AEA Mathematics: Session description

The Advanced Extension Award (AEA) in mathematics is a qualification designed to challenge and differentiate between the most able Advanced Level candidates and will continue to be available at least until June 2012. The qualification is accessible to all able candidates, whatever specification they're studying, as it is based on A Level subject criteria rather than individual specifications. The session will outline a brief history of the qualification and a description of what the papers aim to achieve. The focus of the session will be on how teachers can help students to become more independent in tackling these papers; using past questions to illustrate recurring themes with ideas of how questions can be used as enrichment in A Level teaching.

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the **Further Mathematics** Support Programme

www.furthermaths.org.uk

Advanced Extension Award (AEA): Enriching and supporting students

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MEI
Mathematics in Education and Industry

Advanced Extension Award

- *A brief history of the qualification*
- *What do the papers aim to achieve?*
- *Supporting students*

Background

- AEAs were introduced in 2002, in response to the *Excellence in Cities* report, as a means of testing students against standards comparable with the most demanding to be found in other countries

- Aimed at the most able A level students (top 10%) to provide challenge and opportunities for students to demonstrate greater depth of understanding than that required at Advanced GCE
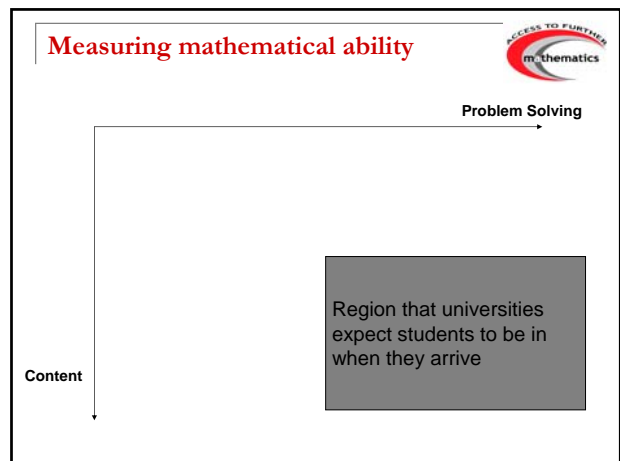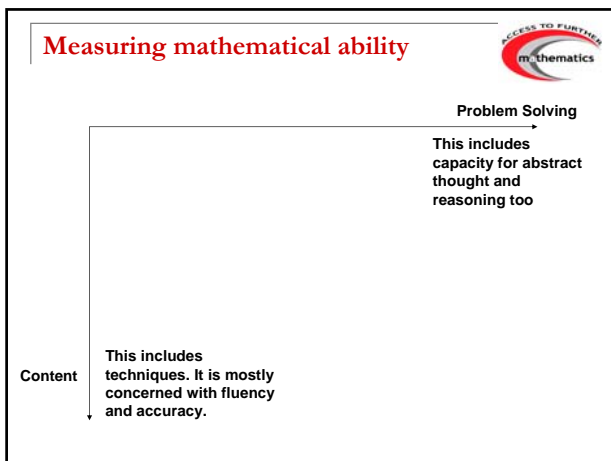

Background

- Designed to be accessible to all able students, whatever their school or college and whichever specification they are studying; requiring no additional teaching or resources (!)
- Proposed to ensure that significantly more young people have the opportunity to take them (cf. Special Papers)
- Intended to differentiate between the most able candidates, particularly in subjects with a high proportion of A grades[†] at Advanced GCE, in order to avert the need for universities to develop their own entry tests.

[†] 2008 25.8% of all A level subjects were given an A grade.

'Measuring' mathematical ability

Problem Solving

Content

Measuring mathematical ability

Problem Solving

This includes capacity for abstract thought and reasoning too

Content

This includes techniques. It is mostly concerned with fluency and accuracy.

Measuring mathematical ability

Problem Solving

Content

Region that universities expect students to be in when they arrive

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Change

- 'Stretch and challenge' has been introduced to the A2 part of the A level specifications and a new A* grade has been introduced to reward exceptional performance.
- Since 2009, AEA qualifications have been withdrawn for all other subjects **except Mathematics**
- AEA for Mathematics has been extended until at least June 2012 (Edexcel) June 2013 (QCDA)
- What are the alternatives? New A level? STEP, EPQs….

Stop press!

Letter from DfE to MEI 16th June 2010:

The Minister of State for Schools, Nick Gibb MP, has therefore announced today that the current review of A levels and other level 3 qualifications in mathematics subjects will not continue. In doing so he has noted that these are immensely important qualifications which should be as rigorous as any in the world, and must properly reflect the views and needs of universities in their development.

The current suite of level 3 mathematics qualifications, including the Advanced Extension Award, will continue to be available until the new qualifications development procedures are in place and the mathematics suite can be reviewed through them.

AEA Mathematics:

AIMS (Edexcel Specification)

The AEA in mathematics aims to provide a sense of achievement and a stimulating mathematical challenge through:

- encouraging students to use what they have been taught;
- encouraging students to think beyond what they have been taught;
- encouraging students to develop **confidence, stamina and fluency** in working through **unfamiliar and/or unstructured problems** which might demand **multi-step analysis or the exploration** of different possibilities;

AEA Mathematics:

AIMS (Edexcel Specification)

- building chains of logical reasoning and using concepts of proof;
- testing critical thinking and the critical evaluation of a mathematical argument;
- rewarding elegance, clarity and insight in the solution of mathematical problems.

Assessment

- 3 hour written examination
- **use of a calculator NOT permitted**
- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- Answer ALL questions.
- There are typically 7 questions in the question paper (vary in length, awarded 6 - 20 marks).
- The total mark is typically 100, of which 7 marks are for style, clarity and presentation.

2001 Pilot

A: Pure

B: Pure, Mechs, Stats, Decision

How are the papers graded?

The Grades awarded for the AEA

- 1 (Distinction),
- 2 (Merit)
- and U (Unclassified)

'Merit' grade on the AEA paper corresponds to scoring roughly 50%; distinction about 70%

UCAS: Distinction = 40 points   Merit=20 points

Entries and pass rate

Year	No. sat	pass %	distinction %
2002	?	42.3	13.7
2003	1005	32.1	9.7
2004	976	26.6	10.1
2005	1001	31.3	10.3
2006	1168	22.2	7.4
2007	1270	32.9	11.2
2008	1473	40.3	12.6
2009	1496	40.2	12.8

Data includes: Schools, F.E. Private & external candidates, others

Extracts from Examiners' Reports

- Some candidates performance is hampered as they could not quote basic formulae such as the cosine rule (given in the formula booklet!) or recall standard mathematical facts such as $\sin\left(\frac{\pi}{3}\right) = \frac{\sqrt{3}}{2}$
- Calculus questions were handled well.
- Logarithms are still causing problems for many
- Geometrical demands often prove too much for all except the best.
- Style, clarity and presentation marks are awarded infrequently as complete, efficient solutions to whole questions were all too rare.

Extracts from Examiners' Reports

- Many candidates are clearly unprepared for the challenge.
- It's sometimes difficult to understand the strategy being used by schools to enter candidates for this examination; many seem not to meet the design intentions of being in the top third of the A grade range.
- Those gaining a Distinction showed a good grasp of the mathematical techniques involved and an ability to develop logical arguments, provide elegant solutions and carry through extended pieces of algebra and work persistently to complete questions.

What are the issues with supporting students through AEA?

- Questions are longer
- Questions sometimes have no immediately obvious 'way in'
- Questions will frequently require students to use skills from different parts of the curriculum together
- Questions sometimes require knowledge that doesn't get much emphasis in standard A-level Mathematics

Approaches to supporting students

A spectrum of types of support

| Low cost, low expert input | | High cost, high expert input |

Give students access to all the past papers and solutions they need and someone to ask for help

Give students a fully structured course with regular marked homework and explore the 'themes' that tend to feature in AEA

What support is already out there?

- http://meikleriggs.org.uk for solutions to AEA past paper questions (and STEP), kindly made available by Dr Peter Mitchell.
- http://www.maths.cam.ac.uk/undergrad/admissions/step/advpcm.pdf to download Advanced Problems in Core Mathematics by Dr Stephen Siklos
- Graham's Mathematics Emporium (teacher access) http://www.edexcelmaths.com/

What support is already out there?

- Ask NRICH: join a mathematics discussion forum and send questions.
  http://nrich.maths.org/discus/messages/board-topics.html

- MEI Online AEA Resources

- Online STEP and AEA Tutorials

MEI - Online AEA Courses

- Delivered 'live' in real time via the Internet.
- 10 one-hour sessions (typically starting in February and ending in June).
- Students will be expected to look at the questions to be discussed in a session prior to that session and will be sent a weekly e-mail containing the questions, hints and reading references.
- 2010 Course fees £150

AEA online tutorials

Schedule	Topic
Session 1	Constructing a beautiful, coherent, concise argument: the proper use of notation.
Session 2	Using Series imaginatively
Session 3	Solving trig equations without getting too many or too few solutions.
Session 4	Co-ordinate Geometry: a use for GCSE Circle Theorems at last.
Session 5	Polynomials and Graphical Transformations
Session 6	Functions: how to make the simple look difficult.
Session 7	Vectors
Session 8	Differentiation Techniques
Session 9	Integration Techniques
Session 10	Unusual Questions: are they really hard?

Structure of the online resources

The material is divided into ten sections. Each section typically contains

- **Brief Notes** - these contain the main mathematical ideas for the section
- **Weblinks** - some useful background reading
- **Multiple Choice Test** - these are designed to test the key ideas quickly
- **Worked Solutions to the Multiple Choice Test** - look when you've tried it!
- **'Getting Started' Questions** - shorter questions you may wish to attempt before moving on to past paper questions
- **Worked Solutions to 'Getting Started' Questions**
- **Past AEA Questions Sheet** - selected past paper questions
- **Past AEA Questions Worked Solutions**
- **A Video Worked Solution (suitable for IPod format).**

Are these resources being used?

Early April 2010

- 615 students have been given 'logins' since Jan 2010
- 444 students have accessed the resources in the last 4 weeks
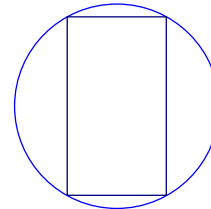- 375 have accessed the resources in the last 10 days

End of June 2010:

80 students in the last 4 weeks

Starting off…

The circle in the diagram has radius 6 cm. If the perimeter of the rectangle is 28 cm, what is its area?

(Not to scale)

Senior Team Maths Challenge 2007
Group Round

Multiple choice

Functions: how to make the simple look difficult.

If $f(x)$ is an even function then so is the function $[f(x)]^2$. This statement is:

(a) always true

(b) never true

(c) sometimes true

(d) only true for polynomial functions

Choose one answer.   ○ (a)
                       ○ (b)
                       ○ (c)
                       ○ (d)

Save without submitting   Submit all and finish

When is it best to start preparing for the AEA?

The general consensus seems to be AS SOON AS POSSIBLE
Whenever you start it is important to:

- build confidence by starting with easier questions

- be there to provide reassurance that students shouldn't necessarily expect to be able to answer questions straight away

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Discussion

- Are you supporting AEA students this year?
    - When do you start preparing?
    - What different models are there for doing this?
    - How do you use the resources available to you?

- If you are going to be supporting AEA students for the first time what kind of advice/support would you find useful?

- A* grade (awarded this summer) …comments?

Websites

- http://meikleriggs.org.uk
- http://www.maths.cam.ac.uk/undergrad/admissions/step/advpcm.pdf
- http://www.edexcelmaths.com/
- http://nrich.maths.org/discus/messages/board-topics.html
- http://www.mei.org.uk/index.php?page=stepandaea

sharontripconey@furthermaths.org.uk

One case..

- We have 14 further mathematicians, 3 with Oxbridge offers and nearly all doing maths or maths related at university. We don't have allocation in the timetable for STEP or AEA lessons.
- Most of our further mathematicians decide to do AEA but some then change their minds when they decide to focus on retakes instead.
- As a school, we're glad that it's still available as it's a great way to extend able students and I personally don't feel the EPQ does the same.
- We have loaded all the old papers and solutions onto the VLE and given passwords to students as and when necessary. The same is true of the STEP papers so students can do these too as they wish.
- The students all took D2 in January and the free hour they now have from this they can study for the AEA or do other maths work. If they do AEA, then the head of maths (who takes this class) will get them to work through the questions at their own pace, but will run through solutions during lessons to keep structure. This is the second year we have done this and it seems to work well. Additionally, we have written hints for all the questions also available on the VLE. We have an ex head of dept who is about 70 and an incredible mathematician - he comes in voluntarily to support the students.
- We emphasise independent learning a lot, and the students appear to meet up outside of lessons. They also have a further maths facebook group which they seem to use. I think the fact that they are competitive adds to their enthusiasm!

A* grade for Advanced level Mathematics and Further Mathematics

- For an able student, averaging over 90 uniform marks in C3 and C4 is more down to not making any silly mistakes than to showing real mathematical flair, because the current papers test students' ability to apply the techniques they have learned to fairly standard problems. The papers are not designed to identify students with high-level mathematical problem solving skills.
- Universities who ask for an A* in Maths in an attempt to identify very mathematically-gifted students won't necessarily find the students they are hoping for.

- It could have highly undesirable unintended consequences on students' behaviour regarding Further Maths. Already cases are emerging where students have dropped FM as a fourth A level in order to concentrate on meeting university offers which ask for an A* in Maths but do not specify FM, even though FM would have been very useful to them on their degree courses.

- Opinion: A* grade in Advanced level Mathematics, as it is currently designed, is not fit for purpose and universities should not try to use it to select the most able students. Universities would be far better to ask for Further Mathematics and, if they wish to identify the really mathematically-gifted students, a separate paper, with unstructured questions and 'thinking time' to solve them should be specified, such as AEA or STEP.

Additional Comments

- Not all of the 'best' students take the AEA as some see it as an increased workload (both for teachers and students)
- It only occasionally forms part of a conditional offer from a university, many students see it as somewhat pointless.
- In some colleges and sixth forms, only students who are applying to Oxbridge / Warwick are allowed to sit the exam.

UCAS

- A Distinction is worth 40 UCAS points, and a Merit worth 20 points.
- Bearing in mind that a grade A at A level is worth 120 points, this adds to the arguments against the AEA being a worthwhile use of school's time and resources.
- However, it should be noted that 40 points is the equivalent of two grade boundaries at A Level, and thus a student with A Level results ABB, for example, would be bumped up to the equivalent of AAA.