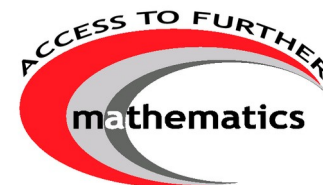


# Further Mathematics Support Programme



the Further Mathematics Support Programme

[www.furthermaths.org.uk](http://www.furthermaths.org.uk)



# Further Mathematics Support Programme

## School to University Transition

Let Maths take you  
Further...

Funded by

Department for  
**Education**



Mathematics in Education and Industry

# A level Biology exam

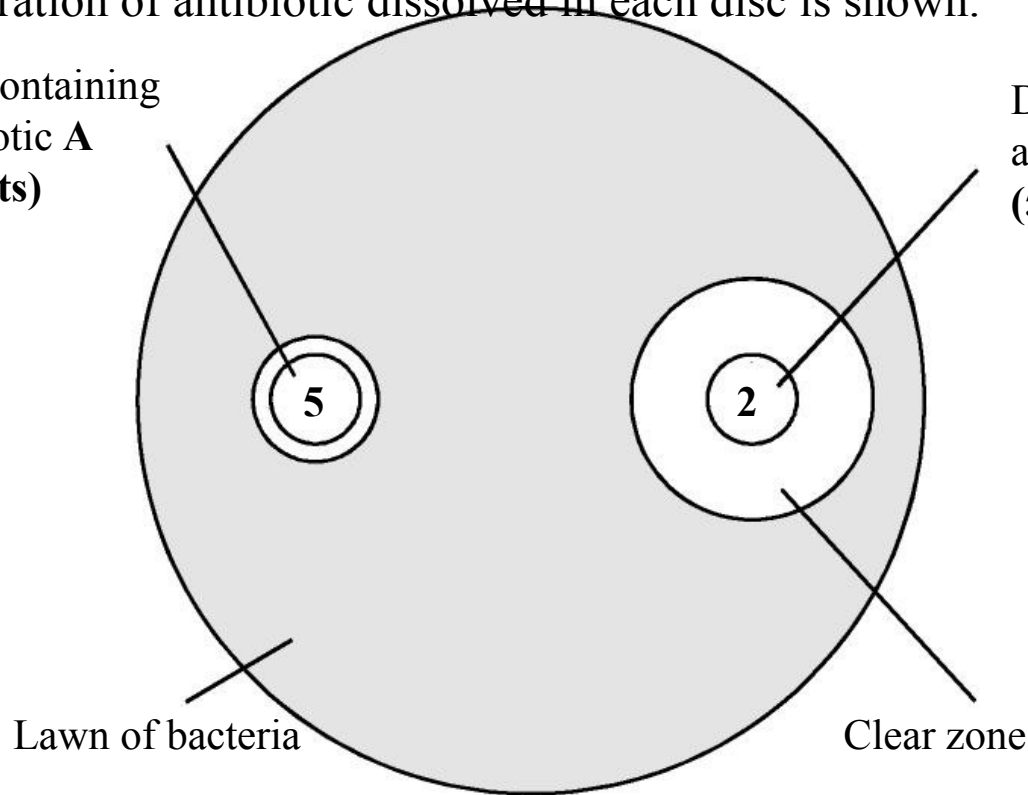
## question

Filter paper discs soaked in two types of antibiotic were placed on a lawn of bacteria growing in a Petri dish.

The concentration of antibiotic dissolved in each disc is shown.

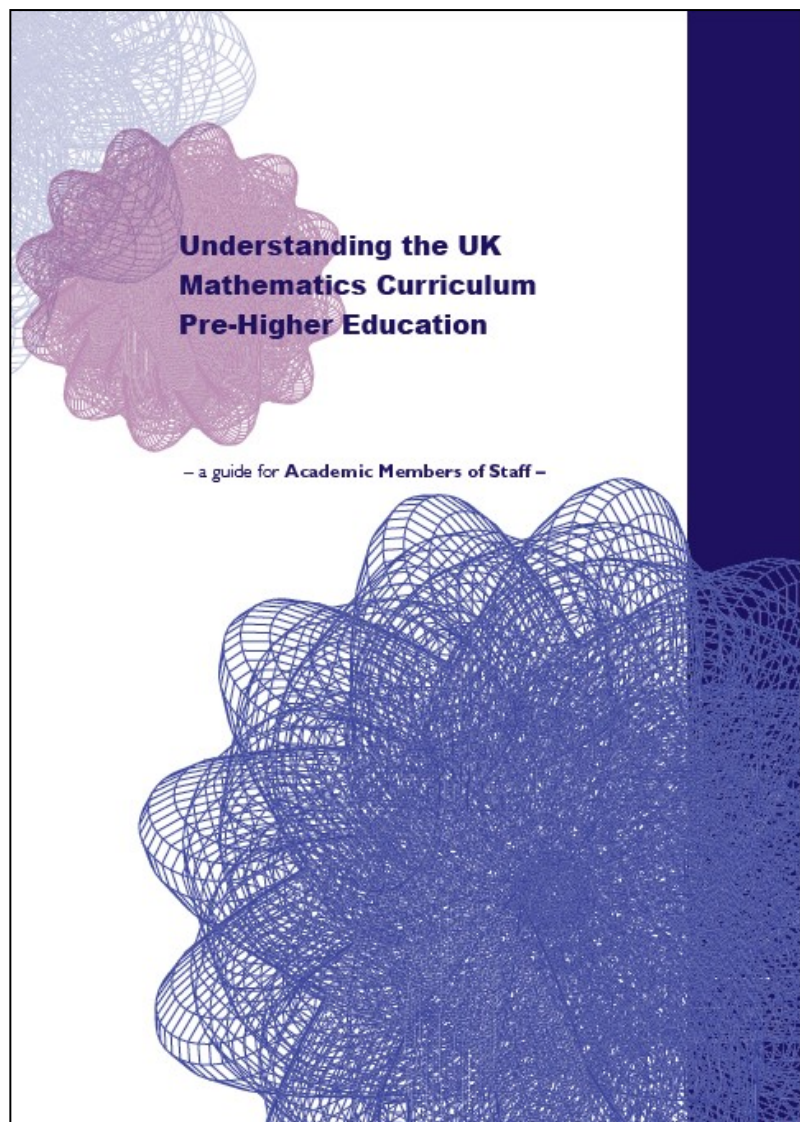
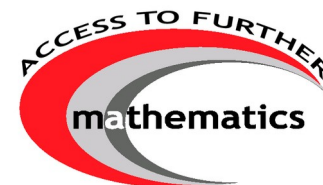
Disc containing  
antibiotic A  
(2 units)

Disc containing  
antibiotic B  
(5 units)



How many times more effective is antibiotic B than antibiotic A?  
Explain how you arrived at your answer.  
(2 marks)

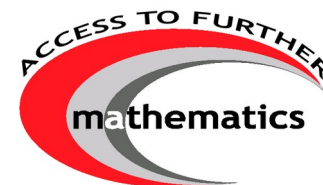
# 'The Guide'



-MSOR, Bioscience, Engineering, Physical Sciences, Materials and Information and Computer Sciences commissioned MEI to compile a mathematics guide.

-It outlines what students with given qualifications in mathematics are likely to know and be able to do.

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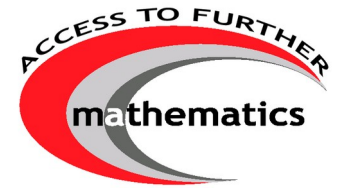
# 2. Setting the scene



## 2.1 Introduction to the main qualifications

- GCSEs / AS and A Levels
  - Academic qualifications
- Apprenticeships
  - Paid work and on-the-job training
- Diplomas
  - Blend of classroom learning and practical experience  
(Science Diploma will not come into existence)

# 2. Setting the scene



## 2.2 Brief historical review of major developments

- See Appendix 5.4 for comprehensive listings of important dates for Mathematics

Basically there has been a lot happening in the last 20 years!

## 2.3 Where and how will entrants have studied pre-higher education?

- Come from a wide range of **BACKGROUNDS** with a wide range of **EXPERIENCES**
- This guide **ONLY** about those with a UK background
- Many types of establishment and much variability in the teaching received, particularly between state and independent schools

# 3. Specific UK qualifications and



## student attributes

1. GCSE
2. AS and A Levels
3. AEA and STEP
4. FSMQ
5. Diplomas
6. Other Qualifications (IB, Pre-U)
7. Wales, Scotland and NI



# 3. Specific UK qualifications



## JUST TO BE CLEAR:

- ❑ The content of qualification specifications cannot be assumed to be an accurate measure of what students will actually know and understand when they start higher education
- ❑ This will be influenced considerably by the nature of their mathematical learning experiences and by the grades they achieved

(Note. There are 3 different English Awarding Bodies)

# 3. Specific UK qualifications



## 3.1 GCSE

- Although a two-year course usually taken by 16 years olds, GCSE Mathematics effectively tests material that has been studied throughout secondary school 11-16
- For GCSEs up to 2012, content is specified by the 1999 National Curriculum

# 3. Specific UK qualifications



## 3.1 GCSE

- From 1997 there were **THREE** tiers available to be studied, since 2006 (so 2008 examinations) there is now just **TWO**
  - Higher A\*, A, B, C
  - Foundation C, D, E, F, G
  - (prior to 2008 exams: Intermediate B, C, D, E)

# 3. Specific UK qualifications



## 3.1 GCSE

- Foundation Tier students will not have studied as much mathematics as those who've taken the Higher Tier
- Grade C on Foundation Tier is much higher than for a C on Higher Tier, so have shown a good understanding of the maths which they have studied

# 3. Specific UK qualifications



## 3.1 GCSE – Topics **NOT** covered in Foundation Tier

- ❑ negative and fractional powers
- ❑ working with numbers in standard form (scientific notation)
- ❑ reverse percentage calculations
- ❑ working with quantities which vary in direct or inverse proportion
- ❑ solution of linear simultaneous equations by algebraic methods
- ❑ factorising quadratic expressions and solution of quadratic equations
- ❑ plotting graphs of cubic, reciprocal and exponential functions
- ❑ trigonometry
- ❑ calculation of length of arc and area of sector of a circle
- ❑ cumulative frequency diagrams, box plots and histograms
- ❑ moving averages
- ❑ tree diagrams and associated probability calculations.

# 3. Specific UK qualifications



## 3.1 GCSE

- Students who have been entered for Higher Tier Mathematics and achieved grade B or C will have an incomplete understanding of items from the list above and are likely to find algebra difficult

# 3. Specific UK qualifications



## 3.2 AS and A Levels

- ❑ Maths AS Levels involve 3 units of study
- ❑ Maths A Levels involve 6 units of study (3 AS units and 3 A2 units)
- ❑ Problems with the implementation of curriculum 2000 meant a revised maths specification was issued for first teaching in 2004

# 3. Specific UK qualifications

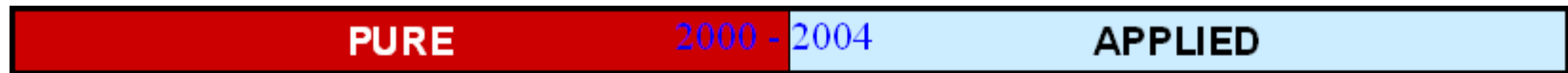


## **2000-2004**

6 Modules: **3** of Pure Mathematics  
**3** of Applied Mathematics

## **2004-now**

6 Modules: **4** of Pure Mathematics  
**2** of Applied Mathematics





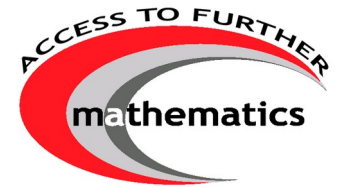
# 3. Specific UK qualifications



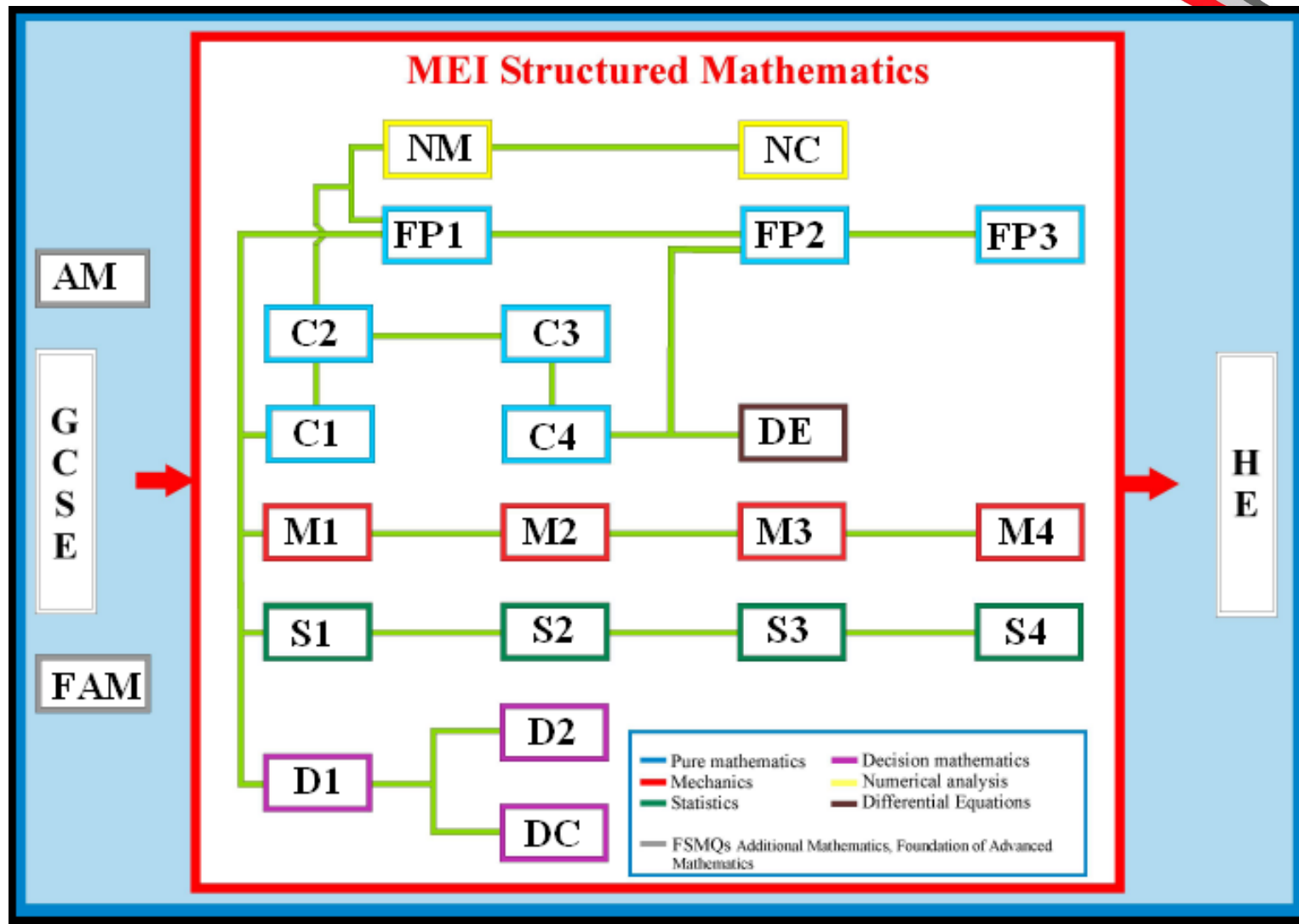
## 3.2 AS and A Levels – Effect of 2004 changes

- The downturn in numbers following the 2000 changes has been reversed; there is an increasing number of students taking A Level Mathematics (and Further Mathematics)
- Students concentrate more on the pure mathematics and should be more confident with it
- Students do less applied mathematics

# The Applied Modules (Edexcel summer 2006)



Applied modules	Number of candidates	Percentage of candidates
M1 S1	8970	45.1
M1 M2	4328	21.8
S1 S2	4012	20.2
S1 D1	1433	7.2
M1 D1	944	4.7
D1 D2	190	1.0
TOTAL	19 877	100



# 3. Specific UK qualifications



## 3.2 AS and A Levels – The 4 Pure Maths units

- C1 and C2 taken at AS  
(For all exam boards, the total content of C1 and C2 is the same)
  
- C3 and C4 taken at A2  
(For all exam boards, the total content of C3 and C4 is the same)
  
- The following slides outline the core content

## **Algebra**

- ❑ Simultaneous equations, including one quadratic
- ❑ Solving quadratics, completion of square
- ❑ Surds/indices
- ❑ Inequalities (only involving linear and quadratic expressions, and the modulus function)
- ❑ Polynomials (factor/remainder theorems)
- ❑ Partial Fractions

## **Sequences and Series**

- ❑ Arithmetic/geometric sequences/series
- ❑ Sigma notation
- ❑ Sequences defined recursively
- ❑ Binomial expansion

## **Exponentials and Logarithms**

- ❑ Logarithms
- ❑ Standard properties
- ❑ Use in solving equations
- ❑ Graphs of  $y = e^x$  and  $y = \ln x$
- ❑ Exponential growth and decay

## **Coordinate Geometry**

- ❑ Equations of straight lines, gradient
- ❑ Parallel and perpendicular lines
- ❑ Equation of a circle

## **Curve Sketching**

- ❑ Graphs of quadratics, polynomials (from the factorised form)
- ❑ Relationships between graphs of  $y = f(x)$ ,  $y = f(x + a)$ ,  $y = f(ax)$ ,  $y = a f(x)$ ,  $y = f(x) + a$

## **Proof**

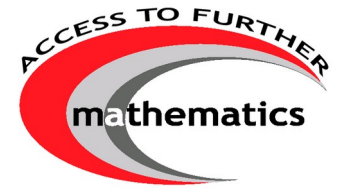
- ❑ Methods of proof, including proof by contradiction and disproof by counter-example.

# Trigonometry



- ❑ Sine rule, cosine rule
- ❑ Radians, arc length, sector area
- ❑ Exact values of  $\sin$ ,  $\cos$ ,  $\tan$  of standard angles
- ❑  $\sec$ ,  $\operatorname{cosec}$ ,  $\cot$ ,  $\arcsin$ ,  $\arccos$ ,  $\arctan$
- ❑ Compound/double angle formulae
- ❑ Trigonometric Pythagorean identities

# Calculus



- ❑ Differentiation of  $x^n$ ,  $e^x$ ,  $\ln x$ ,  $\sin x$ ,  $\cos x$ ,  $\tan x$
- ❑ Tangents, normals, stationary points
- ❑ Product rule, quotient rule, chain rule
- ❑ Integration by inspection
- ❑ Integration by substitution (simple cases only)
- ❑ Integration by parts
- ❑ Differential equations (variables separable only)
- ❑ Implicit differentiation
- ❑ Volumes of revolution



# A2 only content

## **Vectors**

- ❑ Scalar product
- ❑ Equations of lines
- ❑ Intersection of lines

## **Numerical Methods**

- ❑ Roots by sign change
- ❑ Fixed point iteration
- ❑ Numerical integration

## **Functions**

- ❑ Domain and range
- ❑ Composition
- ❑ Inverses, calculating inverses
- ❑ Even, odd, periodic functions
- ❑ Modulus function

## **Parametric Equations**

- ❑ Finding gradients
- ❑ Conversion from Cartesian to parametric equations

# 3. Specific UK qualifications



## 3.4 Free Standing Mathematics Qualifications

- ❑ OCR Foundations of Advanced Maths
- ❑ Level 2 qualification to help bridge gap between GCSE and A Level for B/C grade students  
(2010 circa 2500 students)
  
- ❑ OCR Additional Mathematics
- ❑ Level 3 qualification for able GCSE students comparable in difficulty to AS Level Maths  
(2008 – circa 7500, 2007 – 5500, 2006 – 4400)
- ❑ AQA FMSQs
- ❑ Review guide (page 10) for implications of having these

# 3. Specific UK qualifications



## 3.5 Diplomas

- ❑ These were first teaching in 2008
- ❑ Available at 3 levels
- ❑ Of those available only the Level 3 Engineering Diploma has a compulsory mathematics unit (and an optional one)
- ❑ Uptake, particularly at level 3 has been low (871 for Engineering/3000 for all lines in 2010)
- ❑ General view is that the students these are aimed at need to be more clearly 'defined'

# 3. Specific UK qualifications



## 3.6 Other Qualifications

- ❑ International Baccalaureate
- ❑ Pre-U
- ❑ Access Courses
- ❑ Foundation Courses
  
- ❑ Review guide (page 11) for implications of having these

# 3. Specific UK qualifications



## 3.7 Wales, Scotland and Northern Ireland

- ❑ Wales/Northern Ireland – much overlap with England, particularly in A Levels
- ❑ Scotland – different set of qualifications
  - ❑ Standard Grades (roughly GCSE equiv.)
  - ❑ Highers (roughly AS Levels equiv.)
  - ❑ Advance Highers (roughly A Level equiv.)

## **4. Useful sources of information**

4.1 References made in the guide

4.2 Additional references

## **5. Appendices**

5.1 Acronyms

5.2 A Level Maths numbers 1989-2009

5.3 Overview of content in mathematics A Level

5.4 Important dates for Mathematics

# Pre-University Guide Summary



- ❑ We hope you find the guide useful
- ❑ We hope it will provide you with relevant information and links
- ❑ Please do get in touch with MEI if you have any questions!

# School to University Transition

- ❑ Possible sixth-form mathematics courses appropriate for Biology students
- ❑ The impact of universities on the success of the Further Mathematics Support Programme
- ❑ Opportunities to engage with partners across the transition



# Appropriate 6<sup>th</sup>-form maths courses for

## Biology students

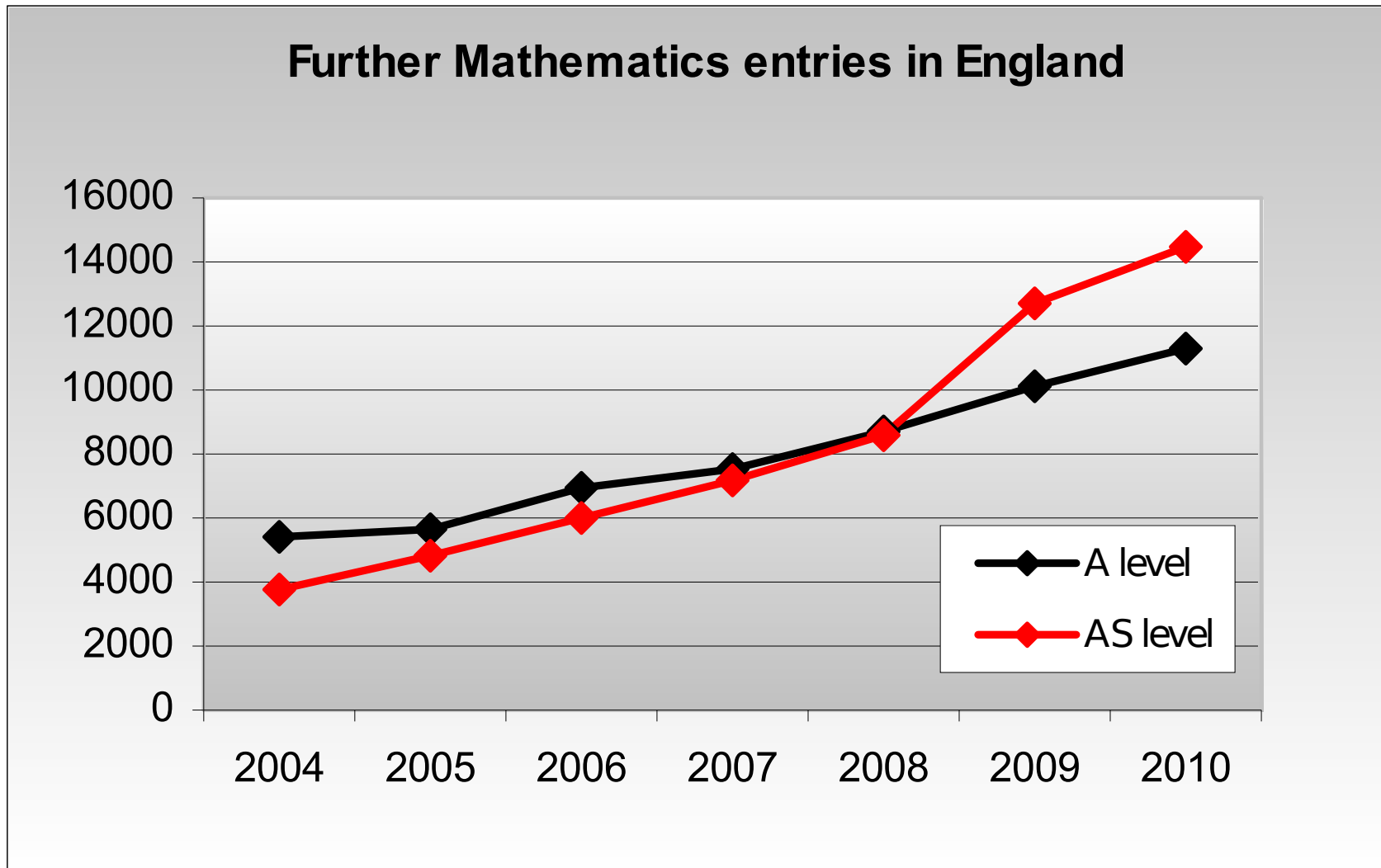
- AS/A level Mathematics
- AS/A level Further Mathematics
- AS level Statistics
- FSMQ Using and Applying Statistics
- The extended project

NB Courses can be taken in year 13

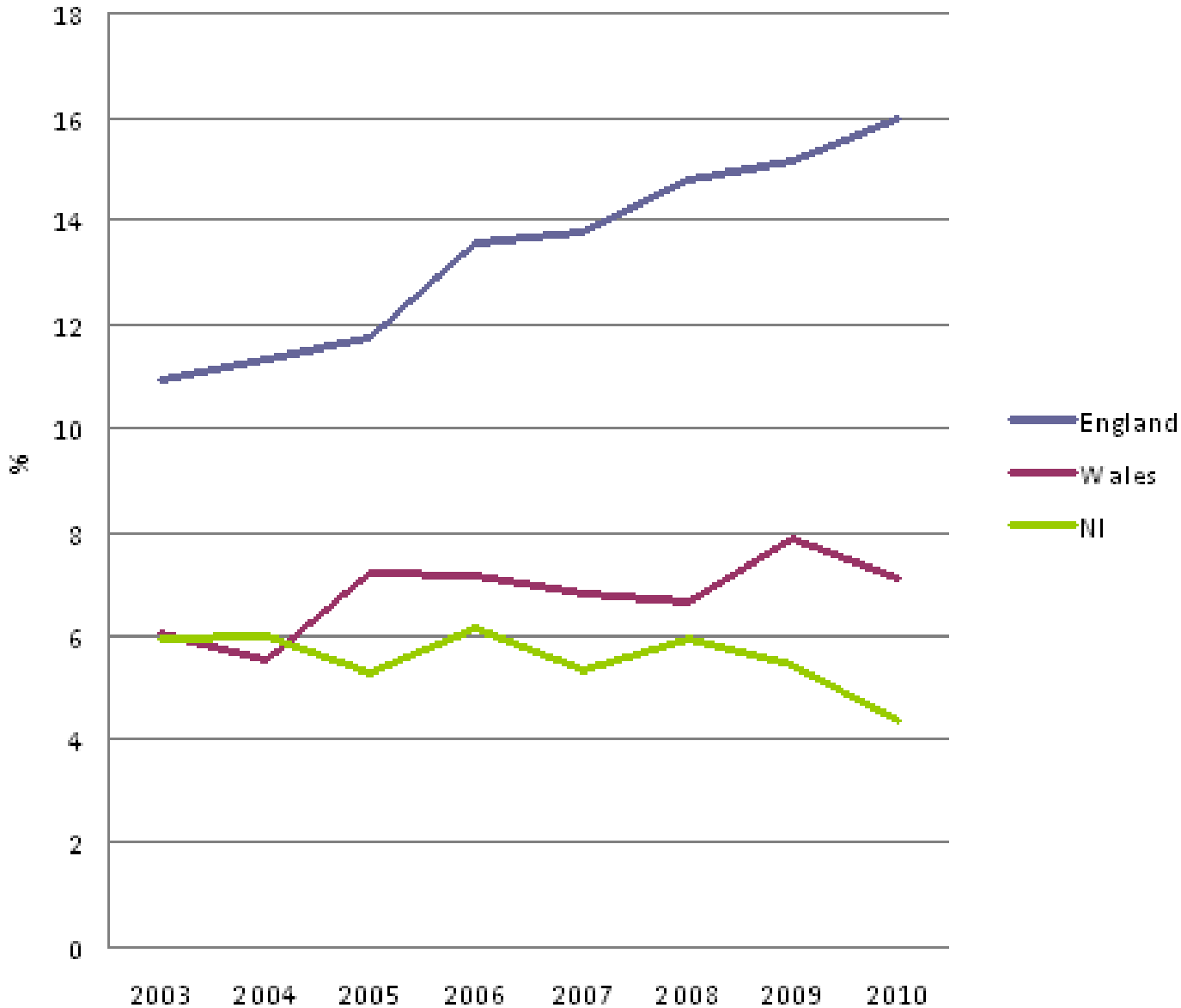
# About the Further Mathematics Support Programme

- ❑ Aims:
  - ❑ Give every student who could benefit from studying Further Mathematics the opportunity to do so
  - ❑ Increase the number of students studying Further Mathematics (and Mathematics)
  - ❑ Increase the number of schools and colleges offering Further Mathematics
- ❑ The FMSP was set up in 2009 and follows on from the Further Mathematics Network (FMN)

# Further Mathematics entries



# Further Mathematics



Percentage  
of  
Mathematics  
Students  
studying  
Further  
Mathematics

*source JCQ*

# Support from universities

- [www.furthermaths.org.uk/universities.php](http://www.furthermaths.org.uk/universities.php) contains statements from over 30 different universities' entry requirements encouraging the study of Further Mathematics

*“The University is prepared to be more flexible with students who have studied Further Mathematics but not met the standard offer.”*

**University of Derby: Mathematics**

*“Even if you do not offer Further Maths as your third A level, but have the chance to study it, you will find the benefits at University.”*

**Imperial : Mechanical Engineering**

# Engagement across the transition

MEI and The Further Mathematics Support Programme have a lot of experience of working with HE partners

- ❑ MEI has an extensive website of support materials for A level Maths and Statistics that have also been used by many universities
- ❑ We would be keen to discuss ways in which we could
  - ❑ Increase the take-up of A level Mathematics by prospective Biosciences students
  - ❑ Promote AS Statistics and/or FSMQ Use of Stats
  - ❑ Develop the use of the extended project

# Contact



- ❑ [www.mei.org.uk](http://www.mei.org.uk)
- ❑ [www.furthermaths.org.uk](http://www.furthermaths.org.uk)
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- ❑ Tom Button: [tom.button@mei.org.uk](mailto:tom.button@mei.org.uk)