73	1103
M	AS M	a	a										a		A 288
	A M	a	a	a	a								a	b	A 534
	AS FM						b			a		c			A 241
	A FM					a	b	u		a	a	c			A 480
N	AS M	a	a								a				A 297
	A M	a	a	a	a								a	b	A 534
	AS FM					a				a	a				A 297
	A FM					a	b		a	a	a	c			A 530
O	AS M	a	a								a				A 297
	A M	a	a	a	a					a	a				A 567
	AS FM					a			a				a		A 280
	A FM					a	b		a			c	a	b	A 497
P	AS M	a	a								a				A 297
	A M	a	a	a	a					a	a				A 567
	AS FM					a			a				a		A 280
	A FM					a	b		a			c	a	b	A 497

The present model M causes the ungraded unit to be used in *AGCE Further Mathematics* and makes it look as though Candidate I has scraped an A grade at 480 whilst the other models do not use the ungraded unit and show a strong A grade for *AGCE Further Mathematics*; this is reflected in the unit grades that would be reported to universities (had reporting been live last summer).

**Candidate J**

model	qualif-ication	C1	C2	C3	C4	FP1	FP2	FP3	FP4	D1	M1	M2	S1	S2	Total
	units	94	94	90	80	83	67	44	64	96	82	86	88	78	1046
M	AS M	a	a								a				A 270
	A M	a	a	a	a								a	b	A 524
	AS FM						c					a	a		A 241
	A FM					a	c	e	c		a	a	a	b	B 426
N	AS M	a	a							a					A 284
	A M	a	a	a	a								a	b	A 524
	AS FM					a				a			a		A 267
	A FM					a	c		c	a	a	a			B 478
O	AS M	a	a							a					A 284
	A M	a	a	a	a					a			a		A 542
	AS FM					a					a		a		A 253
	A FM					a	c		c		a	a		b	B 460
P	AS M	a	a							a					A 284
	A M	a	a	a	a					a			a		A 542
	AS FM					a					a		a		A 253
	A FM					a	c		c		a	a		b	B 460

Here Model M again uses the candidate's lowest score and as a result suggests that Candidate J has done little more than scrape a B grade in *AGCE Further Mathematics* whilst Model N makes clear the candidate has narrowly missed an A

grade and it would be likely the candidate would seriously consider making use of post-result services if any of the units taken at the final sitting (apart from FP3) was particularly disappointing. (Under the proposal as Candidate J's twelve-unit best-best total was 1002, the candidate would have been awarded an AA in *Double A Level in Mathematics and Further Mathematics*.)

### Candidate K

model	qualif-ication	C1	C2	C3	C4	FP1	FP2	FP3	FP4	D1	M1	M2	S1	S2	Total
	units	97	100	83	69	80	89	76	60	93	92	83	83	66	1071
M	AS M	a	a										a		A 280
	A M	a	a	a	c								a	c	A 498
	AS FM						a		c		a				A 241
	A FM					a	a	b	c		a	a			A 480
N	AS M	a	a							a					A 290
	A M	a	a	a	c								a	c	A 498
	AS FM						a			a	a				A 274
	A FM					a	a	b		a	a	a			A 513
O	AS M	a	a							a					A 290
	A M	a	a	a	c					a			a		A 525
	AS FM						a			a	a				A 274
	A FM					a	a	b			a	a		c	A 486
P	AS M	a	a							a					A 290
	A M	a	a	a	c					a	a				A 534
	AS FM						a				a	a			A 264
	A FM					a	a	b				a	a	c	B 477

Here Model P would deprive Candidate K of an A grade in *AGCE Further Mathematics* whilst Model O (which in the previous examples has given the same outcomes as Model P) would preserve the A grade in *AGCE Further Mathematics*.

**6.2.3** Maximising grades in *AGCE Further Mathematics* is important to maximising uptake of the subject, so a model which had the potential to produce lower grades than at present is undesirable. This would seem to exclude Model P. The present Model L tends to report weakest unit grades to universities and penalises candidates who do more mathematics, a perverse and undesirable situation.

Model N is likely, but not certain, to cause the candidate's best units (aside from compulsory units) to be reported to universities. The feasibility of this model has been established as it was the one in use previously. The model provides no relief to the candidate who was asked to obtain a particular score in *AGCE Mathematics* if certifying a *Further Mathematics* title at the same time. Although, in practice, it is likely that information about both qualifications would be available to the university.

Model O maintains candidates' current grades and is also likely to ensure that a candidate's best units (aside from compulsory units) are reported to universities. It also provides some relief to those asked to obtain a particular score in *AGCE Mathematics* while certifying a *Further Mathematics* title at the same time. The only candidate's possibly losing from this model would be those certifying *Mathematics* and *Further Mathematics* who had offers where the UMS score for *Mathematics* was more demanding than the grade for *Further Mathematics*; these are likely to be few in number and there is some indication that the number may diminish once universities develop familiarity with unit grades, about which they can receive information automatically rather than have to use *ad hoc* means.

Model O seems to offer the bet way forward but, as yet, the practicality of implementing Model O has not been established. Where only *Mathematics* and *Further Mathematics* is to be awarded this is readily established. Two

specifications have only three possible unit combinations for *GCE Mathematics*, three have six combinations and one has seven which results in only a small number of possibilities being considered. The implementation of Model O is here illustrated for the AGCE awards for Candidate K above (who did not take D2); a similar process would be carried out for ASGCE awards. (In the AQA specification, which Candidate K took, there are six combinations.)

1 For each of the six combinations for *AGCE Mathematics* determine the total mark.

A M combination	qualification	C1	C2	C3	C4	FP1	FP2	FP3	FP4	D1	M1	M2	S1	S2	Total
units		97	100	83	69	80	89	76	60	93	92	83	83	66	
D1+D2	A M	97	100	83	69					93					# 442
D1+M1	A M	97	100	83	69					93	92				A 534
D1+S1	A M	97	100	83	69					93			83		A 525
M1+M2	A M	97	100	83	69						92	83			A 524
M1+S1	A M	97	100	83	69						92		83		A 524
S1+S2	A M	97	100	83	69								83	86	A 518

2 The combination D1+D2 is eliminated as it has scores for fewer than six units. From the other combinations it is seen that an A grade in *AGCE Mathematics* is possible; any combinations which gave a lower grade would now be eliminated.

3 For each remaining combination identify the best two FP units and put with them the best four of the remaining units to obtain the combination to be used for *AGCE Further Mathematics*.

A M combination	qualification	C1	C2	C3	C4	FP1	FP2	FP3	FP4	D1	M1	M2	S1	S2	Total
units		97	100	83	69	80	89	76	60	93	92	83	83	66	
D1+M1	A M	97	100	83	69					93	92				A 534
	A FM					80	89	76				83	83	66	B 477
D1+S1	A M	97	100	83	69					93			83		A 525
	A FM					80	89	76			92	83		66	A 486
M1+M2	A M	97	100	83	69						92	83			A 524
	A FM					80	89	76		93			83	66	A 487
M1+S1	A M	97	100	83	69						92		83		A 524
	A FM					80	89	76		93		83		66	A 487
S1+S2	A M	97	100	83	69								83	86	A 518
	A FM					80	89	76		93	92	83			A 513

4 No combination is eliminated for using fewer than six scores. It can be seen that an A grade in *AGCE Further Mathematics* is possible, so any combinations which gives a lower grade is now eliminated, so D1+M1 is eliminated.

5 The combination which gives the highest UMS score *AGCE Mathematics* is then used for the award. If more than one combination gave that score then, among those combinations, the one that gave the highest UMS score for *AGCE Further Mathematics* would be used.

A M combination	qualification	C1	C2	C3	C4	FP1	FP2	FP3	FP4	D1	M1	M2	S1	S2	Total
units		97	100	83	69	80	89	76	60	93	92	83	83	66	
D1+S1	A M	97	100	83	69					93			83		A 525
	A FM					80	89	76			92	83		66	A 486

6 In this case *AGCE Mathematics* would be awarded using C1+C2+C3+C4+D1+S1 giving an A grade with UMS total 525 and unit grades aaacaa, and *AGCE Further Mathematics* would be awarded using FP1+FP2+FP3+M1+M2+S2 giving an A grade with UMS total 486 and unit grades aabaac.

The situation is more complicated when awards for all three titles are to be made simultaneously, in that approached naively the number of combinations to be considered expands greatly and would demand much processing time. The awarding bodies' processing departments may be able to find an efficient solution to this challenge. If not, a practical if inelegant solution may be available. Last summer only 71 entries were made for *AGCE Further Mathematics (Additional Award)* and 166 for *ASGCE Further Mathematics (Additional Award)*, of these 53 and 128 obtained A grades (and some of these might not have been certifying all three titles simultaneously). Given that if the qualification grades are the same then Models O and P give the same unit allocations, one could apply best-best and then hand process the small number of candidates for whom this did not give three A grades.

If it was found not to be practical to implement Model O then a return to Model N would be the best course of action.