Response to the QCA consultation questionnaire:

Level 3 Mathematics Qualifications Overarching Issues

1a)   *In what capacity are you responding to this questionnaire?*

<u>Response</u>
Other—Learned Society for mathematics

1b)   *Are you responding to this consultation as an individual or on behalf of a named group?*

<u>Response</u>
Named group: London Mathematical Society

2a)   *A level mathematics should be separate from A level further mathematics and provide the same general grounding in mathematics for all students (Model A).*

<u>Response</u>
Mainly Disagree

<u>Reasons</u>
There are both advantages and disadvantages of splitting mathematics and further mathematics. The advantage of this split is that it makes further mathematics more distinctive, so it really does become further mathematics rather than 'more mathematics'. This would allow it to then enthuse, stretch and enrich the mathematics teaching of the more able students.

However, the splitting of further mathematics from mathematics raises some practical problems, which might cause some centres to stop offering further mathematics. It is important that many schools, and not only those with large cohorts, can offer further mathematics; and not put off students who like the flexibility of the current structure. The growth in the numbers of students doing further mathematics is very welcoming and has led to an overall rising in the standards of students doing not only mathematics but also physics and engineering at post A level. No changes should be contemplated which might in anyway reduce this.

Consider mechanics; it is essential that we get this right. Not only is mechanics important for university admissions for mathematics, it is also essential for those students wishing to study engineering or physics. If the changes to mechanics teaching deter such students from doing further mathematics then the consequences would be very serious. It would also certainly be bad if schools or colleges, as a result, found it harder to offer further mathematics. Model A suggests that mechanics should be components of both the AS and A2 applications modules, with the A2 being rather bitty and possibly hard to teach systematically, due to the small, select nature of the mechanics in the AS applications of mathematics giving a poor starting point for the mechanics for the A2 and further maths modules.

In particular, we agree with the Institute of Mathematics and its Applications (IMA): that this has opened up a debate about the nature of the teaching of applied mathematics in schools, which should be followed up—quickly—after the analysis of the questionnaire.

Q2b) *Which of the alternative models would be your preferred option?*

Response
Each of the models proposed has certain advantages and disadvantages and we do not think there is a clear model that works best for all circumstances. For example, the models B1 (of limited change) and D1 (of effectively retaining the status quo) both have merits for different reasons.

Reasons
One reason for each model having merits relates to the advantages and disadvantages of reducing the number of modules from six to four and the possible effects of the removal of choice. There are arguments on both sides.

The argument for four modules is that it reduces fragmentation and means fewer modules are taken in January. Furthermore, almost all other A level subjects are moving away from taking January modules, saving a great deal of teaching from being blocked out by these exams. There is certainly a strong case for not examining mathematical exams too early: mathematics usually takes a long time to absorb and be understood by the students. Individual exams could be longer if fewer are taken and we would hope that this would then lead to less prescriptive and more challenging, unstructured questions for students. These could be used both for assessment of current students and for the training of future students.

However, such a change could lead to a lot of—possibly unnecessary—reorganization within the teaching of schools and colleges, and therefore must be considered with great care especially once you have taken into account that weaker students often find the split into modules very helpful.

Choice at too early a stage can close doors. Removing choice would allow HE to have more evenly prepared entrants, resulting in less repetition of the material during first year teaching. Removal of choice in A level mathematics could thus, in principle, be a good thing from the HE perspective as they would know better what they had been exposed to. At present, it is increasingly hard to deliver a first year programme of study as students arrive having gained different mathematical knowledge, resulting in a lack of common ground on which to build upon. Moreover, students often see mathematics as a very disconnected subject and fail to appreciate the deep links and unity within it. This has meant that some universities have had to use 'calibration tests' at the beginning of the first year of teaching, to see what mathematical knowledge the students have. It would be very useful for first year programme organizers if a common knowledge of (say) algebra, calculus, statistics and mechanics could be assumed. However, this must be considered within the context of courses that will have a diverse intake with some students having done the International Baccalaureate and diplomas, as well as students from overseas. All HEI departments would appreciate a larger pool of well-qualified mathematics students than many disjoint smaller ones.

However, the idea of a couple of modules (at AS and A2 level) each containing small chunks of mechanics, statistics and discrete mathematics is not very attractive and could lead to a fragmented teaching of mechanics. As we have described above, there are certainly many problems envisaged with this, possibly rather disjointed, way of teaching mechanics, resulting in a challenge to design good modules for the applied elements of the A level.

Students should never have applied unit choices forced onto them due to lack of teacher competence; this is a CPD issue. It is also not clear why teaching mechanics for one year followed or preceded by statistics is better than equal amounts of both being taught side-by-side throughout both years of an A level course.

Q3) *Do you think that pure mathematics content, comprising one-third of the AS and one-third of the A2, should be common to all further mathematics specifications?*

Response
Agree

Q4a) *FSMQs should be used with both use of mathematics and use of statistics.*

Response
Agree

Q4b) *The name of 'statistics' should be changed to 'use of statistics' to make this a coherent group of linked qualifications.*

Response
Agree

Q4c) *Use of mathematics is currently available as an AS level but also as a full A level in a pilot.*

There should be a full A level in use of mathematics.

Response
Disagree

Reasons
There is a growing fear in the mathematics community that the use of mathematics A level could become the 'bulk-buy' option, preferred over A level mathematics and regarded as easier options, formally equivalent. There is not a lot of support of the use of mathematics from the Education Committee, but there is a feeling that it will be inevitable that this A level will be used for students to whom A level mathematics is considered too hard. Following on this concern, this might lead to some centres not offering the usual mathematics A level which would then lead to problems with HE admissions, particularly onto mathematics programmes.

Similar to the Institute of Mathematics and its Applications (IMA), we feel if a full A level is introduced then its uptake should be monitored carefully, particularly in regard to the numbers taking mathematics programmes. We must be confident that there is a growth of numbers in new students rather than a movement from students switching from mathematics to use of mathematics A level.

Q5a) *Do you agree that this proposed suite of qualifications contains qualifications that will meet the needs of all learners who wish to select mathematics for the extended core of their Advanced Extended Diploma?*

Response
Agree

Q5b) *Do you agree that the suite contains qualifications that offer the flexibility to be contextualised in a Diploma line of learning?*

Response
Disagree

Reasons
We are in agreement with the statement from the Institute of Mathematics and its Applications (IMA) on this issue. The model envisaged for the FSMQs, which allows only a single mode of assessment for each FSMQ, will be an obstacle to learners applying the mathematical content learnt to their lines of learning (this holds good for learners taking other level 3 courses). The present FSMQ structure provides for a timed written examination and a portfolio; these seems far better suited to assessing the mathematical concepts and their application in the context of the line of learning. The FSMQ criteria should be altered to permit this and the criteria for GCE use of mathematics and GCE use of statistics amended to exploit this.

Question 6a) *The proposals (ie mathematics, further mathematics, use of mathematics, use of statistics and FSMQs) will provide a coherent set of pathways for mathematics at level 3 covering the needs of all learners.*

Response
Disagree

Reasons
Along with the Institute of Mathematics and its Applications (IMA), we believe that the Advanced Extension award (AEA), or a modified version of it, should be an important element in satisfying the need for stretch and challenge in mathematics.

Also, without the form of FSMQs as suggested in the answer to question **5b)**, the pathway on which learners set out aims for a single FSMQ before deciding to progress further to GCE use of mathematics or GCE use of statistics will be far less attractive.

Q7a) *The revised specifications in AS/A level mathematics and further mathematics should be introduced in 2012 to align them with the changes to the key stage 4 programme of study and the revised GCSE in mathematics which will be introduced in 2010.*

Response
Disagree

Reasons
We feel strongly that any change ought to be managed very carefully with many consultations and pilots with schools/colleges/teachers, and must be taken slowly so as not to disrupt the increase of numbers now doing mathematics and further mathematics A

level. Certainly, any change should only be contemplated if it delivers improved numbers of competent and well-trained students.

Q8) *Given that the revised A levels in mathematics and further mathematics will have more 'stretch and challenge' questions in the A2 assessments, there will no longer be a need for an AEA-style examination in mathematics.*

<u>Response</u>
Disagree

<u>Reasons</u>
There was very little support for A* which was felt to lead to a mindset of just trying to polish answers than really challenging the students.

There was almost universal agreement between the London Mathematical Society (LMS), Institute of Mathematics and its Applications (IMA) and Advisory Committee on Mathematics Education (ACME) that AEA (or equally rigorous qualification) is better than the A* grade for assessing. Also it is felt that further mathematics alone is not sufficient, or appropriate, for someone who is talented but does not wish to take two mathematics A levels.

We would hope and expect that further mathematics could also stretch and challenge students, and we must ensure that the provision of this remains accessible for the greatest number of learners.

We would also hope and expect to see stretch and challenge for students arising through other mechanisms, such as the use of Internet resources (eg. +*plus magazine*), creative use of the United Kingdom Mathematics Trust (UKMT) materials, mathematics Summer Camps, and enrichment activities from schools and colleges working with HE.

One further way to ensure stretch and challenge is to have good textbooks. The community is concerned that many of the A level texts are not trying to challenge or even enthuse students; this area is one in which HE could get involved and help produce better textbooks.