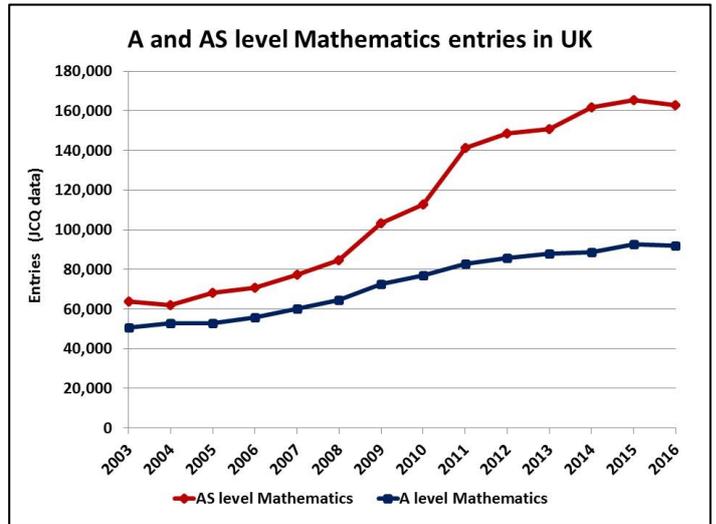# A level Mathematics

Over the last 10 years the number of students taking AS and A level Mathematics in the UK has increased at a rapid rate.

In 2016 over 92 000 students entered A level Mathematics, an increase of 75% since 2005. Entries for AS level Mathematics have increased even more sharply, by 139% since 2005.

There are now more students taking A level Mathematics than any other A level subject.

The table shows the entries in the UK for A/AS level Mathematics and Further Mathematics for 2016.

Qualification	Entries in 2016	Entries in 2010	Entries in 2005	% increase since 2010	% increase since 2005
A level Mathematics	92 163	77 001	52 897	20%	75%
A level Further Mathematics	15 257	11 682	5 933	31%	157%
AS level Mathematics	162 741	112 847	68 178	44%	139%
AS level Further Mathematics	26 742	14 884	5 054	80%	429%

(data source: JCQ)

A number of factors have contributed to the rise in entries for A/AS level Mathematics

- **Promotion of mathematics A levels through careers presentations and enrichment events aimed at GCSE students.** In 2015/16 the Further Mathematics Support Programme organised mathematics enrichment events for over 12 000 14-16 year olds.

- **Increased numbers of A* and A grade students at GCSE Mathematics.** Prior attainment at GCSE is a key factor in students' choices of A level subjects. The proportion of A*/A grades in 2016 was 15.9% compared with 13.0% in 2005.

- **Increasing awareness of students and their teachers that A level Mathematics is an essential or desirable subject for progression to STEM, social science, business and economics degree courses.** Information provided on university websites and at HE open days encouraging the study of A and AS level Mathematics helps to convince students, teachers and school leaders of its importance.

- **Increasing awareness that having an A level Mathematics qualifications is linked to higher potential career earnings.** "*The earnings and employment returns to A levels*" report in March 2015 found that studying A level Mathematics can boost earnings by 8% for males and 33% for females.

- **More mathematics teachers confident and skilled in teaching A level Mathematics.** Each year the FMSP provides professional development courses focused on improving subject knowledge and pedagogy to thousands of teachers. These have helped improve the teaching of A level Mathematics and increase capacity in schools and colleges.

What is covered in A level Mathematics courses <u>currently</u>?

(Below are extracts from *Understanding the UK Mathematics Curriculum Pre-Higher Education*, MEI 2016.
The full guide can be downloaded here www.mei.org.uk/files/pdf/pre-university-maths-guide-2016.pdf)

Since the structure of A level Mathematics (and Further Mathematics) was changed in September 2004, students with a single A level in Mathematics will have studied only two applied modules (in addition to the four core modules, Core 1 to Core 4, which cover the compulsory 'pure' content of the A level).

Possible combinations of modules studied for A level Mathematics are:

Core 1, Core 2, Core 3, Core 4 + one of the combinations of two applied modules shown below					
Statistics 1	Mechanics 1	Decision 1	Statistics 1	Mechanics 1	Decision 1
Mechanics 1	Decision 1	Statistics 1	Statistics 2	Mechanics 2	Decision 2

There are no prescribed applied modules that are required to be studied, hence students could study any one of these combinations in order to gain an A level in Mathematics.

Content in the common core (Core 1 to Core 4 units)

Algebra
- Simultaneous equations
- Solving quadratics, completion of square
- Surds/indices
- Inequalities (only involving linear and quadratic expressions, and the modulus function)
- Polynomials (factor/remainder theorems)
- Binomial expansion
- Partial fractions

Trigonometry
- Sine rule, cosine rule
- Radians, arc length, sector area
- Exact values of sin, cos, tan of standard angles
- Sec, cosec, cot, arcsin, arccos, arctan
- Compound/double angle formulae

Exponential and Log
- Graphs of exponential and logs
- Standard properties
- Use in solving equations

Coordinate Geometry
- Equations of straight lines, gradient
- Parallel and perpendicular lines
- Equation of a circle
- Circle theorems

Vectors
- Scalar product
- Equations of lines
- Intersection of lines

Numerical Methods
- Roots by sign change
- Fixed point iteration

Curve Sketching
- Graphs of quadratics, polynomials (from the factorised form)
- Relationships between graphs of $y = f(x)$, $y = f(x + a)$, $y = f(ax)$
- Parametric Equations
- Finding gradients
- Conversion from cartesian to parametric equations

Sequences and Series
- Arithmetic/geometric sequences/series
- Sigma notation
- Sequences defined recursively

Functions
- Composition
- Inverses, calculating inverses
- Even, odd, periodic functions
- Modulus function
- Inverse trig functions

Calculus
- Differentiation of powers of x, e^x, ln x, sin x, cos x, tan x
- Product rule, quotient rule
- Chain rule
- Integration by inspection
- Integration by substitution (simple cases only)
- Integration by parts
- Differential equations (to include only variables which are separable)
- Implicit differentiation
- Volumes of revolution

AS Level Mathematics

AS Mathematics consists of the 2 compulsory modules, C1 and C2, and an applied module, which could be in mechanics, statistics or decision mathematics. Students marks in these modules (or units) can contribute to the A level Mathematics grade if the student continues and completes all 6 modules.

A level Mathematics and Further Mathematics specifications are changing

The new draft specifications have been submitted to Ofqual for accreditation. First teaching begins September 2017 and the first awards of the new AS and A level Mathematics will be in August 2018, together with AS Further Mathematics. First award of A level Further Mathematics will be August 2019.

The main changes to the AS/A level Mathematics and Further Mathematics specifications

- All AS and A levels will be linear with examinations in the summer.

- AS levels can be co-taught with A level, but will have separate examinations. Marks in AS will not count towards the A level grade.

- Since the first teaching of the courses will be from 2017, all students will have also done the new GCSE Mathematics course and will be better prepared for A level.

- For AS and A level Mathematics 100% of the content is prescribed. All students will have covered the same topics whatever examination board they have followed.

- AS and A level Mathematics will consist of a pure mathematics section (about two thirds of the content, i.e. similar in size and content to the current core), a statistics section and a mechanics section (each about one sixth of the content).

- Decision mathematics has been removed from AS and A level Mathematics, but it is permitted as an option in Further Mathematics.

- For A level Further Mathematics 50% of the content is prescribed and common to all specifications. This is a core of pure mathematics techniques. Students will have some choice over additional applied and pure mathematics content that is studied depending on the examination board followed.

All Mathematics specifications must encourage students to:

- reason logically and recognise incorrect reasoning

- generalise mathematically

- construct mathematical proofs

- solve problems in context

- understand the relationship between problems in context and mathematical models

- read and comprehend mathematical arguments

- read and comprehend mathematical articles

- use technology such as calculators and computers effectively

The FMSP website page furthermaths.org.uk/2017 has further details of all four main specifications in England together with summaries and comparisons of the content and structure of the different specifications for Mathematics and Further Mathematics.

About the Further Mathematics Support Programme

The Further Mathematics Support Programme (FMSP) is funded by the Department for Education and managed by Mathematics in Education and Industry (MEI), an independent educational charity.

FMSP Area Coordinators, covering the whole of England, work with schools and colleges to support and promote the study of AS and A level Mathematics and Further Mathematics and to arrange Further Mathematics tuition for students when their schools and colleges cannot provide it themselves.

Our aims are to increase participation and improve provision of A level Mathematics and Further Mathematics.

All English schools and colleges can register free of charge with the FMSP to receive expert advice about support. Registered schools receive free access to extensive online resources and get regular updates about professional development opportunities for teachers and enhancement and enrichment events for KS3, KS4 and sixth-form students provided by the FMSP.

To help schools and colleges to offer Further Mathematics, the FMSP:

- engages with around 4000 schools and colleges providing news, information, and resources;
- delivers over 3000 teacher days of professional development each year through a range of innovative and flexible courses for GCSE and A level Mathematics and Further Mathematics , including support for higher-level problem-solving skills and preparation for STEP, AEA and the MAT examinations;
- promotes the study of A level Mathematics and Further Mathematics through enrichment events, talks and careers presentations to over 12 000 14-16 year-old students each year;
- provides face-to face and online tuition so that schools/colleges can offer Further Mathematics. The FMSP has provided tuition to thousands of students tutoring around 400 students each year;
- maintains local networks of teachers to share and develop good practice.

FMSP support for Higher Education Institutions and students preparing to go to university

- The FMSP promotes the benefits of studying of AS/A level Mathematics and Further Mathematics by providing information to teachers, students and parents. The key message being that studying mathematics makes the transition to a many university courses easier. These qualifications offer transferable skills for all STEM subjects, the social sciences, business and economics and enable students to distinguish themselves as able mathematicians at university and in the employment market.

- The FMSP supports students preparing for STEP, AEA and the MAT examinations, through online tuition and resources and has established regular problem-solving support classes for year 12 and year 13 students in over 30 locations. Many of these classes take place in partnership with local universities and colleges. furthermaths.org.uk/supporting-step

- The FMSP also provides CPD for teachers to enable them to support STEP/AEA/MAT in their institution and to enhance students' mathematical skills through exposing them to unfamiliar questions.

- The FMSP liaises with universities to encourage clear signalling of the importance of studying AS/A level Mathematics and Further Mathematics in their entry requirements.

- The FMSP works with universities to develop pre-university mathematics resources to help prepare students for a range of degree courses. furthermaths.org.uk/universities

For more information contact admin@furthermaths.org.uk