



Department  
for Education

**Consultation Response Form**

**Consultation closing date: 19 September 2014**

**Your comments must reach us by that date**

**Reformed GCSE and A level subject content**

**If you would prefer to respond online to this consultation please use the following link: <https://www.education.gov.uk/consultations>**

The government is reforming GCSEs and A levels to ensure that they prepare students better for further and higher education, and employment. GCSEs are being reformed so that they set expectations which match those of the highest performing countries, with rigorous assessment that provides a reliable measure of students' achievement. The new A levels will be linear qualifications that make sure that students develop the skills and knowledge needed for progression to undergraduate study.

Information provided in response to this consultation, including personal information, may be subject to publication or disclosure in accordance with the access to information regimes, primarily the Freedom of Information Act 2000 and the Data Protection Act 1998.

If you want all, or any part, of your response to be treated as confidential, please explain why you consider it to be confidential.

If a request for disclosure of the information you have provided is received, your explanation about why you consider it to be confidential will be taken into account, but no assurance can be given that confidentiality can be maintained. An automatic confidentiality disclaimer generated by your IT system will not, of itself, be regarded as binding.

We will process your personal data (name and address and any other identifying material) in accordance with the Data Protection Act 1998, and in the majority of circumstances, this will mean that your personal data will not be disclosed to third parties.

<b>Please tick if you want us to keep your response confidential.</b>	<input type="checkbox"/>
Reason for confidentiality:	

Name: <b>David Holland</b>	
Please tick if you are responding on behalf of your organisation.	<input checked="" type="checkbox"/>
Name of organisation (if applicable): <b>Mathematics in Education and Industry</b>	
Address: <b>Monckton House</b> <b>Epsom Centre</b> <b>White Horse Business Park</b> <b>Trowbridge</b> <b>Wiltshire</b> <b>BA14 0XG</b>	

If your enquiry is related to the DfE e-consultation website or the consultation process in general, you can contact the Ministerial and Public Communications Division by email: [consultation.unit@education.gsi.gov.uk](mailto:consultation.unit@education.gsi.gov.uk) or by telephone: 0370 000 2288 or via the GOV.UK ['Contact Us'](#) page.

What best describes you as a respondent?

<input type="checkbox"/> Academy	<input type="checkbox"/> Awarding organisation	<input type="checkbox"/> College
<input type="checkbox"/> Employers/business sector	<input type="checkbox"/> Further education	<input type="checkbox"/> Headteacher
<input type="checkbox"/> Higher education	<input type="checkbox"/> Local authorities	<input type="checkbox"/> Organisation representing school teachers and lecturers
<input type="checkbox"/> Parent	<input type="checkbox"/> School	<input type="checkbox"/> Subject association
<input type="checkbox"/> Teacher	<input type="checkbox"/> Young people	<input checked="" type="checkbox"/> Other

<p>Please Specify:  <b>MEI is a charity and a membership organisation. It is an independent curriculum development body for mathematics. It is a major provider of mathematics teaching and learning resources, and of mathematics CPD for secondary school and post-16 mathematics teachers.</b></p>
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MEI developed and manages the DfE-funded Further Mathematics Support Programme. MEI plays a key role in the management of the National Centre for Excellence in Teaching Mathematics. MEI was responsible for developing, and provides resources and CPD for, a suite of GCE Mathematics qualifications run by OCR.

1 Is the revised GCSE content in each of these subjects appropriate? Please consider:

- whether there is a suitable level of challenge
- whether the content reflects what students need to know in order to progress to further academic and vocational education

Please provide evidence to support your response.

1 a) Art and design

Yes

No

Not Sure

Comments:

1 b) Computer science

Yes

No

Not Sure

Comments:

1 c) Dance

<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Not Sure
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Comments:

1 d) Music

<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Not Sure
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Comments:

1 e) PE

Yes

No

Not Sure

Comments:

2 Is the revised A level content in each of these subjects appropriate? Please consider:

- whether the content reflects what students need to know in order to progress to undergraduate study

Please provide evidence to support your response.

2 a) Dance

Yes                       No                       Not Sure

Comments:

2 b) Music

Yes                       No                       Not Sure

Comments:

2 c) PE

Yes                       No                       Not Sure

Comments:

3 Is the revised AS qualification content in each of these subjects appropriate?

Please provide evidence to support your response.

3 a) Dance

Yes

No

Not Sure

Comments:

3 b) Music

Yes

No

Not Sure

Comments:

3 c) PE

Yes

No

Not Sure

Comments:

4 Is the revised A level content in each of these subjects appropriate in view of the issues raised in ALCAB's reports? Please consider:

- whether the content reflects what students need to know in order to progress to undergraduate study

Please provide evidence to support your response.

4 a) Modern foreign languages

<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Not Sure
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Comments:

4 b) Ancient languages

<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Not Sure
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Comments:

#### 4 c) Mathematics

Yes

No

Not Sure

##### Comments:

We start our comments by stating our agreement with the ALCAB mathematics panel<sup>1</sup> that issues of content are 'intertwined with assessment, structure and delivery'. AS and A level Mathematics and Further Mathematics have enjoyed significant growth in numbers of students over recent years, and this has provided university departments in many subjects with an increasing supply of numerate undergraduates. A key feature behind this success has been the modular structure in the design of the course. We note ACME's view<sup>2</sup> that this 'is an essential feature of A-levels in mathematics and must be retained. In particular, it is crucial that reformed A-levels in mathematics include a choice of applied options, and that Mathematics and Further Mathematics continue to share components'.

Removing this modular structure creates two serious problems. Firstly it causes some technical design difficulties which we note in our response below. Secondly it introduces features which 'risk reducing uptake of these subjects [mathematics and further mathematics]<sup>3</sup>'; we comment on this at the end of this section.

We believe that the current AS and A levels in Mathematics and Further Mathematics can certainly be improved in ways which meet the requirements of Higher Education. However we are very concerned that the changes in structure which have been imposed on the qualifications mean that we will end up with a set of qualifications less fit for purpose than the current ones, despite the best efforts of the mathematics community.

Despite these serious concerns we wish to engage with the current process, and so we offer our response below.

We agree with the *Introduction, Purpose and Aims and objectives* and *Background knowledge* sections.

In the *Overarching themes* section we welcome the increased emphasis on mathematical argument, language and proof, and the clarification that accompanies it. We believe that a few adjustments in 'proof' would improve the preparation for the different kinds of undergraduate study which candidates in AS and A level

<sup>1</sup> <https://alevelcontent.files.wordpress.com/2014/07/letter-from-alcab-mathematics-and-further-mathematics-chair-to-dfe-8-july-2014.pdf>

<sup>2</sup> ACME response to Ofqual consultation on A level Reform – September 2012 <http://www.acme-uk.org/media/10163/acme%20response%20to%20ofqual%20consultation%20on%20a-level%20-%20final%20submitted.pdf>

<sup>3</sup> ACME *ibid*

Mathematics move on to.

Mathematical proof is an important feature of mathematics undergraduate study, where some modules examine the progression of mathematics from axioms to other results through rigorous proof, with all concepts carefully defined. Students intending to study an undergraduate course like this should be taking A level Further Mathematics.

Mathematical reasoning, at least the ability to set out mathematics logically, is also an important feature of undergraduate study in many science, engineering and computer science courses; mathematical proof is not part of these courses. Students intending to follow such undergraduate courses should be studying Further Mathematics, at least to AS.

Students who take only AS Mathematics are not moving on to undergraduate study which requires mathematical proof, and the emphasis is likely to be on statistical reasoning rather than mathematical reasoning. Nevertheless we believe that AS and A level mathematics courses should include some understanding of proof, since it is so fundamental to the subject.

With this in mind we suggest that the proposals should be adjusted as follows.

- It should be stated clearly that students and teachers should, as a matter of routine and where appropriate, prove results encountered on the course. Students are not expected to learn these proofs but, where the mathematics is at an appropriate level, the understanding of such proofs will be assessed in the examinations; students should be able to understand and interpret such proofs. Proofs of related results may also be asked for.
- In addition, it should be a requirement that a section on proof, including the construction of proofs, must be included in any further mathematics qualification. Exam boards may choose to associate this with whatever topic they wish (eg complex numbers, groups), or it could be a standalone topic.

This proposal allows for all students to appreciate the importance of proof in mathematics, and those students who need it to experience the axiom/definition/proof approach to mathematics.

We suggest that OT1.4 is reworded slightly, replacing 'conclusion' by 'general result'. This helps to emphasise that proof refers to a general result, and is distinct from the demonstration of a particular example. For example, 'prove that the area of the region between  $x = 0$  and  $x = \pi$  under the curve  $y = \sin x$  is 2' is not satisfactory; proof should involve aspects of generality.

We welcome the increased emphasis on problem solving (OT2), and the clarification that accompanies it. This is one of the key ways in which Higher Education would like A level Mathematics to be improved.

We welcome the increased emphasis on modelling (OT3), and the clarification that

accompanies it. This is one of the key ways in which Higher Education would like A level Mathematics to be improved.

While we welcome these improvements, we fear that the changes to assessment will hold them back. We have considerable experience to support our view that the validity of assessment of problem-solving and modelling can be improved by the use of a wider range of assessment instruments than timed written examinations; we have made this point in our response to the parallel Ofqual consultation. We are also concerned at the lack of trials of examination questions which assess problem solving and modelling; we are asked to believe that this is possible without evidence. We say more about this in our response to the parallel Ofqual consultation. We also comment below about the suitability of the proposed content as a basis for modelling.

We welcome the step forward in use of technology, but consider it does not go far enough. Para 9 needs to be clearer about whether spreadsheets (which are available on some calculators) are required in examinations. We welcome the requirement for technology (currently calculators) to have specific statistical capabilities, detailed in paras 9 and 14. This is helpful to setters of examinations, who no longer have to try to make questions calculator-neutral, and to candidates and teachers who now know what is permitted and expected. We note that there are other places where such clarity would be helpful. We suggest that calculators used in A level Mathematics examinations should have an iteration capability so that the numerical methods section can be examined adequately.

There remains the problem of the inappropriate use of calculators. It needs to be clear to candidates whether they may use a calculator, for example, to evaluate an indefinite integral or to solve simultaneous equations. We suggest that exam boards are required to make their requirements of candidates clear.

In our view, paras 9 and 10 do not move us far enough forward in the use of technology. This would be rectified if statistical problem-solving were assessed by coursework, or similar, which involved the use of spreadsheets or specialist statistical packages. In our view, para 11 should be strengthened to make it explicit how the use of large data sets can be required by specifications

We reluctantly agree that, if A level Mathematics is to be linear, then prescribing 100% of the content is sensible (para 12). We regret some of the consequences of this, particularly the reduced flexibility in student choice of applied options in both mathematics and further mathematics. The diversity of applied options has evolved over time, reflecting considerable collective wisdom as to the best way of developing young minds mathematically. We hear the comments from Higher Education that they would prefer to know what the content of A level Mathematics is, but we do not believe that the same mathematics is suitable for all the undergraduate courses which use mathematics.

We make some points here about decision mathematics. We agree that, if 100% of the content of A level Mathematics is prescribed, that the applications studied should be statistics and mechanics. However, we do not feel comfortable about the consequences for decision mathematics, given the thousands of students who take the option currently. We note that ALCAB consulted with some end-users of mathematics about decision mathematics, but we are not convinced that their sample was representative of the vast number of users of mathematics in higher education; our own experience of talking with colleagues in higher education, including Russell Group computer scientists and mathematicians, suggests a more nuanced range of opinions. What is particularly regrettable is that there is no curriculum body<sup>4</sup> that could, for example, ensure the place of decision mathematics in Core Maths, nor did the timing of the development of post-16 mathematics qualifications allow for planning of this sort. Unlike mechanics and statistics, decision mathematics does not have a natural place in another subject. Ofqual<sup>5</sup> has commented on 'the significant role of decision mathematics in the modern world' and it is regrettable that many students will have no access to it anywhere in the curriculum.

The proportions of pure mathematics, statistics and mechanics seem about right in A level Mathematics. However, we feel that the total amount of content is rather too much for A level Mathematics; the new aspects of problem-solving will require proper teaching time. This is one of the features of the proposals which we believe will make A level Mathematics harder than currently, and may mean the reforms do not achieve what is intended.

We are happy to accept ALCAB's views on the changes to the pure content in A level Mathematics. No doubt arguments can be made in favour of this or that topic; this list seems coherent enough, but see our observations above about total content.

We note that inflexion/inflection is not spelt consistently.

We make a few comments about some sections of the prescribed content where the wording does not seem clear enough to ensure it is interpreted in the same way by different exam boards.

- A10 Is there a limit to how many terms are allowed in the denominator?
- C1 The restriction to 'linear and quadratic functions' seems odd, given the

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<sup>4</sup> As recommended by the House of Commons Education Select Committee and by ALCAB. House of Commons Education Committee (2012) *The Administration of Examinations for 15–19 Year Olds in England – First Report of Session 2012–13*. London, the House of Commons. Available at:

[www.publications.parliament.uk/pa/cm201213/cmselect/cmeduc/141/141.pdf](http://www.publications.parliament.uk/pa/cm201213/cmselect/cmeduc/141/141.pdf)

ALCAB's letter is here <https://alevelcontent.files.wordpress.com/2014/07/letter-from-alcab-mathematics-and-further-mathematics-chair-to-dfe-8-july-2014.pdf>

<sup>5</sup> Ofqual 2012 *International Comparisons in Secondary Assessment*

use of recurrence relations in H2 where such a restriction makes no sense.

- C5 In the last sentence it is not clear whether learners should know under what circumstances the expansion is valid.
- D8 Is this defined well enough?
- F1 Convex and concave are defined differently in different textbooks. It might be helpful to pick on one definition here.
- H2 Is the geometrical interpretation of the Newton-Raphson method included? It should be specified if so. Presumably the phrase about cobweb and staircase diagrams is not meant to apply to Newton-Raphson?
- H3 For the purposes of common interpretation this needs to be specified more clearly eg the trapezium rule.

We welcome very much the change in approach to statistics: the removal of tedious calculations and drawing of diagrams; the emphasis on a problem solving approach with real data; the inclusion of hypothesis testing in AS Mathematics. We note, however, that the content does not cover the entire statistical problem solving cycle, and we do not believe this partial approach is satisfactory.

There are also some statements which lack clarity.

- J1 There are many sampling techniques. Which are intended?
- K3 The calculator statement above section J suggests that summary statistics are to be calculated, but this is not stated in the content, for example at K3. Do learners need to calculate (say) standard deviation from raw data using calculator functions? Do they need to be able to calculate standard deviation given  $n$ ,  $\Sigma x$ ,  $\Sigma x^2$ ? Which version of standard deviation is intended? There is no mention of variance, which may be needed for work on distributions.
- L3 What does this mean? Is it clear enough to be interpreted in the same way by different exam boards?
- M1 How are the mean and standard deviation of a probability distribution to be understood? Are they to be calculated? How is the 'link to the binomial expansion' to be assessed?
- N4 This is the first mention of correlation coefficient. Should it have been mentioned in section K? Which correlation coefficient is meant?

We have concerns about the mechanics content in sections O to R. In places we believe it is not sufficiently clear what is meant. For instance

- In P3/4/5 and Q4, what exactly does ‘using vectors’ mean? Does it mean more than candidates should be able to understand and use standard vector notation?
- In Q2, what does ‘in 1 dimension’ mean? Is it the motion that is in 1 dimension (so it could be motion on an inclined plane) or does it mean all the forces acting are in one dimension (so you cannot even have the motion of a car on a horizontal road)? Is what is intended ‘straight line motion on a (perhaps rough) horizontal plane’?
- In Q6, what is meant by ‘Coulomb’s model of friction in 1 dimension? We suggest, ‘Understand and use Coulomb’s model of friction; coefficient of friction; motion of a body on a rough surface; limiting friction ( $F \leq \mu R$ ) and static equilibrium’.

In addition we are concerned that the mechanics content in A level Mathematics may not be sufficient to allow achievement of the requirements of the Assessment Objectives and Overarching Theme 3 for modelling. Inclusion of, say, the use of smooth pulleys and the statics and dynamics of connected particles connected by a light inextensible string or rod would provide a much needed rich source of scenarios requiring multi-step arguments and the opportunity for modelling (please see below in 5c). If this makes the content too large then we suggest some topic is removed (not necessarily from the mechanics) in order to ensure that the mechanics content can be properly assessed. We note that there is strong feeling from the engineers and physicists that the mechanics part of the assessment should work well. If a topic has to go from the mechanics then, regrettably, we think it should be section R on moments. If from the Statistics, omit correlation; if from the Pure omit partial fractions.

Given our concerns about both the volume of the content and some aspects of its detail, we request that ALCAB should revisit the content in the light of the consultation responses.

Of great concern to us is the risk to uptake of mathematics and further mathematics. We wish this to be clearly heard by both Ofqual and the DfE, so we repeat below what we have written in our response to the Ofqual consultation.

“We are also very concerned about uptake, believing that there is a high risk of a significant drop in the numbers of students taking AS/A levels in mathematics and further mathematics. We recall that much smaller changes to the qualifications in Curriculum 2000 resulted in a drastic drop in numbers taking A level Mathematics which took a quick change in specifications and

several years for recovery. We note that Professor Mark Smith collected a considerable amount of evidence that supports our view<sup>6</sup> and he recommended that ‘there will need to be careful modelling of the new qualifications’ to avoid ‘a severe setback in uptake’. This has not happened. ALCAB was given a remit of looking only at content, but they have expressed serious concerns about the effects on uptake of the overall proposed changes, in a well-argued letter which merits careful reading.<sup>7</sup>

“We have to add our voice to these warnings. All the evidence we are aware of leads in one direction – there is a huge risk that the overall effect of the changes proposed will be a significant drop in the number of students taking A levels in mathematics and further mathematics. Our concerns include the following.

- The overall effect of the reforms will be to make the examination papers harder. No doubt the grade-thresholds can be arranged to produce comparable outcomes, but many students will be aware that there are considerable parts of the paper which they cannot tackle. This will result in loss of confidence among students, and the message will soon spread that mathematics is hard. One of the consequences of harder exam papers in Curriculum 2000 was a bimodal distribution of marks; mathematics seemed to become a subject that either you could do or you couldn’t, and so students dropped out.
- Success at mathematics is based on confidence, which is based on success. The current modular system is ideal for this; it was designed for mathematics (before other subjects) for this reason. Students who succeed with a small amount of mathematics often can then be persuaded to take some more. After succeeding with this they often then tackle even more. The linear model asks students to commit to a two year course in a subject which they already know (from the data) is harder than other subjects, and which they hear has just got even harder.
- The decrease in flexibility of options may make mathematics less attractive. For example, thousands of students currently take A level Mathematics studying statistics and/or decision maths, and there is a risk that a proportion of such students may be put off by mechanics being compulsory.”

As well as our concerns about uptake we have serious concerns about the

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<sup>6</sup> <http://ofqual.gov.uk/files/2013-09-06-smith-review-of-specification-content-july-2013.pdf>

<sup>7</sup> <https://alevelcontent.files.wordpress.com/2014/07/letter-from-alcab-mathematics-and-further-mathematics-chair-to-dfe-8-july-2014.pdf>

assessment objectives and how they are implemented. We have expressed this in our response to the parallel Ofqual consultation. Our concerns are serious enough that we have written

“... we do not believe that the assessment arrangements for new AS/A levels in Mathematics and Further Mathematics are yet fit for purpose, and we call for a delay in implementation of the reforms. There needs to be proper time for

- ‘careful modelling of the new qualifications’ to avoid ‘a severe setback in uptake’, which Professor Mark Smith called for;
- trial question papers to be written, to investigate whether the proposed assessment objectives and their weightings are workable and achieve what ALCAB expect;
- discussion and consultation about how the assessment objectives are to be implemented, before the development process starts;
- a review of the evidence about non-exam assessment and the place of technology, in the light of the increased emphasis on problem-solving and modelling.”

4 d) Further mathematics

Yes

No

Not Sure

Comments:

Please see the opening four paragraphs of our response to question 4c).

We agree with the *Introduction, Purpose and Aims and objectives and Background knowledge* sections.

In the *Overarching themes* section we welcome the increased emphasis on mathematical argument, language and proof, and the clarification that accompanies it. We believe that a few adjustments in ‘proof’ would improve the preparation for the different kinds of undergraduate study which candidates in AS and A level Mathematics and Further Mathematics move on to. Please see our response to question 4c) for our suggestions.

Please see our response to question 4c) for our comments on the use of technology. In addition it should be made clear whether it is expected that

technology (currently calculators) can manipulate matrices; we believe this should be a requirement for all specifications. We would also want exam boards to make such matters clear when they are relevant to content which they choose to be in further mathematics specifications.

We welcome the prescription of 50% of the content for A level Further Mathematics. However we believe that there is a considerable problem in the definition of what '50% of assessment' means in paragraphs 6 and 13. It might seem at first to be acceptable to have a question paper, or two, which cover this 50% core, worth 50% of the marks. On closer examination you would find that some of the marks in an optional mechanics paper are actually awarded for using content from the core, and that a different number of marks are awarded for using core content in an optional statistics paper. Does this break the 50% rule? It needs to be made clear that this is not the case, otherwise options become impossible. Something needs to be said along the lines of 'if the core content is used in a question where the focus of the question is an application, then this does not count towards the 50%'. This does not cover section H, where modelling using differential equations is part of the core. It would seem that using differential equations in an applied paper would be difficult, as it would have to count towards the core, H3. We suggest the wording used in science may be helpful: "The skills, knowledge and understanding for A level must comprise approximately 60 per cent of an A level specification." Note there is no mention of assessment. So the first sentence in paragraph 6 of the draft content could be changed to "A level further mathematics has a prescribed core which must comprise approximately 50% of an A level further mathematics specification".

We are happy to accept ALCAB's views on this prescribed content, though there are places where the wording lacks clarity. This matters if exam boards are required to interpret the wording in the same way. We give some examples below.

A11 What types of algebraic problem? This is very open to interpretation.

B6 Is it the intention that learners use a calculator to calculate the inverses (and in B5 the determinants) of matrices?

D6 Does 'associated functions' include completing the square?

E5 Is it intentional to omit distance from point to plane, point to line etc?

G1 'and use'? as for inverse functions in G3? Are equations involving hyperbolic functions included?

We have concerns about how the remaining content will be decided. Who will decide whether what is proposed by awarding organisations is acceptable? What

criteria will be used? How will comparability be assured? We think it is vital that the process and the criteria are published and consulted on before development begins; it would not be satisfactory if it were left to Ofqual to invent its own criteria without consultation.

4 e) Geography

Yes

No

Not Sure

Comments:

5 Is the revised AS qualification content in each of these subjects appropriate?

Please provide evidence to support your response.

5 a) Modern foreign languages

Yes

No

Not Sure

Comments:

5 b) Ancient languages

Yes

No

Not Sure

Comments:

5 c) Mathematics

Yes

No

Not Sure

## Comments:

The proportions of pure mathematics, statistics and mechanics seem about right in AS Mathematics. However, the attempt to include a coherent body of mechanics and statistics in AS Mathematics, together with the inclusion of  $e^x$  for modelling, makes AS a bit crowded if problem-solving is to be developed well.

We welcome very much the change in approach to statistics: the removal of tedious calculations and drawing of diagrams; the emphasis on a problem solving approach with real data; the inclusion of hypothesis testing in AS Mathematics. We note, however, that the content does not cover the entire statistical problem solving cycle, and we do not believe this partial approach is satisfactory.

Please see our comments about the lack of clarity in the mechanics sections O to R in our response to question 4c.

In addition we are very concerned that the mechanics content in AS Mathematics is not sufficient to allow achievement of the requirements of the Assessment Objectives and Overarching Theme 3 for modelling. There are some large omissions, such as resolution of forces, that reduce the potential scope of any multi-step task. For instance, even scenarios for motion on a horizontal plane would be limited as, without resolution of forces, you cannot have scenarios such as a sledge pulled by a piece of string at an angle to the motion. There is also no mention of connected bodies so another whole set of interesting problems has been lost. One can contrive scenarios that avoid the need for resolution in common situations but repetition would make them seem artificial.

We believe that it is necessary to show that questions based on the given content can be written which arise naturally from real-world situations without undue artificiality and that meet the modelling requirements and the requirements of AO2 and AO3. There must also be sufficient scope for such questions not to become predictable. It would help if the proportion of marks assigned to AO2 and AO3 were reduced for AS. We have made suggestions in our response to the parallel Ofqual consultation. To enrich the content, as in A level, we suggest including the use of smooth pulleys and the statics and dynamics of connected particles connected by a light inextensible string or rod. Room would have to be made for this and we suggest omitting vectors from AS as what is needed builds directly from coverage at GCSE.

The reason for these difficulties is that the removal of modularity requires a small amount of statistics and a small amount of mechanics in AS Mathematics, and this does not turn out to be sensible for mechanics. (The alternative is to put only statistics in AS Mathematics, but this is unsatisfactory for A level mathematicians who are examined on it at the end of Year 13 and it would make it difficult, if not impossible, to include any mechanics in AS Further Mathematics that would not overlap with the mechanics in the second year of A level Mathematics.)

Given our concerns about both the volume of the content and some aspects of its detail, we request that ALCAB should revisit the content in the light of the consultation responses.

5 d) Further mathematics

Yes

No

Not Sure

Comments:

Please read this response in the light of the opening four paragraphs of our response to question 4c. The effect of removing modularity raises particular design issues for AS Further Mathematics, as the list of concerns below demonstrates. We believe that, even if our suggested modifications below are accepted, we will end up with a mathematics curriculum less well-designed than the current one.

Below are two paragraphs which we have included in our response to the parallel Ofqual consultation on assessment arrangements. We fear very much that the new arrangements will lead to a serious drop in the number of students taking further mathematics, and we think the key to this is the place of AS Further Mathematics.

“We believe strongly that AS Further Mathematics should be treated in a different way from other AS qualifications. Among all subjects it is the only AS that follows on from another subject, mathematics, as well as being a subset of its own corresponding A level; it does not make sense to decouple it from its surroundings and we believe this should not be done. It is an invaluable qualification, highly-regarded by universities. Currently many students take AS Further Mathematics in Year 12, alongside AS Mathematics. The intention of the DfE consultation document is that this arrangement should continue to be possible. A different cohort of students, encouraged by their success in AS Mathematics and realising that the course they now intend to take in HE would benefit from more mathematics, take up AS Further Mathematics in Year 13; many Sixth Form Colleges have at least one class of such students. The mathematics they need is not necessarily the same as those who sit AS Further Mathematics in Year 12.

“We note that ALCAB recommends a staged move towards linearity<sup>8</sup>, because of its concerns about the possible risks associated with the change. We strongly recommend that AS Further Mathematics and A level Further Mathematics are not decoupled for at least the first four years of the new qualifications, allowing two cohorts of students to complete the course, so

<sup>8</sup> Letter from ALCAB to the DfE at <https://alevelcontent.files.wordpress.com/2014/07/letter-from-alcab-mathematics-and-further-mathematics-chair-to-dfe-8-july-2014.pdf>

that it can be seen whether ALCAB's and our concerns are justified. This would

- encourage more students to move from AS to A level in Further Mathematics
- allow for students to select options appropriate to their future intentions
- encourage take-up of AS Further Mathematics in Year 13.”

We have concerns about para 7 'the content of AS further mathematics ... must not overlap with, or depend upon, other A level mathematics content'. We fear that this may make AS Further Mathematics unworkable as a coherent specification. We suggest changing the wording to 'the content of at least one option in any AS Further Mathematics specification ... must not overlap with, or depend upon, a significant amount of other A level Mathematics content'. We have two reasons for this.

- Our analysis of the content (below\*) suggests that without some small dependency on or overlap with the content of A level Mathematics it will not be possible to produce a coherent AS Further Mathematics specification. Exam boards will naturally want to minimise this dependency to make their specifications attractive.
- Allowing optional routes to AS Further Mathematics which do rely on dependency on or overlap with the content of A level Mathematics will allow students who choose to start AS Further Mathematics in Year 13 to choose topics which are more relevant to their intended undergraduate course, for example more advanced mechanics for Engineering; being forced to study only topics which can be co-taught with AS Mathematics will be very limiting and unattractive.

One unintended consequence of the current para 7 is that decision mathematics will appear in AS Further Mathematics, almost by default. This is deeply ironic, given the comments of ALCAB about decision mathematics; the consequence of the new arrangements appears to be that the students aiming at mathematics, physical sciences and engineering at the top universities are forced to do decision mathematics. This is very unsatisfactory. This situation has arisen because of the removal of modular specifications; in the current arrangement some units can count towards either mathematics or further mathematics and this allows enough flexibility that a rule like that in para 7 is not required.

\* This is our analysis of the problems caused by keeping para 7 as a strict requirement. Ruled out of AS Further Mathematics would appear to be:

- A8 – A11 from Complex numbers
- C4-C6 from Further algebra and functions (also, it would seem strange to do C7 – C9 before Numerical methods from A level Mathematics, though it

might be possible).

- D1 – D6 from further calculus, apart from trivial cases of volumes of revolution and mean value, and some improper integrals
- E1 – E7 ie all of further vectors, because 'vectors in 3D' is not in AS Mathematics but is in A level Mathematics
- F2 – F3 from Polar coordinates
- G2 – G5 from Hyperbolic functions
- H1 – H9 ie all of Differential equations

This list suggests it may not even be possible to select a further 10% of suitable content from the prescribed core content of A level further mathematics, as para 7 currently lays down.

In addition the following applied content would appear to be ruled out from AS Further Mathematics:

- Motion in 2 or 3 dimensions
- Rigid bodies and frameworks in equilibrium in 2 dimensions (resolving forces in A level mathematics but not AS)
- Work done by a force at an angle to its line of action
- Energy methods involving potential energy in 2D
- Any situation with friction
- Impulse and momentum in 2 dimensions
- Centre of mass beyond simple cases
- Circular motion
- SHM
- Bivariate data, since interpreting correlation coefficients is not in AS Mathematics
- Anything that involves selecting a probability distribution (so can't ask whether Binomial or Poisson is appropriate in this context)
- Continuous random variables, where they depend on integration by parts

In addition, any further numerical methods would appear to be ruled out from AS Further Mathematics.

The topics from pure mathematics, mechanics and statistics which are permitted do not appear to make a very coherent course, so it would seem likely that decision mathematics would become a standard and substantial part of AS Further Mathematics.

5 e) Geography

Yes

No

Not Sure

Comments:

- 6 Is the revised modern foreign languages content, covering assessment of all four skills (reading, writing, speaking and listening), applicable to all languages currently available for study at AS and A level?

Yes

No

Not Sure

Comments:

Thank you for taking the time to let us have your views. We do not intend to acknowledge individual responses unless you place an 'X' in the box below.

**Please acknowledge this reply.**

**X**

Email address for acknowledgement: [daholland@btinternet.com](mailto:daholland@btinternet.com)

Here at DfE we carry out our research on many different topics and consultations. As your views are valuable to us, please confirm below if you would be willing to be contacted again from time to time either for research or to send through consultation documents?

Yes

No

All DfE public consultations are required to meet the Cabinet Office [Principles on Consultation](#)

The key consultation principles are:

- departments will follow a range of timescales rather than defaulting to a 12-week period, particularly where extensive engagement has occurred before
- departments will need to give more thought to how they engage with and use real discussion with affected parties and experts as well as the expertise of civil service learning to make well informed decisions
- departments should explain what responses they have received and how these have been used in formulating policy
- consultation should be 'digital by default', but other forms should be used where these are needed to reach the groups affected by a policy
- the principles of the Compact between government and the voluntary and community sector will continue to be respected

Completed responses should be sent to the address shown below by 19 September 2014

Send by email to: [Gcseandalevel.consultation@education.gsi.gov.uk](mailto:Gcseandalevel.consultation@education.gsi.gov.uk)

Send by post to: Alex Smith, Floor 2, Sanctuary Buildings, Great Smith Street, Westminster, London SW1P 3BT, UK

If you have any comments on how DfE consultations are conducted, please contact Aileen Shaw, DfE Consultation Co-ordinator, tel: 0370 000 2288 / email: [aileen.shaw@education.gsi.gov.uk](mailto:aileen.shaw@education.gsi.gov.uk)

**Thank you for taking time to respond to this consultation.**