

A-Level Mathematics



Post 16 Mathematics options

- A Level Mathematics (Edexcel)
- A Level Further Mathematics (Edexcel)

Timeline

Year 12

<i>Sept - Feb</i>	<i>Feb - May</i>	<i>May-June</i>
<i>Pure 1</i>	<i>Statistics and Mechanics 1</i>	<i>Exams</i>

Year 13

<i>July – Feb</i>	<i>Jan– May</i>	<i>May-June</i>
<i>Pure 2</i>	<i>Statistics and Mechanics 2</i>	<i>Exams</i>

What is covered in A Level Mathematics?

All of the content in the 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, sequences, coordinate geometry and vectors.

Statistics (17%)

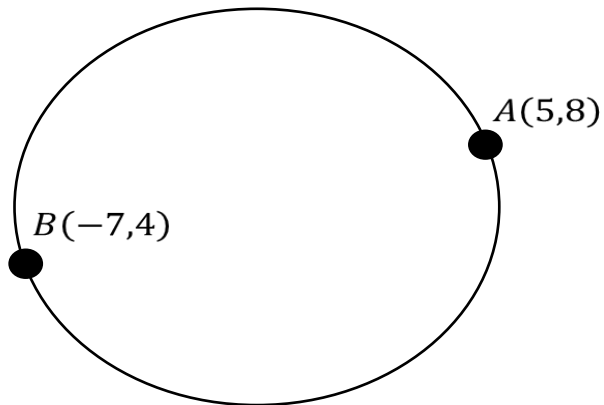
statistical sampling, data presentation and probability leading to the study of statistical distributions

Mechanics (17%)

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

Pure mathematics

Finding the equation using points



A line segment AB is the diameter of a circle, where A and B have coordinates $(5, 8)$ and $(-7, 4)$ respectively. Determine the equation of the circle.

Hint: What two things do we need to use the circle formula?

Centre: $C(-1, 6)$

We can use the distance BC or AC as the radius. Using $B(-7, 4)$ and $M(-1, 6)$

$$r = \sqrt{6^2 + 2^2} = \sqrt{40} = 2\sqrt{10}$$

Statistics

Reaching conclusions from data

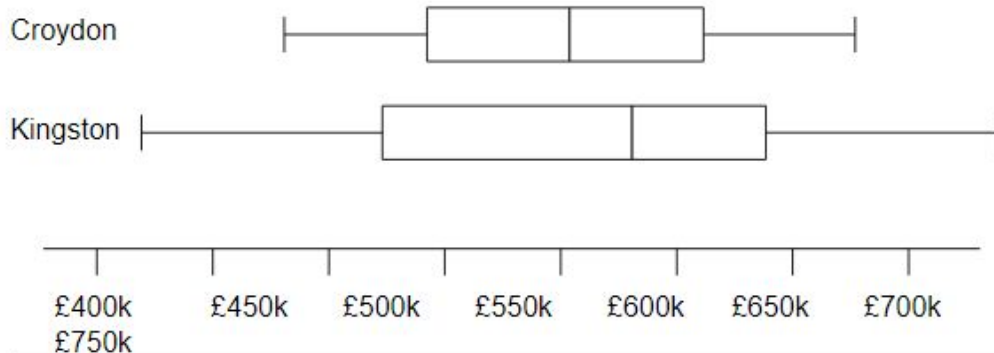


Actuaries study statistical information to calculate the risk of a driver of a certain age having a car accident or the risk of flood. This information would be used by insurers in establishing the cost of the annual premiums.

Statistics

Comparing Box Plots

Box Plot comparing house prices of Croydon and Kingston-upon-Thames:



“Compare the prices of houses in Croydon with those in Kingston”. (2 marks)

For 1 mark, one of:

- In **interquartile range** of house prices in Kingston is greater than Croydon.
- The **range** of house prices in Kingston is greater than Croydon.

Include some measure of **spread**.

For 1 mark:

“The **median** house price in Kingston was greater than that in Croydon.”

Include some measure of **location** (median is best).

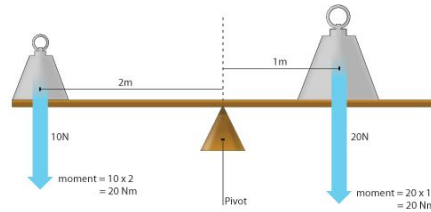
Mechanics

- The modelling of the world around us, the motion of objects and the forces acting on them.
- *What angle should a cricketer aim to hit the ball in order to maximise the distance it will travel?*
- Students planning careers in physics or engineering would find mechanics particularly useful.



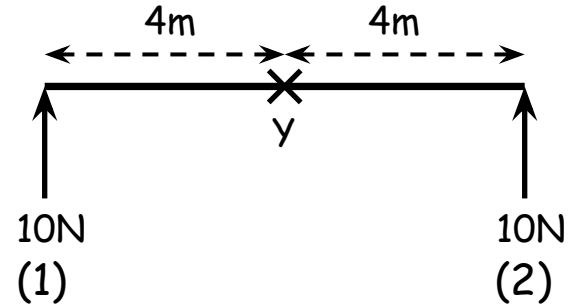
Mechanics

Moments



You can solve problems about bodies resting in equilibrium by equating the clockwise and anticlockwise moments.

- When a rigid body is in equilibrium, the resultant force in any direction is 0
- The moments about any point on the object will also sum to 0



Calculate the sum of the moments acting about the point Y

- Calculate each moment separately

$$(1) 10N \times 4m = 40Nm \text{ clockwise}$$

$$(2) 10N \times 4m = 40Nm \text{ anticlockwise}$$

As the moments are equal in both directions, the rod will not turn and hence, is in equilibrium!

As the rod is fixed at Y it will not be lifted up by the forces either!

Further Mathematics

- Mathematics and Further Mathematics can both be taken at either AS level or at A level.
- Further Mathematics is an additional A level qualification taken alongside an A level mathematics course.
- It is designed to stretch and challenge able mathematicians and prepare them for university courses in mathematics and related quantitative and scientific subjects.

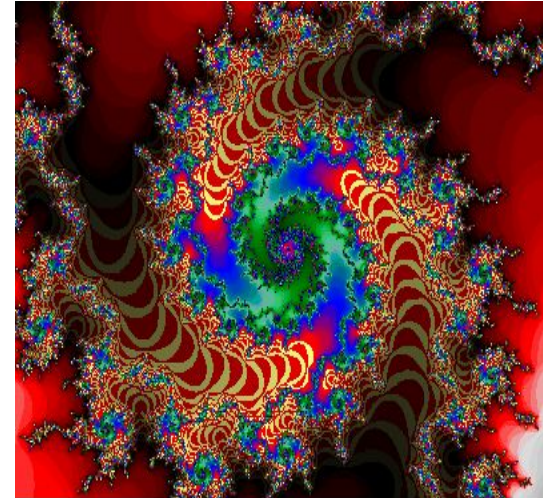
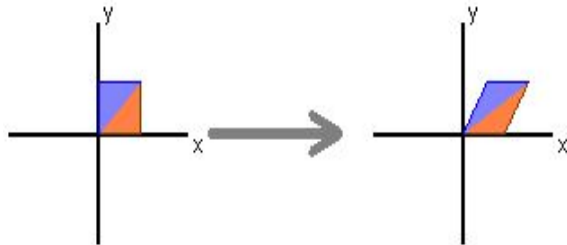
What is covered in Further Mathematics?

- Pure mathematics content, making up at least 50% of the A level.
- The remainder of the content is made up of options which include:
 - Additional pure mathematics
 - Additional statistics and/or mechanics
 - Discrete / Decision Mathematics

What pure maths is covered in Further Maths?

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.



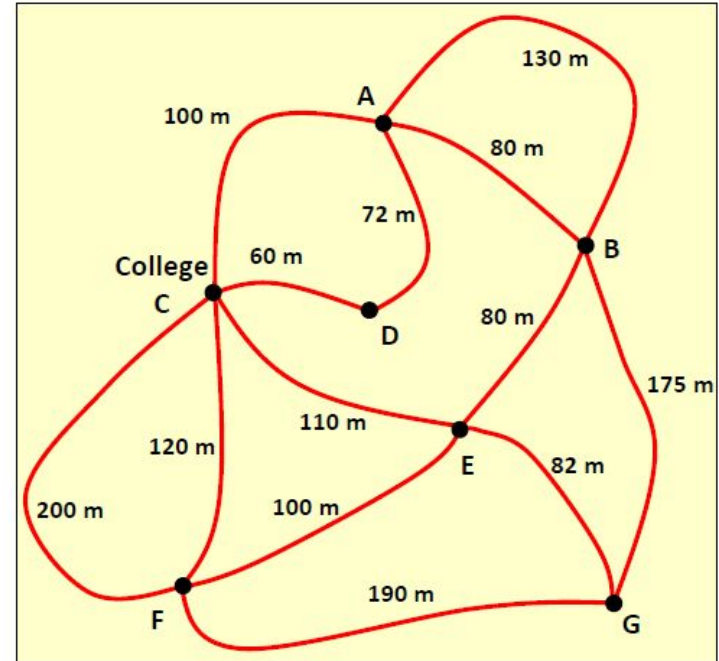
Complex numbers are based on the 'imaginary' number $\sqrt{-1}$. They lead to the study of lots of new areas of mathematics, including fractals like those shown in the image above.

What is Discrete/Decision Mathematics?

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 a network of streets?

This topic uses algorithms which are vital in computer science.



(Image taken from

<http://www.nuffieldfoundation.org/sites/default/files/files/FSMA%20Chinese%20postman%20problems%20student.pdf>)

Why study Mathematics A Level?

Studying Mathematics and/or Further Mathematics will:

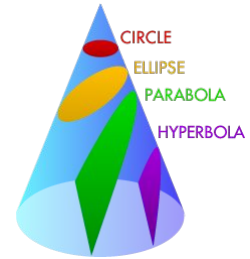
- provide a stimulating and challenging course;
- develop key employability skills such as problem-solving, logical reasoning, communication and resilience;
- increase knowledge and understanding of mathematical techniques and their applications;
- support the study of other A level subjects;
- provide excellent preparation for a wide range of university courses;
- **lead to a versatile qualification that is well-respected by employers and higher education**

Common career misconceptions

- Unless you plan to do a STEM (Science, Technology, Engineering, Mathematics) degree, you don't need A level Mathematics.
- 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 no longer true.

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



What are the career opportunities?

“...the subjects that keep young people’s options open and unlock the door to all sorts of careers are the STEM subjects (science, technology, engineering and maths). The skills gained from studying these subjects come in useful in almost any job you could care to name - from the creative and beauty industries to architecture.”

Nicky Morgan, former Secretary of State for Education

What are the career opportunities?

“Maths is the only A level proven to increase earnings in later life - by an average of 10%.”



What are the career opportunities?

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



There are many new applications of mathematics in technology:

- Games Design
- Internet Security
- Programming
- Communications



What are the career opportunities?

On-going applications in engineering, such as

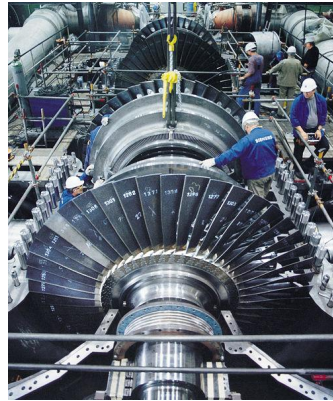
Aircraft Modelling

Fluid Flows

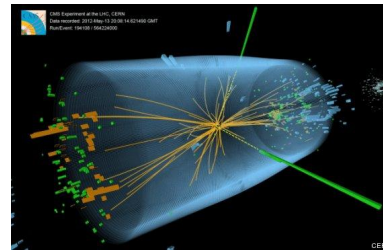
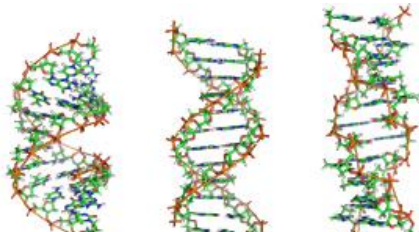
Acoustic Engineering

Electronics

Civil Engineering



...and new scientific processes such as modelling populations and Diseases, Quantum Physics, Astronomy, Forensics and DNA sequencing.



What are the career opportunities?

Financial systems and online purchasing systems are also underpinned by mathematics, relying heavily on online security and encryption.

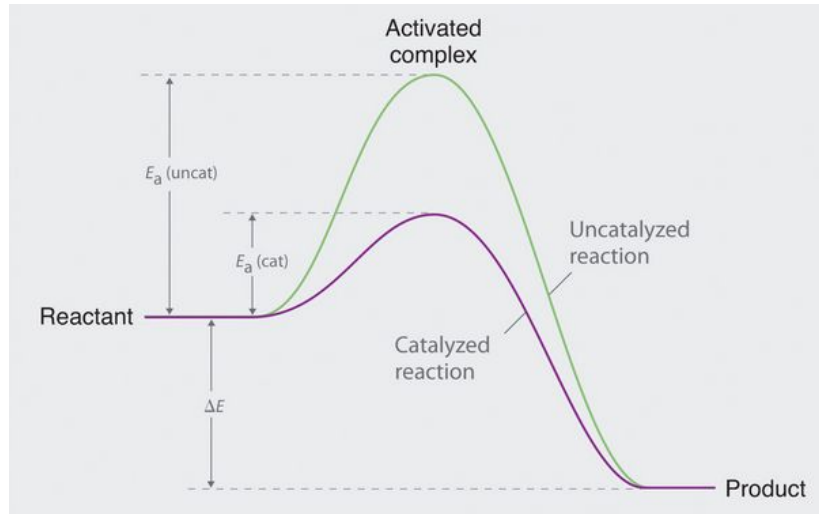
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GCHQ has the largest group of mathematicians working anywhere in the country!

What are the career opportunities?

A good understanding of algebra, graphs, logarithms and probability are beneficial for the study of chemistry, biology and geography.



Psychologists use statistics to analyse the relationships between variables and predict behaviours.

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.
- 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.

Exemplar Entry Requirements

Typical offers are:

- AAA or A*AB
- AAB or A*BB , including Further Mathematics A-level
- AAB or 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), 2017 entry

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Exemplar Entry Requirements

ABB-BBB including Mathematics and Chemistry. Other recommended subjects include Physics, Further Mathematics, Design Technology, IT/Computing and Biology.

Swansea University (Chemical Engineering degree), 2017 entry

Our courses require three A-levels at AAB/AAA including Maths and either Physics, Electronics or Further Maths

Manchester University (Electrical Engineering degree), 2017 entry

Exemplar Entry Requirements

- Typical Offer: A*AA.
- Mathematics at grade A or above.
- Preferred subjects: Apart from Mathematics there are no other essential requirements. We prefer traditional A level subjects. Further Mathematics is highly desirable

Last year, besides Mathematics and Economics the top 5 subjects taken by successful candidates were: Further Mathematics 25%, Physics 23%, History 12%, Chemistry 12%, Geography 11%

University of Bath (Economics degree), 2017 entry

Exemplar Entry Requirements

Our typical offers for students who are studying 3 A-levels are:

- ABB for students taking Chemistry with two other acceptable science or mathematics subjects
- AAB for students taking Chemistry with at least one other acceptable science subject or Mathematics
- AAA for students taking Chemistry with no other science or mathematics subject

Southampton University (Chemistry degree), 2017 entry

Exemplar Entry Requirements

Typically ABB and above at A2 level from three subjects including Biology, however, we consider applications with BBB in Biology and two other subjects of Chemistry, Maths, Further Maths, Physics or Geography

Queen Mary, University of London (Biology degree), 2017 entry

AAB – ABB. For applicants offering at least one of the following subjects at A level: Psychology, Biology, Chemistry, Maths or Physics, the typical offer will be ABB.

Swansea University (Psychology degree), 2017 entry

Exemplar Entry Requirements

- Look at the entry requirements on the individual university's website for the degree subjects that your son/daughter might be interested in.
- In some cases a qualification in Mathematics or Further Mathematics will reduce the grades required for entry to a degree course in a related subject.
- Look at www.ucas.ac.uk for additional information.



My son/daughter loves mathematics – how can they be stretched?

- Take Further Mathematics
- Participate in the Senior Maths Challenges in the Autumn term
- Tackle problems on NRICH website
- Study for additional qualifications in mathematics such as AEA, STEP, TMUA or the MAT, which are required for entrance to some leading universities to study mathematics



Additional resources

- The mathematics teachers at RHS
- FMSP website www.furthermaths.org.uk
- Maths Careers website www.mathscareers.org.uk
- Future Morph careers website www.futuremorph.org
- Universities and Colleges Admissions Service (UCAS)
www.ucas.com
- Best course 4 me www.bestcourse4me.com
- Tomorrow's Engineers www.tomorrowsengineers.org.uk
- The Institute of Physics (IOP) www.iop.org