# Why study Mathematics?

## A guide for Students, Parents and Carers

# Why study Maths after GCSE?

- Stimulating and challenging courses;
- Increase knowledge and understanding of mathematical techniques and their applications;
- Support the study of other A levels;
- Develop key employability skills such as problem-solving, logical reasoning, communication and resilience;
- Excellent preparation for a wide range of university courses;
- Leads to versatile qualifications that are well-respected by employers and higher education.

# Why study Maths & Further Maths?

- **Intellectual challenge**
- **Enjoy problem solving**
- **Satisfaction** of solving a problem
- Universities regard Maths & Further Maths as **one of the top academic 'A' level subjects**
- Many courses at university **require Maths** – Physics, Economics, Computer Science & Engineering.
- **Highly regarded** by many other courses such as Medicine, Architecture, all the sciences

# What is covered in AS/A level Mathematics?

All of the content in the AS/A level Mathematics qualification is compulsory and is the same for all examination boards.

**Pure Mathematics** **(66%)**

methods and techniques which underpin the study of all other areas of mathematics, such as, proof, algebra, trigonometry, calculus, and vectors.

**Statistics** **(17%)**

working with data from a sample to make inferences about a population, probability calculations, modelling real life data using statistical distributions and hypothesis testing.

**Mechanics** **(17%)**

the study of the physical world, modelling the motion of objects and the forces acting on them.

# Chipping Norton School Grade Requirements

- A level Maths require a grade 6 or higher
- Further Maths require grade 7 or higher

## Maths

Pure Maths (Two 2 hour papers)

Mechanics & Statistics (One 2 hour paper)

## Edexcel Further Maths

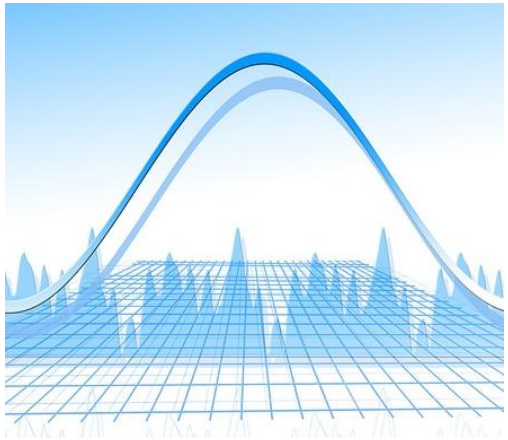
Further Maths Core 1 & 2 (Two 1 ½ hour papers)

Mechanics 1 (One 1 ½ hour paper)

Decision 1 (One 1 ½ hour paper)

# What is Statistics?

Reaching conclusions from data and calculating the likelihood of an event occurring.



*"The majority of private sector organisations believe the use of data analytics will be the most important factor in increasing growth in UK businesses"*

***Professor Sir Adrian Smith***

Source: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/630488/AS_review_report.pdf

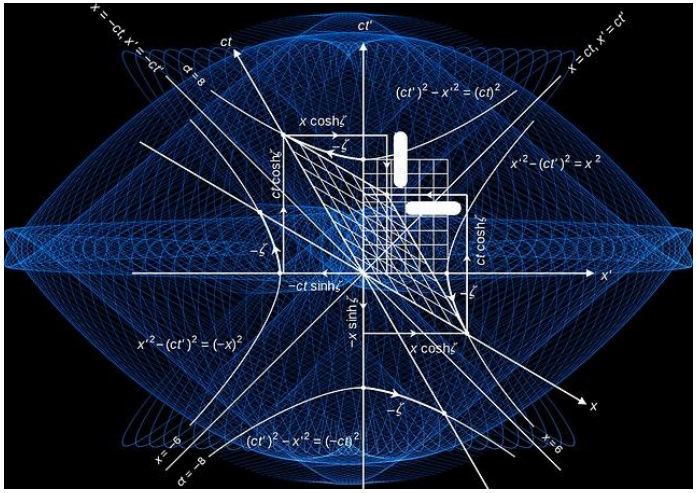
# What is Mechanics?

The modelling of the world around us, the motion of objects and the forces acting on them.

Students planning careers in physics or engineering would find mechanics particularly useful.

# What is Further Mathematics?

Further Mathematics is an additional AS/A level qualification taken **in addition to** an AS/A level in Mathematics.

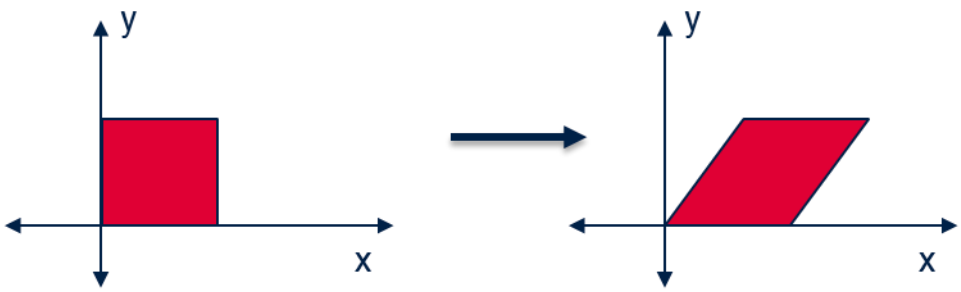



It is designed to stretch and challenge able mathematicians and prepare them for university courses in mathematics and related quantitative and scientific subjects.

# Pure maths in Further Mathematics

Two examples of important Further pure topics are complex numbers and matrices.

Matrices are arrays of numbers such as $\begin{pmatrix} 1 & 0 \\ 0 & 2 \end{pmatrix}$. They can be used to solve sets of simultaneous equations and to represent transformations such as the shear shown in the diagram below.

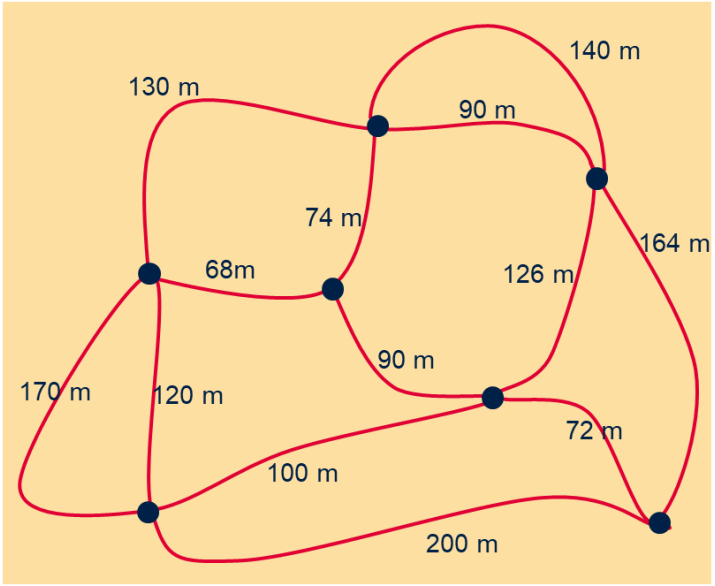



Complex numbers are based on the 'imaginary' number $\sqrt{-1}$. They lead to the study of lots of new areas of mathematics, including fractals like those shown in the image above.

# What is Discrete/Decision Maths?

One area of discrete mathematics is graph theory, which includes solving problems such as:

*What would be the most efficient route for delivering post around this network of streets?*

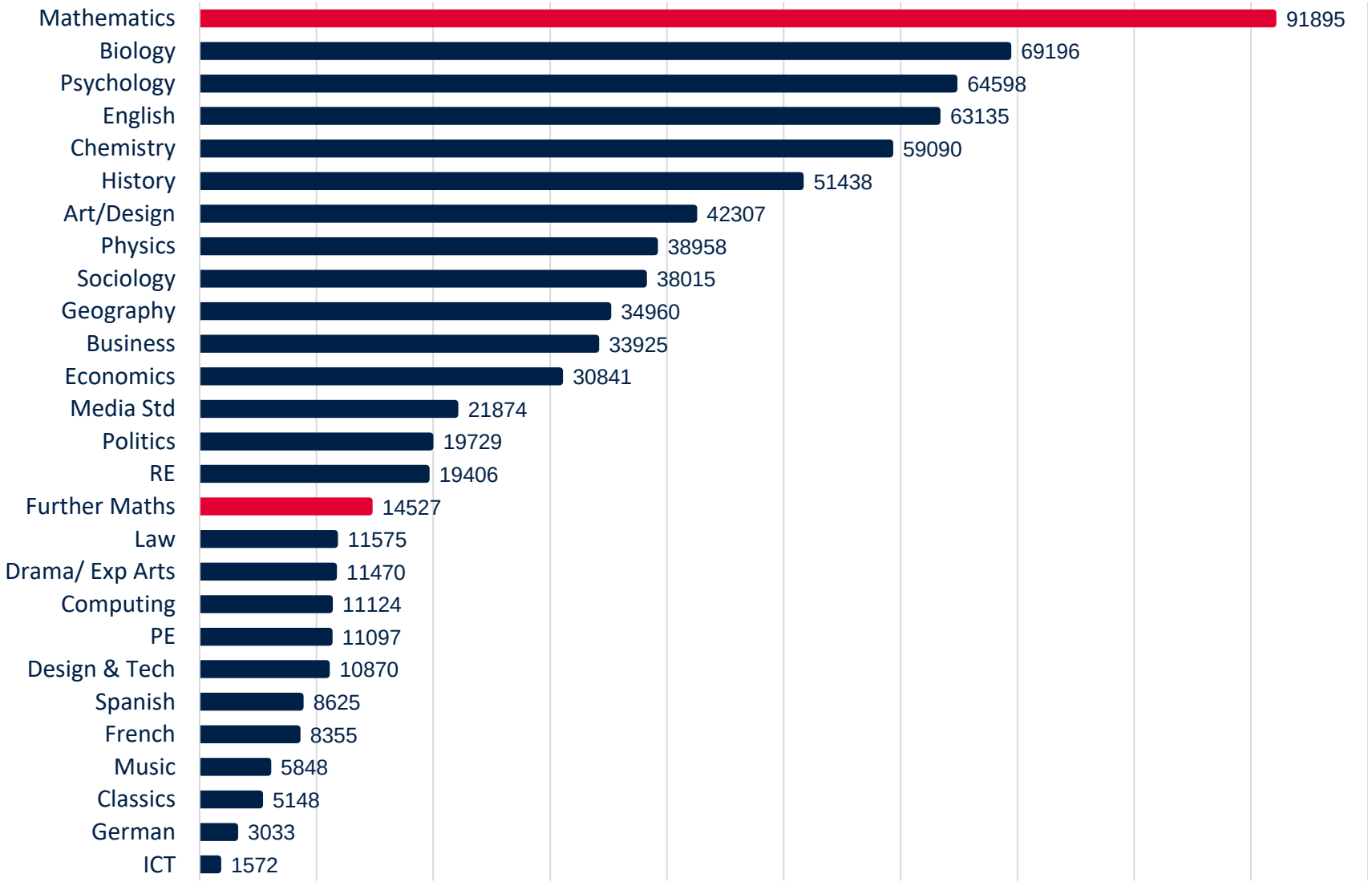



This topic uses algorithms vital in computer science.

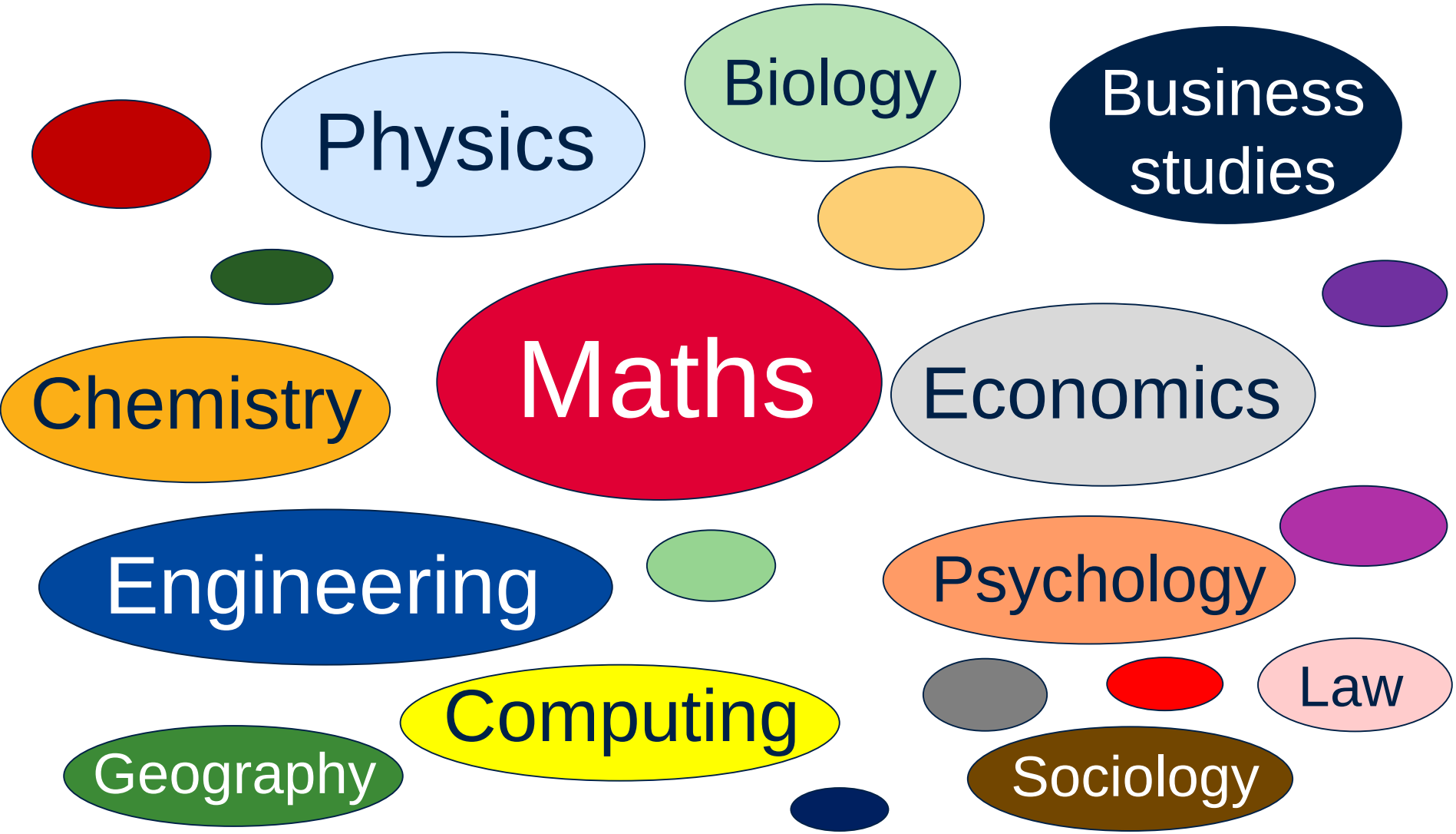
# What skills does Maths help develop?

- **Logical thought**
- **Problem solving**
- **Model 'real world' situations**
- **Analytical skills**
- **Making deductions & reasoning skills**
- **Independent thinking & study skills**
- **Skills that employers want**

# 2019 UK A level entries by subject (JCQ data)



# Many subjects use maths



# Maths in other A levels

Geography (no specific percentage but geographical skills include quantitative and qualitative skills equally)

Economics (at least 20%)

Biology (at least 10%)

Business (at least 10%)

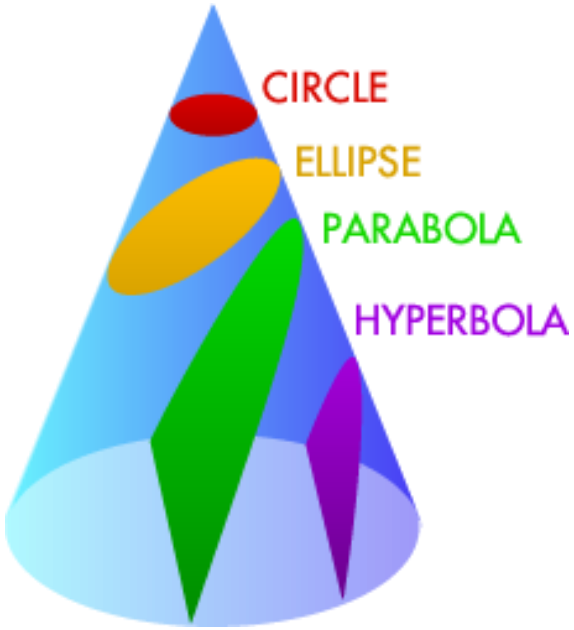
Psychology (at least 10%)

PE (at least 5%)

Sociology (no specific percentage but you will be analysing data)

# Common career misconceptions

- Unless you plan to do a STEM (Science, Technology, Engineering, Mathematics) degree, you don't need to study mathematics post-GCSE
- Most careers that require A level Mathematics are male-dominated.
- You only do a mathematics degree to become a mathematics teacher.
- Further Mathematics is an A level just for students who want to become engineers or physicists.




**These are not true!**

**Mathematics is relevant to many different careers, apprenticeships and degrees, all of which now require better quantitative skills.**

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Managed by MEI Mathematics Education Innovation

# What are the career opportunities?

# What are the career opportunities?

"Quantitative skills are required in a wide range of occupations and activities, embracing not only the mathematical and physical sciences but also the social sciences, the humanities and the creative arts. Mathematics is now intrinsic to some aspects of the creative arts… and learned societies argue that students across the sciences, social sciences and humanities need significant quantitative skills, and these should be a central component of their education."

*Professor Sir Adrian Smith*

Source: Review of Post-16 Mathematics

# What are the career opportunities?

"…analysis highlights the economic value of good mathematical skills and of higher level qualifications… There is compelling evidence of continued wage returns of up to 11% to A level Mathematics. "

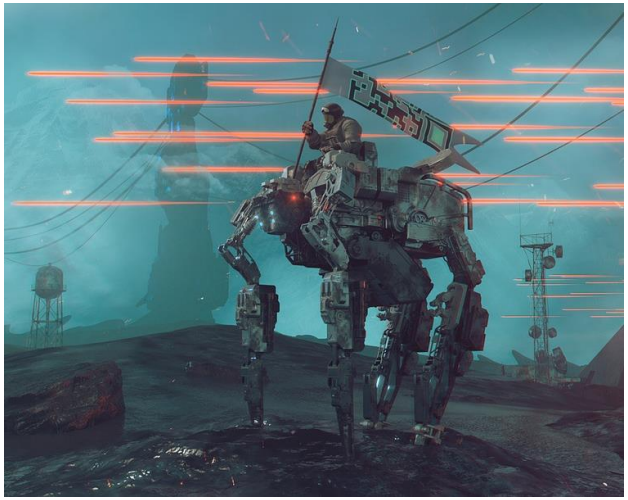
(Source: Rethinking the Value of Advanced Mathematics Participation, 2016 http://www.nottingham.ac.uk/education/documents/research/revamp-final-report-3.1.17.pdf)

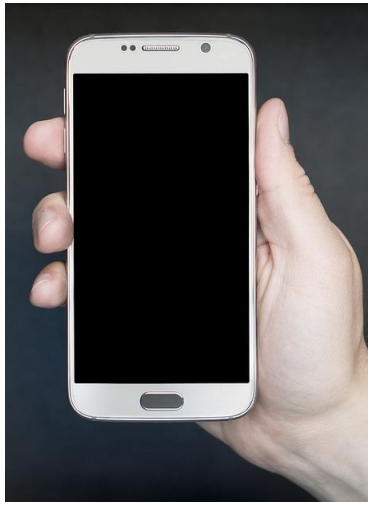
# Careers using Maths

There is a huge shortage of people with STEM skills needed to enter the workforce.

**Applications of mathematics in technology:**

- Medical
- Games Design
- Internet Security
- Financial Cryptography
- Programming
- Communications

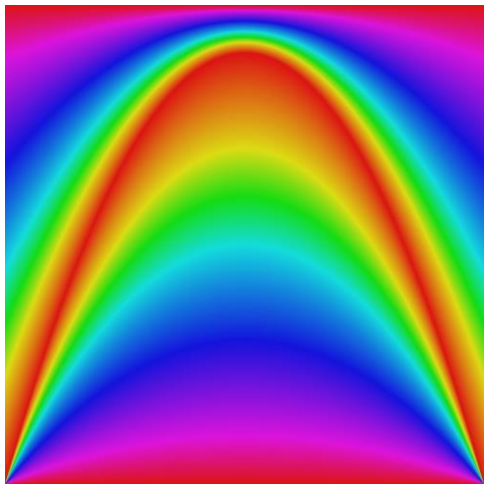




# Careers using Maths

**On-going applications in engineering, such as**:

- Aircraft Modelling
- Fluid Flows
- Acoustic
- Engineering
- Electronics
- Civil Engineering.



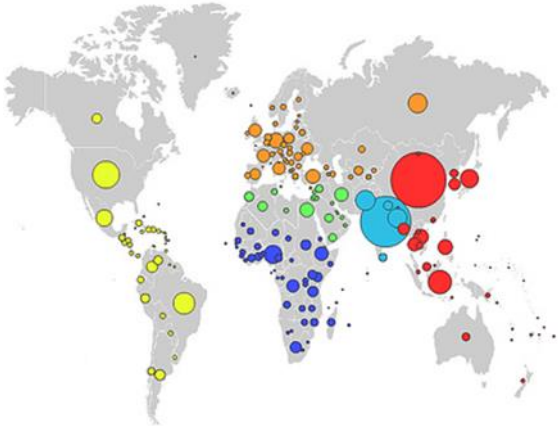
**New scientific processes such as:**

- Modelling populations and Diseases
- Quantum Physics
- Astronomy
- Forensics
- DNA sequencing

# Careers using Maths

**Applications relating to human behaviours and interactions:**

- Data Science
- Psychology
- Law
- Economics
- Climate Change
- Environmental Modelling
- Political Science
- International Development




# What are Higher/Degree Apprenticeships?

- Designed to offer degree-equivalent qualifications.
- A popular alternative to obtaining a degree directly from a university.
- The employer will cover the cost.
- Paid a salary while you study.
- A levels or equivalent qualifications required for entry.
- Mathematics is also essential or desirable for a wide range of apprenticeships.
- Examples include.
  - Actuarial
  - Data Science
  - Software Engineering
  - Quantity Surveying

# Is A level Mathematics needed for entry to university degree courses?

- It is important to have strong maths skills for progression to many degree courses at university.
- A level Mathematics is also essential or desirable for a wide range of degree courses including economics, computing, social sciences and business.
- According to research by UCL, students with an A level in Mathematics are more likely to attend a Russell Group university.
- Any student applying to study a degree in a STEM subject should also consider taking Further Mathematics to at least AS level alongside A level Mathematics.

# A level Maths and degree courses

| Degree subject category | % of accepted students with A levels who have studied A level Maths (entry 2016) |
|---|---|
| Mathematics (G1) | 100% |
| Physics (F3) | 99% |
| Chemical, Process and Energy Engineering (H8) | 98% |
| Mechanical Engineering (H3) | 93% |
| Pre-clinical medicine (A1) | 75% |
| Economics (L1) | 70% |
| Computer Science (I1) | 57% |
| Chemistry (F1) | 34% |

# A level Further Maths and degrees

| Degree subject category | % of accepted students with A levels who have studied A level Further Maths (entry 2016) |
|---|---|
| Mathematics (G1) | 65% |
| Physics (F3) | 38% |
| General Engineering (H1) | 28% |
| Mechanical Engineering (H3) | 26% |
| Chemical, Process and Energy Engineering (H8) | 17% |
| Computer Science (I1) | 16% |
| Economics (L1) | 11% |
| Chemistry (F1) | 8% |

# A level Maths opens the door to leading universities

"Taking maths at A-level is more helpful for landing a place at a Russell Group university than studying at a grammar or private school, research from University College London's Institute of Education suggests. There is even a maths premium for degree subjects that are not directly related to maths or which require a different skillset, such as languages and humanities."

Source: https://schoolsweek.co.uk/a-level-maths-is-more-useful-for-top-university-places-than-private-school

# Exemplar Entry Requirements

Maths

- AAA / A*AB **alternatively**

  AAB / A*BB, including Further Mathematics **or**

  AAB / A*BB, PLUS Grade A in AS level Further Mathematics

In all cases, the first grade quoted is the Mathematics A level.

*Leeds University (Mathematics degree), 2020 entry*

- A*A*A -Mathematics, Further Mathematics and one other subject. Also, Grade 1 in STEP II and III.

*Cambridge University (Mathematics degree), 2020 entry*

# Exemplar Entry Requirements

Engineering

- AAB-BBB to include Maths.

  *Swansea University (Chemical Engineering degree), 2020 entry*

- AAB including Mathematics and either Physics, Electronics, Further Mathematics or Chemistry.

  *Manchester University (Electrical & Electronic Engineering degree), 2020 entry*

# Exemplar Entry Requirements

Science

- ABB to include Chemistry and one further science subject (from Biology, Human Biology, Physics, Maths, Further Maths, Psychology, Geography or Geology).

  *Southampton University (Chemistry degree), 2020 entry*

- ABB-BBB including grade B in Maths.

  *Reading University (Meteorology and Climate degree), 2020 entry*

# Exemplar Entry Requirements

**Social Science**

- ABB. One science A level required, two science A levels preferred and may lead to a lower offer. (List of sciences includes Mathematics and Further Mathematics.)

  *Liverpool University (Psychology degree), 2020 entry*

- A*AA. Applicants must have achieved an A in A level Maths.

  *University of Warwick (Economics degree), 2020 entry*

# Other sources of information

- AMSP website www.amsp.org.uk
- Maths Careers website www.mathscareers.org.uk
- Apprenticeship websites e.g. www.amazingapprenticeships.com
- Universities and Colleges Admissions Service (UCAS) www.ucas.com
- Russell Group Universities www.informedchoices.ac.uk
- Tomorrow's Engineers www.tomorrowsengineers.org.uk
- The Institute of Physics (IOP) www.iop.org

# Y12 & 13 Checklist & Expectations

## To be a successful 'A' level mathematician you must ……

- **Pick up your pen and do!**
  - Answer lots and lots of questions during your independent study time
  - Deal with issues immediately, don't let misunderstanding / misconceptions build up – speak to your teacher / come to clinic
- **Keep an organised folder**
  - Programme of study at start of topic
  - Notes & examples from lessons
  - Assessed work & feedback sheets together
  - Mark all questions from exercise book
  - Note areas of difficultly
  - Regular folder check by your teachers
- **Attend Thursday lunch in E6 or after school & E4**
- **High levels of understanding in every topic assessment**
  - Under performance in a topic assessment will require a re-take after school Thursday (E1 / E4) or Thursday lunchtime (E6)
- **Use Mymaths to consolidate understanding from lessons**
- **Pre-lesson preparation**
  - Use your programme of study & read through the notes for your next lesson
  - Watch you tube videos on that topic before lesson
- **Meet deadlines for your assignments**
  - If you have an issue with meeting a deadline then you must talk to your teacher before-hand. Good communication is key!