Sixth Form Handbook

Further Mathematics

Contents

About the course

Whilst this book shares some similarities with the A-level Mathematics handbook, please read through this as there are some important differences – especially for your extra summer tasks.

Further Mathematics A level goes far deeper (like a Mandelbrot zoom!) into the world of Maths. This course will be excellent preparation for those of you looking to do Maths, Physics, Chemistry, IT, Computing and many scientific degrees or jobs.

You will be in separate lessons to your A-level Mathematics class – possibly with different teachers. Make sure you do not get confused with study time. **You need to allocate enough study time to both Further and ordinary Mathematics A levels, just as you would to two separate A-levels. Both require substantial practice.**

The exam board for Further Maths is MEI. This is a sub group of OCR – who only produce Maths tests and resources. MEI stands for 'Mathematics in Education and Industry' and they are passionate about excellent content for you to study.

How you will be assessed

Year 1

Further Mathematics is the only subject to take AS levels in year 12. This is because it is often chosen as a 4th A level option – and with an AS qualification at the end of year 12, some students may wish to pursue their other three subjects into year 13. Having an AS in Further Maths will make you stand out, and will mean the years study throughout year 12 went towards something. There will be tests and assessments throughout the year to track your progress.

Year 2

Due to the linear course, all exams will be sat at the end of year 13. Your AS results will neither help or hinder you here, the A level exams are separate and slightly different to the AS exams. There will be a Pure Maths paper, accompanied by 3 'minor' papers. These being: Mechanics, Statistics, and Modelling with Algorithms.

Tasks before September

Before September – we are expecting you to prepare so that you hit the ground running. This is the hardest A-level our country has to offer – you need to respect this and get excited for the challenges ahead!
Make sure you are confident with the standard A- level tasks and then you also need to complete the following:

Research 'complex numbers'. What is a complex root? What is a complex conjugate? (You should be familiar with what a conjugate is from surds – but look this word up if not!)

You then have a worksheet to complete on complex numbers – at the end of this handbook.

Senior Maths Challenges

Poole High School have managed to secure hosting the Senior Team Maths Challenge this year and are hoping to field a strong team of 4 (2 from each year 12 & 13).

Separate to this we will also be entering all students who are interested into the individual Senior Maths Challenge. This is an individual competition with lots of tricky but fun questions to try and answer – so please make yourself known if you are interested in this!

Course Reading List & Materials

A list of fantastic Maths books can be found here:

http://www.mei.org.uk/books2

From puzzles, engaging stories, history of Maths, or the classic Euclid's elements – one or more of these would make an excellent summers read!

Useful websites

https://www.youtube.com/user/numberphile

Numberphile is a fantastic youtube channel that has now hundreds of videos about Mathematics! Some are more complicated than others, but many have engaging animations to help you understand the puzzles.

Many are filmed at the Mathematical Sciences Research Institute – and feature professional Mathematicians talking about their current research!

Mr. Miller's favourite 3 are:

- Simon Pampena
- Zvezdelina Stankova - Professor of Mathematics at Mills College
- And of the more recent videos - Tadashi Tokieda – who has many puzzles and tricks you can try to create with simple objects such as paperclips, rubber bands and strips of paper. Give them a go and consider what is happening – try to create rules and your own patterns!

Who can I contact for help?

You will be entered into a google classroom – please login in and accept your invitation. Mr. Miller will share some videos that he finds interesting (who knows, you may too!)

The google classroom will be the ideal place for discussions with each other. Mr. Miller will check in every now and then and get involved and help to answer questions. If you find anything interesting out there in the World Wide Web, please share it for us all to enjoy here!

Teacher	**Can be found at…**
Mr. Miller	Maths office
Mrs. Nash	Sixth form office
Mrs. Scott-Brown	Maths office
Miss Pipe	Room 34

The Mathematics department is looking forward to meeting you in September.

The journey starts NOW! Good luck with the tasks, and enjoy your summer break.

In mathematics
the art of proposing a question
must be held of higher value
than solving it.

Georg Ferdinand Ludwig Philipp Cantor
(1845-1918, German mathematician)

(For some really cool Maths – look up some of the work of Cantor! It has links to the **Menger sponge** and Chaos Theory)

Complex numbers introduction

Do some research on complex numbers. How were they discovered? Why are they useful? You should read about what 'i' is.

Then, please attempt the following problems:

Simplify the following, using i

$\sqrt{-9}$ $\sqrt{-8}$ $\sqrt{-200}$ i^2 i^3 i^4

How about: i^{11} ? i^{106} ?

$(2+i)(7-8i)$ $(9i-5)(3+2i)$ $(17i-17)(3i-1)$ $(5i-1000)(5i+1000)$

Solve these equations, whose discriminants are less than zero, using the quadratic formula:
(Again, in you have forgotten or are not aware of the discriminant test - please look it up! It is related to the formula and massively important!)

$7x^2 - 3x + 11 = 0$ $\frac{x^2}{2} = 5x - 17$ $3x^2 + 10 = 4x$ $x + \frac{5}{x} = 3$

What do you notice about the roots of the equations above?

Show that $(x+7)(x^2+3x+8) \equiv x^3 + 10x^2 + 29x + 56$

Hence, find the 3 solutions to the equation:

$x^3 + 10x^2 + 29x + 56 = 0$

Matrices – introduction

Look up matrices. Try to find out the following:

i) How do we describe the size of matrices?
ii) What sized matrices can be multiplied together? Is there a rule?
iii) How do you multiply matrices together?
iv) What is the identity matrix?

Then try the following:

a)

$$\mathbf{A} = \begin{pmatrix} 2 & 0 \\ 1 & 3 \end{pmatrix} \quad \mathbf{B} = \begin{pmatrix} 5 \\ 4 \end{pmatrix}$$

Work out the matrix **AB**.

b) $A = \begin{pmatrix} 7 & 5 \\ -2 & 4 \end{pmatrix}$ $B = \begin{pmatrix} 9 & -1 \\ 4 & 0 \end{pmatrix}$

Calculate: i) AB ii) BA iii) A^2 iv)B^2 v) A^3 vi) 3A

c) Multiply these two matrices together:

$$\begin{bmatrix} 1 & 2 & -1 \\ 3 & 4 & 0 \\ 1 & 5 & -2 \end{bmatrix} \begin{bmatrix} 2 & -1 & 3 \\ 1 & -2 & 1 \\ 0 & 3 & -2 \end{bmatrix}$$

d) Obtain the product AB if $A = \begin{bmatrix} 1 & -2 \\ 2 & -3 \end{bmatrix}$ and $B = \begin{bmatrix} 2 & 4 & 1 \\ 6 & 1 & 0 \end{bmatrix}$

e)

Work out the values of a, b and c.

$$\begin{pmatrix} 2 & a \\ 3 & 1 \end{pmatrix} \begin{pmatrix} 1 & 3 \\ 2 & b \end{pmatrix} = \begin{pmatrix} 12 & 13 \\ c & 26 \end{pmatrix}$$