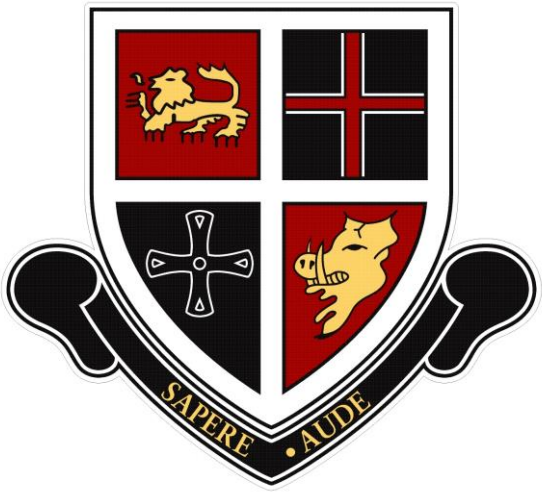


Durham Johnston Mathematics Department

An introduction to A Level Mathematics.

Notes

An introduction to A level mathematics at DJCS.

Thank you for choosing to study Mathematics at Durham Johnston. We follow the new OCR linear specification, Mathematics A – H230/H240 and Further Mathematics A – H235/H245.

All mathematics students at Durham Johnston will sit AS mathematics exams at the end of Year 12. If you also opt for further maths you will sit AS exams in further maths too.

Algebra is the language of mathematics and your success in the examinations next year is dependent upon your fluency in basic number work and in algebraic manipulation as well as your ability to write clear, coherent and detailed solutions to problems. You must be willing to perfect a range of skills that you have already met at GCSE such as simplifying surds, working with indices and rearranging formulae.

In week 2 of your course you will take a basic algebra test. The pass mark for this test is 60%. If you do not pass this test you will be interviewed by the Subject Leader, to discuss your next steps and your parent/guardian will be informed. You will be given a programme of additional work to complete and you will take a second test immediately after the October half term holiday. This second test will take place at the end of a school day.

A mock test is provided in this booklet.

It is important to cultivate good study skills from the very beginning of your course. Organise your notes and examples in a folder and make sure that you take an active part in every lesson. Complete every set task and meet deadlines. You must persevere when the going gets tough and take action when you need help. The teachers in the mathematics department at Durham Johnston are very experienced and are always willing to provide support and guidance.

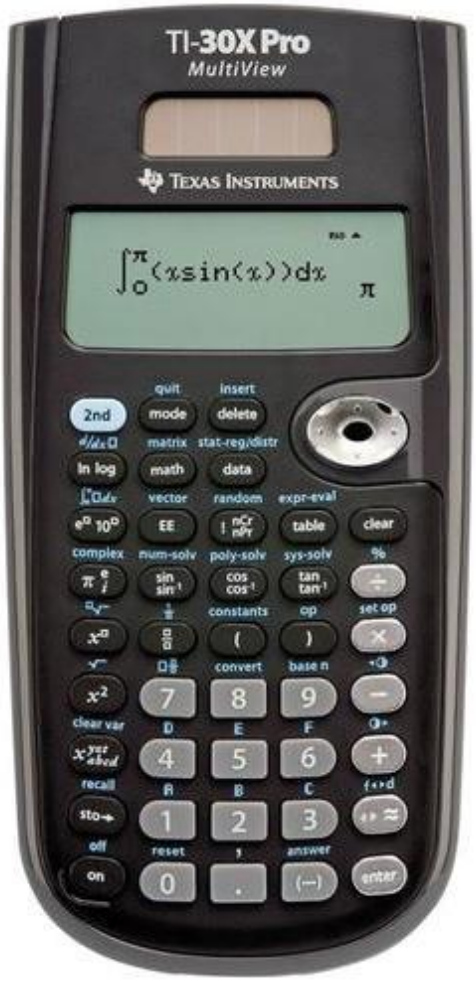
Mrs Urwin

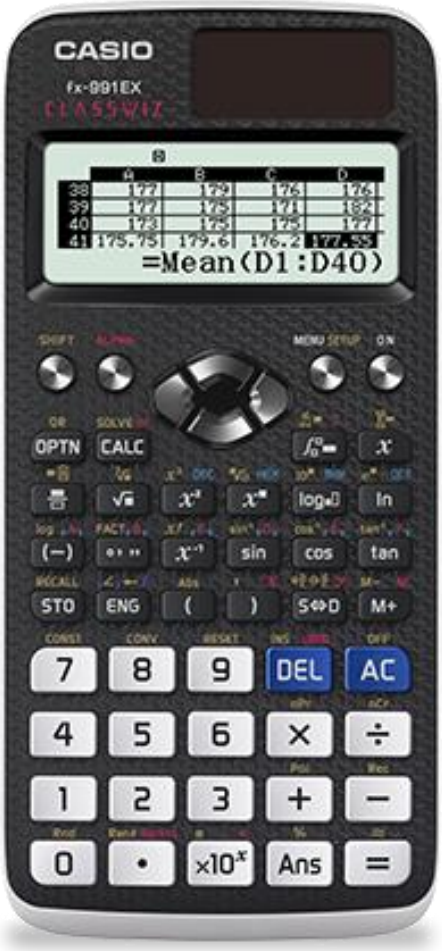
Subject Leader for Mathematics

June 2019

Calculators and Computers

The new linear A level specifications starting in September 2017 all require an advanced calculator with built-in statistical distribution functions. The calculator you used for GCSE and the "advanced" calculators available in the shops will not be good enough. There are two current non-graphical calculators that are suitable. The **TI 30X-Pro** is available for about £17 and the **Casio Fx-991EX Classwiz** is available for just over £20 if you hunt around on the web (Amazon is about £25, but you can sometimes find deals). **We definitely prefer the Casio**. If you wait until September you will be able to buy a Casio through the school for about £20.





You should also have the facility to draw graphs and manipulate statistical data to aid your learning throughout the course. There's no need to purchase expensive equipment or software for this. We recommend the excellent and free **Geogebra**. You should download their graphing calculator app to your phone/tablet (iOS or Android) and install Geogebra Classic on your Windows machine or Mac.

Further help

- The exam board, OCR, provides a very useful bridging guide. This contains detailed examples and exercises for you to work through. It can be found on the website at http://www.ocr.org.uk/Images/373371-bridging-the-gap-between-gcse-and-as-a-level-mathematics-a-student-guide.docx . Alternatively, a pdf version is available on the school website at http://www.tinyurl.com/DJCSMaths19
- A very useful source of help is Khan Academy www.khanacademy.org

  You will need to register and create a username and password.

- You may also find the following books useful:

Head Start to A-Level Maths Published by CGP Workbooks ISBN: 978 1 78294 792 9 £5.95	AlphaWorkbooks Preparation for AS/A level Mathematics Available from www.alphaworkbooks.co.uk £3.99 The Mathematics Department has a supply of these books available for £2.00 each

Suggested Reading List

Alex's Adventures in Numberland by Alex Bellos

Professor Stewart's Cabinet of Mathematical Curiosities by Ian Stewart

Fermat's Last Theorem by Simon Singh

The Num8er My5teries by Marcus du Sautoy

How Many Socks Make a Pair? Surprisingly Interesting Maths by Rob Eastway

The Curious Incident of the Dog in the Night-time by Mark Haddon

The Penguin Dictionary of Curious & Interesting Numbers by David Wells

The Code Book by Simon Singh

50 Mathematical Ideas You Really Need to Know by Tony Crilly

Gödel's Proof by Ernest Nagel and James R. Newman

Gödel, Escher, Bach: An Eternal Golden Braid by Douglas R. Hofstadter

The Pleasures of Counting by T. W. Körner

How to be a successful mathematics student

Don't expect the teacher to notice you are stuck – ask for help.	Take an active role in your learning. Those who get highest marks are often those who ask lots of questions and discuss their work with others.
Set work out in exactly the same way as your teacher does – there is always a good reason for this.	Write equals signs underneath each other. Remember to answer the question and say what it is you've calculated.
Be intrigued if you're wrong – work out why.	Mathematicians are people who don't necessarily get the right answer straight away – but they are interested in why their answer is wrong and they PERSEVERE to correct it. Mathematics is about trial and improvement – not right and wrong.
If you can't explain something to someone else, you're not sure enough – do more work on it.	EXPECT to have to work at something and for it to take several goes. This may feel different to GCSE where perhaps you didn't have to.
Mark your own work using the answers in the back of the text book.	Using the answer to help you to understand isn't cheating. When handing in work, tick the work that is correct and annotate wrong answers to help your teacher to see where you are having difficulties.
Rewrite work – don't expect the teacher to plough through lots of incorrect working.	Make your work neat and easy to read – take pride in its appearance.
Show all the steps of your method.	Communicating your ideas is an important skill to practise.
Deadlines are important so don't ignore them.	You can't miss them at university or at work, so get into good habits now.
If you miss a lesson, find a way to catch up.	A good way is to ask someone who was in the lesson to explain it to you – that's good for them too. Copy up notes carefully – and read them!
Always do your corrections and get them checked…	…otherwise there is no point in doing them.

DJCS Mathematics Department

GCSE to AS induction - practice exercise.

1. Evaluate

$$10^2 \qquad 64^{1/2} \qquad 8^{4/3}$$

2. Express as a power of 3

$$3^2 \times 3^5 \qquad 3^{10} \div 3^2 \qquad (3^2)^3 \qquad 3^2 \times 9^4$$

3. The points A, B and C have the following coordinates: A $(7, 5)$, B $(3, -3)$ and C $(-1, 9)$.
   - Find the gradient of AB, BC and CA.
   - What type of triangle is triangle ABC?
   - Find the area of triangle ABC
   - Find the equation of the line parallel to AB, passing through the point D$(1,4)$

4. Expand and simplify:
   - $(5x + 3)^2 + (3x + 1)^2$
   - $(5x + 3)^2 - (3x + 1)^2$
   - $3(5x + 3)^2 + 2(3x + 1)^2$
   - $3(5x + 3)^2 - 2(3x + 1)^2$

5. Simplify

$$\sqrt{75} \qquad \sqrt{72} \qquad \sqrt{48} \qquad \sqrt{80} \qquad \sqrt{98}$$

6. Express in the form $a\sqrt{b}$

$$\sqrt{75} + \sqrt{48} \qquad \sqrt{98} - \sqrt{72}$$

7. Rationalise

$$\frac{10}{\sqrt{5}} \qquad \frac{12}{\sqrt{3}} \qquad \frac{4}{1+\sqrt{7}} \qquad \frac{42}{5-\sqrt{2}} \qquad \frac{10}{2-\sqrt{3}}$$

8. Solve the following, leaving your answers in surd form where necessary.
   - $x^2 + x - 12 = 0$
   - $2x^2 + 5x - 3 = 0$
   - $16 - x^2 = 0$
   - $3x^2 + 10x - 5 = 0$

9. Solve the following inequalities
   - $2x + 10 \leq 17$
   - $x^2 + x - 12 \leq 0$
   - $2x^2 + 5x - 3 \geq 0$

Dr T's Useful Links

This is a curated collection of links to extension tasks for ambitious students.

General links

You should join Khan Academy This provides thousands of hours of videos in maths and also computer science at all levels from kindergarten to undergraduate and beyond.. They are building up content in a number of other areas. They have a huge set of interactive practice exercises and mastery challenges. You earn points for watching videos and solving problems. There are badges for achieving mastery of topics and whole areas. I have an embarrassing 1,500,000 points and 452 badges. See if you can beat me. My username on Khan Academy is DrMThornber.

For those thinking of a career in engineering or the sciences, now might be a good time to learn modern scientific computing. In my view this means Python with a scipy stack. The right way to do this is in Jupyter notebook. The simplest way is to sign up for a free Microsoft Azure account. This provides cloud computing in Jupyter notebook. You should sign in with your school email and password. The front page also has links to a number of interesting courses. I would suggest the Python at Cambridge project. Use the button at the top left to clone the project before you start. You can now do hardcore coding in a browser on your phone! If you'd rather work locally you can download the full Anaconda Distro to a laptop or desktop. Get the Python 3.7 version.

Those interested in Computer Science should definitely sign up for Isaac Computer Science. This site has some resources for GCSE and A level and it is growing all the time. At the moment Khan Academy is more extensive so sign up for both.

Those interested in Physics or Engineering should sign up for Isaac Physics It has extensive sets of problems ranging from preparation for A level up to Oxbridge entrance. Their books of problems are cheap and excellent quality.

There's also an Isaac Chemistry sub-site. It seems to be in an earlier stage of development, but they do have a nice mastery book

Those interested in maths at university should register with the STEP Support Program You don't have to be aiming for maths at Cambridge to take advantage of their advanced problem solving help. The foundation modules are a set of 25 assignments aimed at students in Y12, although accessible to a strong GCSE student too. Each assignment contains a little theory and a set of accompanying problems. Try one set a week to begin with.

Ideas for Y11 planning to take A level maths or further maths

Check the DJCS Maths Page Click on the A level tab and then open the Algebra Practice document. This indicates the algebra skills you will be tested on at the start of Y12 and has links to revision materials on Khan Academy.
Once your algebra is practised and secure you can look at some Y12 topics on Khan Academy:
The Unit Circle, Trig Graphs, Limits, Derivatives (up to and including quiz 2 for Y12 work)

Ideas for Y12 going into Y13 maths

You can use Khan Academy to work on the material we normally study at the end of Y12:
Functions (Domain and Range, Inverse Functions, Composing Functions) Absolute Value, Radian Measure, Trig Identities

Ideas for Y12 going into Y13 further maths

Use Khan Academy to work on the material we study at the end of Y12:
Continuous Random Variables (it's a bit basic), Hooke's Law (again, a bit basic), Series and Induction, Vectors

Ideas for Y12 planning to apply for maths at university

In addition to the end of year work you should make sure you work on the STEP Support Program (see above). You should also check out the Oxford Maths Admission Test This is taken in October of Y13 so has less content than STEP. There are lots of past papers to practice with. These are good practice for those applying to other universities. Make sure you know APs and GPs.

It's a good idea to use time now to learn basic calculus from Y13 maths. Product and Quotient Rule, Chain Rule, Integration by parts, Substitution, Partial Fractions

Learn programming for number theory with MEI. You can email me at my school address for a student login to see all the resources.

Ideas for Y13 waiting for university

Learn a skill via Khan Academy or learn advanced coding in Python. See the links at the start.

I really like the Isaac Physics Quantum Mechanics book. It's hard but working through it will set you up for a physics degree or a degree with a mathematical physics component.

Read a book! Here are a few classics, get them cheap on Amazon marketplace.

How to Solve It ***Polya*** A small classic on the art of solving undergraduate problems.

Calculus ***Spivak*** A challenging mix of basic calculus with all of the proofs included and every hard problem there is.

Concrete Mathematics ***Graham/Knuth/Patashnik*** A lovely book with a nice, chatty introduction to finite mathematics (summing series, binomial identities etc.) Written for Computer Science students.

A Mathematician's Apology ***G.H. Hardy*** A small but influential book by a giant of British mathematics. (Jeremy Irons played him in the recent movie *The Man Who Knew Infinity*)

The Pleasures of Counting ***T.W. Körner*** I really like this. It gives lots of applications of simple ideas.

Gödel, Escher, Bach ***D. Hofstadter*** Great for those interested in mathematical logic or theoretical computer science..

Surely You're Joking, Mr Feynman ***R.P. Feynman*** Everybody recommends this. It's a riotous read. See the next book too.

QED: The Strange Story of Light and Matter ***R.P. Feynman*** Less outrageous than the previous book, but with more physics.

The Design of Everyday Things ***D. Norman*** Every engineer or computer scientist should think more about usability. This is the standard introduction.

Dealers of Lightning: Xerox Parc and the Dawn of the Computer Age ***M.A. Hiltzik*** A fascinating introduction to why computers are the way they are. These guys planned it all out in 1970!

The New Turing Omnibus ***A.K. Dewdney*** A set of short articles on lots of aspects of computer science. Often recommended reading for University courses.

A Man for All Markets ***E.O. Thorp*** The autobiography of the man who used maths to beat the casinos at blackjack and then went on to make a fortune in the stock market.