



A Level Mathematics

A Level Further Mathematics

Student Handbook

Kingsdale Foundation School

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Why study mathematics?

- A Level mathematics is a much sought-after qualification for entry to a wide variety of full-time courses in higher education. There are also many areas of employment that see an A Level in mathematics as an important qualification and it is often a requirement for the vocational qualifications related to these areas. An AS in mathematics is very valuable as a supporting subject to many courses at Advanced GCE and degree level, especially in the sciences, computing, geography, psychology, sociology and medical courses.
- Careers or higher education courses that often require mathematics qualifications include economics, medicine, engineering, accountancy, teaching, psychology, physics, biochemistry, computing, and information and communication technology.
- People entering today's most lucrative industries, such as IT, banking and the stock market, need to be confident using mathematics on a daily basis. To be sure of this, many employers still look for a traditional mathematics A-level qualification. Researchers at the London School of Economics have found that people who have studied mathematics can expect to earn up to 11% more than their colleagues, even in the same job.

What is Further Maths?

A Level Further Mathematics is a stand-alone course offering further exploration of mathematical topics that will develop students' understanding much further than just the A Level Maths course. Students who choose Further Mathematics must already be studying Mathematics. It is an extra A Level and it is timetabled like any other course with several hours teaching and homework a week.

Why study Further Maths?

- Fastest-growing subject studied at A Level.
- Supports the learning of the normal A Level Mathematics course
- You become better at maths. As such your appreciation and enjoyment of the subject is enhanced.
- Students studying Further Maths perform half to one full grade better in the A Level Maths course, than students of comparable ability who don't take Further Maths.
- The decision, mechanics and statistics content supports other subjects, such as computing, physics, geography and psychology.

About studying mathematics

- Mathematics and Further Mathematics at AS and Advanced GCE are courses worth studying not only as a supporting subject for the physical and social sciences, but in its own right. It is challenging but interesting. It builds on work you will have met at GCSE, but also involves new ideas produced by some of the greatest minds. While studying mathematics you will be expected to:
 - use mathematical skills and knowledge to solve problems.
 - solve problems using mathematical arguments and logic. You will also have to understand and demonstrate what is meant by proof in mathematics.
 - simplify real-life situations so that you can use mathematics to show what is happening and what might happen in different circumstances.
 - use the mathematics that you learn to solve problems that are given to you in a real-life context.
 - use technology to enhance your learning and application of the subject

What is the structure of the course?

A linear course – no more modules

In previous years, students studied A Level Maths and Further Maths in modules. There are no more modules and all students will sit three exams at the end of Year 13 (or two exams at the end of Year 12).

AS and full A Level available

There will still be the option to study for an AS in Mathematics (and Further Maths), but grades awarded at AS level will no longer contribute to an A Level. You can sit the AS exam at the end of Year 12 or Year 13.

Content

In both years of your A Level you will study pure maths, mechanics and statistics. Further Maths students will also study discrete (also called 'decision') maths.

- Pure mathematics includes topics already met at GCSE level such as trigonometry, geometry and algebra. These topics are taken to a more advanced level and the discipline of calculus is also introduced.
- Mechanics consists of topics perhaps previously associated more with physics than with mathematics. Students learn about forces, motion, and static equilibrium.
- Statistics is a study of the collection, organisation, presentation and analysis of data from real life problems. The aim is to model for future outcomes using probability theory.
- Discrete theory (also called 'decision') is the study of algorithms, networks, optimisation, sorting and matching problems. It is highly applicable to computer science and business. You will learn how to make optimised decisions and to computerise tasks in a variety of applications.

Special emphasis on technology

Students will be expected to use technology through their studies. This technology will be in the form of spreadsheets, advanced calculators (see section on *Recommended Calculators*) and graphing software. Students should be familiar with their use and use them for effective learning.

Compared to GCSE

- A Level mathematics is naturally more challenging than GCSE. Skills that used to be regarded as difficult questions in their own right in GCSE will be regarded as basic tools needed to solve problems with. Many of the key ideas studied in GCSE will be continued and developed, with the addition of some brand new concepts. The most important change from GCSE is a need to be very confident and accurate in your use of algebraic techniques. If these skills are not secure then it must be the first thing to address before you can progress comfortably with the course.
- Pupils will also be expected to work more hours each week on their mathematics and spend more time studying outside of class, but this will be the same for all A Level subjects.

How do I succeed?

- The simple answer is that it will take hard work. You will need to keep up with all work set.
- In previous years students who did not keep up with work did not perform as well.
- There is always support available. You must make use of it. Speak to your teacher if you feel you are not coping, or that you require more help. We will help you!

What happens if I am struggling?

Speak to your teacher. They will always help you and should be the first person you speak to. Also confide in your tutor.

You can get extra support on Wednesdays during Enrichment. Please go to the FLC during P5-6. Take work with you and a teacher will be there to help and answer questions.

Additionally you can go after school on Wednesdays in MA3 from 3.45 to 5.15. Again take work and there will be a teacher ready to help.

Every topic your teacher will give you a topic test. Should you not meet the required standard of that test then you will be required to attend the extra classes on Wednesday during enrichment, or the session after school, for 3 weeks. After 3 weeks you will sit a similar topic test and are expected to show progress, at which point the sessions become voluntary again.

After 6th form

Whatever your plan, an A-level (or equivalent) in maths will impress both prospective employers and university admission tutors. It shows you can think logically, accurately process information, and skillfully manipulate numbers.

Thinking of going straight into employment?

- Employers look for hard-working, self-motivated, and intelligent people to join their staff. Obtaining a maths A-level shows that you have what it takes. You may not use algebra or geometry in your job every day, but the transferable skills of analysis, logic, and problem solving will always come in handy.

Thinking about university?

- Some degree subjects like physics and engineering ask for a maths A-level as part of the entry requirements. Others such as medicine and architecture don't make it a necessity, but they still have a decent amount of mathematical content. If you go in with a maths A-level, you'll have a much easier time than those who don't.

Thinking about a maths degree?

- If you've decided to study maths at university, there's great news: qualified mathematicians are always in demand. If you wish to apply to Oxford, Cambridge or Imperial universities you may be required to complete an entrance exam. They are very hard so you will need to spend several months preparing.
- The modern world needs mathematicians. Maths and science are required for the continued development of our increasingly technological lives. The UK's knowledge economy needs more mathematical skills for the financial, communication, transportation sectors and areas like genome modeling, etc. Without mathematicians, we'd be in trouble!
- You may need to sit entrance exams at the beginning of Year 13. You should be preparing for these throughout Year 12 by looking at past papers and coming to the extra support sessions.

Thinking about teaching maths?

- You might be close to finishing your secondary education, but there are thousands of 11-year-olds just starting each year. They need someone to teach them maths, and it could be you. After completing a maths degree you can go on to train as a teacher and government incentives mean that maths teachers are generally paid more than any of their colleagues. There is also currently the chance to claim £30,000 in tax-free bursaries.

Thinking about earning more?

- It's not just maths teachers that earn more – a maths degree is a great investment, whatever career you choose. The Office for National Statistics has data (2011) showing that maths graduates earn, on average, twice that of non-graduates and 24% more than other graduates. The Institute of Fiscal Studies backs up this claim (2016).
- With all of the opportunities a maths qualification can offer, you probably want to learn a bit more about where it can take you. The Maths Careers website is full of useful advice and fantastic career profiles, so have a look around to find out what maths can do for you.

<http://www.mathscareers.org.uk/>

Studying mathematics at Kingsdale Foundation School

Some key points to remember when studying maths;

- **You will be provided with a folder, writing pad and file dividers.** You must bring them every lesson and keep them organised. You must supply your own paper refill pads. Your folder will be inspected regularly.
- **Keep notes from every lesson.** This will often be in the form of model answers with annotation. If you are unsure what should be written down and when, then ask your teacher. These notes should be kept neat and organised in your folder. Your teacher will periodically check these.
- **You will be responsible for marking all your work, except assessments.** Any mistakes should be annotated with corrections and explanations before you move on. Your teacher will review and provide feedback on homework assignments.
- **You should have an advanced calculator (graphical is best).** A scientific calculator is sufficient for the course but some of you may wish to think about getting a graphic calculator especially if you are considering a degree course with a high percentage of mathematical content, e.g. mathematics, physics, economics.
- **Practise maths regularly.** You should expect to spend at least as much time studying mathematics outside lessons as you do in lessons (5 hours). This will need to increase if you are having difficulties with a particular topic.

If I fall behind or struggle?

- **Ask for help.** If you are having difficulties with homework, see the teacher **before** the lesson the work is due.
- **Be persistent!** Try a question, if you get it wrong – try again. If you still get it wrong get help from any member of the faculty. If you can't get started, look back through your notes and the examples in the textbook. There are many online resources that can also help.

- **Catch up on missed learning.** If you miss a lesson due to illness you should aim to catch up as soon as possible, ideally before your next mathematics lesson. Copy any notes or examples and work through any questions on your own. Ask your teacher for help if necessary. If you know in advance that you need to miss a lesson you should first gain permission from your mathematics teacher and then agree an action plan for catching up any missed work.
- **Ask for help (again).** If you are really struggling, talk to your teachers. Don't just hope for the best; get some help!
- Do you know your Fermat from your Leibniz? Take an interest in mathematics; the more you discover the more interesting it gets!
- **Assigned Intensive support.** For students who have struggled on a topic, they will be instructed to attend 3 weeks of intensive help on that topic. At the end of this time you will be tested again. If you have not shown the required improvements then we will assign another 3 week programme.

If in doubt talk to your teachers – they are nice, helpful people!

Brief course overview

AQA specification for A/AS Maths and the Edexcel specification for Further Maths.

AQA Advanced Subsidiary GCE in Mathematics 7356

AQA Advanced GCE in Mathematics 7357

www.aqa.org.uk/subjects/mathematics/as-and-a-level

Edexcel AS Further Mathematics 8FM0

Edexcel A Level Further Mathematics 9FM0

qualifications.pearson.com/en/qualifications/edexcel-a-levels/mathematics-2017.html#tab-3

A Level Mathematics (AQA)

Year 12 (and AS Maths)

Pure maths: Proof, basic algebra, polynomials, trigonometry, calculus, exponentials and logarithms

Statistics: Collecting, representing and interpreting data, probability and discrete random variables, hypothesis testing 1

Mechanics: Vectors, kinematics, forces and Newton's laws

Year 13

Pure maths: advanced algebra, sequences and series, trigonometric identities, differentiation, integration and numerical methods.

Statistics: probability and continuous random variables and hypothesis testing 2.

Mechanics: Motion in two dimensions and forces.

A Level Further Mathematics (Edexcel)

Year 12 (and AS Maths)

Pure: complex numbers, series, roots of polynomials, linear transformations, vectors, proof, curve sketching, volumes of revolution and matrices.

Mechanics: momentum & impulse; work, energy & power; elastic collisions

Discrete: algorithms, graphs theory, network optimisation, critical path analysis and linear programming.

Year 13

Pure: proof, series, complex numbers, further algebra and functions, differential equations, further calculus, further vectors, polar coordinates and hyperbolic functions.

Mechanics: moments, elastic strings and springs, collisions and dimension analysis.

Discrete: graph theory, network optimisation and the simplex algorithm.

Assessment

External

A Level Mathematics and A Level Further Mathematics will now be studied linearly with exams take at the end of Year 13. There will be no opportunity to repeat exams. You will have one chance.

All papers are equally weighted.

A Level Mathematics

Exams to be sat, in June, at the end of Year 13.

Paper 1 (2 hours): Pure mathematics

Paper 2 (2 hours): Pure & Mechanics

Paper 3 (2 hours): Pure & Statistics

A Level Further Mathematics

Exams to be sat, in June, at the end of year 13.

Paper 1 (1.5 hours): Pure mathematics

Paper 2 (1.5 hours): Pure mathematics

Paper 3 (1.5 hours): Further Mechanics

Paper 4 (1.5 hours): Decision

AS Mathematics

Exams to be sat, in June, at the end of the school year.

Paper 1 (1.5 hour): Pure & Mechanics

Paper 2 (1.5 hour): Pure & Statistics

AS Further Mathematics

Exams to be sat, in June, at the end of the school year.

Paper 1 (1 hr 40 minutes): Further Pure

Paper 2 (1 hr 40 minutes): Decision and Further Mechanics

Your marks will be standardised and converted into a Uniform Mark Scale (UMS). These will be the points that will determine your grade.

Internal

As well as the external assessment there will be regular internal assessment carried out by your teachers.

These will normally come in one of three forms.

1. Regular small assessments at the end of each topic based on past exam questions. These will be approximately 30 minutes and form the majority of your continual assessment. Students will be given warning of these but should expect one after completion of a chapter.
2. Half term assessments based on all topics taught to date in their current modules of study.
3. Full mock papers in the form of past papers. These will be done on completion of modules and during exam preparation.

Recommended calculators

You generally have a choice of two types of calculators to choose: graphical and scientific. Graphical calculators have more functions but are more expensive. There is very useful free software for graph plotting, which can help in your studies, but this software cannot be used in exams.

We only recommend one calculator – the Casio FX-991EX *Classwiz*

All students will be expected to have one.

This calculator has major new functions over previous Casio calculators and older/cheaper models will not be adequate for the new A Levels.

These calculators will also be supports in online resources that will show you how to use the calculator and solve problems in efficient methods.



Could I use a graphical calculator?

Yes, but there aren't any that we would recommend at this time. Currently they offer the power to draw graphs, but their interfaces are more complex and less user-friendly. In experiments, it was found that the latest Casio and Texas graphical calculators were slower to use in exams than the Classwiz, and the graphing functions offered little advantage. This is why they are not recommended.

Recommended reading

While not a necessity for success in the course, some potentially interesting reading;

A History of Mathematics by *Carl B. Boyer*

Infinity: The Quest to Think the Unthinkable by *Brian Clegg*

The Man Who Loved Only Numbers by *Paul Hoffman*

A Brief History of Time by *Stephen Hawking*

Introduction to Mathematical Philosophy by *Bertrand Russell*

Fermat's Last Theorem by *Simon Singh*

A Very Short Introduction to Mathematics by *Timothy Gowers*

Flatland: A Romance of Many Dimensions by *Edwin Abbott Abbott*

Journey Through Genius: The Great Theorems of Mathematics by *William Dunham*

The Simpsons and their Mathematical Secrets by *Simon Singh*

Things To Make And Do In The Fourth Dimension by *Matt Parker*

Automate This: How Algorithms Came To Rule Our World by *Christopher Steiner*

Interesting mathematical websites

Information is Beautiful

www.informationisbeautiful.net

Lovely examples of presenting information using infographics.

Spurious Correlations

www.tylervigen.com/spurious-correlations

Fun examples of how correlation does not equal causation

Reddit: Data is beautiful

www.reddit.com/r/dataisbeautiful/

Posts of interesting data from around the world. Often related to current socio-political events.

BBC More or Less

www.bbc.co.uk/MoreOrLess

Weekly podcasts investigating the numbers in the news.

Useful websites or apps

Please note that some may not be free. These are not essential for the course.

Kerboodle

www.kerboodle.com

Access the textbook online. You can also view help videos, learn how to use your calculator effectively, get worked solutions and complete assessments.

Physics & Maths Tutor

www.physicsandmathstutor.com/a-level-maths-papers/

All the past exam papers available online. Plus exam revision materials.

Exam Solutions

www.examsolutions.net

Revision tools. A phone app is also available.

MyMaths

www.mymaths.co.uk

Yes, there is an A Level section! Homework and revision tools. As of July 2017 was being redesigned to work without Flash and therefore should work on more devices.

Username: kingsdale Password: chocolatecake

Math Centre

www.mathcentre.ac.uk

Revision and learning tools.

Maths Careers

www.mathscareers.org.uk

More information on what careers mathematics can lead to.

AQA

www.aqa.org.uk/subjects/mathematics/as-and-a-level

Course information for A Level Mathematics.

Edexcel

qualifications.pearson.com/en/qualifications/edexcel-a-levels/mathematics-2017.html

Course information for A Level Further Mathematics.

Wolfram Alpha

www.wolframalpha.com

A 'computation engine' for solving many types of problems. An app is also available.

Desmos

www.desmos.com

A graphing app for plotting all types of equations.

Geogebra

www.geogebra.org

A geometry program that allows you to explore all kinds of geometry as well as algebra and graphs.