

Reading List for A-Level Maths/Furthers Maths, especially for STEM interviews

There are lots of excellent books about both mathematics and mathematicians, such as <u>The Man Who Loved</u> <u>Only Numbers</u>: a biography of Paul Erdös, one of the most prolific mathematicians ever! I have highlighted some of my favourites below, focusing on books that promote mathematical thinking for A-level students. For more options, NRICH keep a list here of interesting books, organised by target age and category, with a short summary of each: <u>https://nrich.maths.org/9477.</u>

Collections of problems and questions - the titles link to shops selling the books

Advanced Problems in Mathematics

For years this was the standard STEP preparation book, written by <u>Stephen Siklos</u>, the man responsible for STEP. It has an excellent selection of graded problems, including hints, solutions and discussions for each.

The Stanford Maths Problem Book

Similar to "Advanced Problems" above, this is an excellent collection of problems with hints and solutions. The problems are designed to test "aptitude" rather than "achievement" and will reward creativity and insight. The problems were selected by <u>George Pólya</u>, who wrote one of the classic texts on problem solving (see below).

Professor Povey's Puzzling Problems

A collection of interesting physics problems, with discussions of each. This is particularly useful for students considering courses in physics or engineering, where these types of questions may come up in interviews. The questions encourage students to deal carefully with modelling assumptions and limiting or boundary cases, with some discussion of the differences between "real" and "idealised" situations.

Fifty Challenging Problems in Probability

A collection of interesting probability problems. More than any other area of mathematics, the solutions to probability problems can seem counter intuitive and contrary to our expectations. These puzzles cover many classic and interesting situations and encourage critical thinking about chance and risk. Note that the book was first published in 1965 in America, so there are assumptions in some puzzles that may have changed, such as knowledge of local landmarks. However, the reader should be able to adapt these and the discussion of what are valid assumptions is also interesting.

Algorithmic Puzzles

A collection of interesting problems that require you to find an algorithm to solve a problem, or generalise to solve a whole class of problems. Finding an algorithm is part of the exercise, proving it works in all cases may be harder! These problems would appeal to students studying the discrete/decision modules in further maths, or students studying maths with computer science.

A Problem Solver's Handbook

A discussion of problem-solving techniques, particularly focused on the UKMT (and therefore a good bridge towards MAT, STEP, interviews etc.).

How to Solve It

The classic work on mathematical problem solving for students and teachers! Pólya's work has influenced generations of problem solvers and has shaped many of the ways we teach problem solving. His other books are less well known, but also very valuable, namely *Mathematical Discovery* (<u>Volume 1</u> and <u>Volume</u>) and <u>Mathematics and Plausible Reasoning</u> (<u>Volumes 1 and 2 combined</u>). There is also an application of his methods to computer science in the book <u>How to Solve It by Computer</u>.

The following websites provide free resources for advanced problem solving, including preparation for Oxbridge interviews/exams. Some of the best preparation you can do now is to solve lots of interesting problems that encourage you to think around your subject and explore beyond the A-level specification.

My favourites are <u>https://maths.org/step</u> for maths and <u>https://olympiad.org.uk</u> for computer science.

- The following course is a very well-structured approach to STEP preparation: <u>https://maths.org/step</u>
 - This site also includes links to other resources, including the classic STEP book: <u>https://www.openbookpublishers.com/product/1050</u>
 - \circ Both of these are excellent resources to work through across year 12 and 13
- Past papers and solutions for STEP are available in many locations:
 - o <u>https://stepdatabase.maths.org/database/index.html</u> Searchable database of questions
 - Dr Frost Maths has lots of valuable resources, including collections of interesting problems with solutions <u>https://www.drfrostmaths.com/page.php?id=4</u>
 - Worked solutions to STEP and AEA questions are available via MEI and Integral (free) here: <u>https://mei.org.uk/step-aea-solutions</u>:
- This part of the NRICH site is also very good for problem solving: <u>https://nrich.maths.org/advancedps</u>
 NRICH has many interesting open problems for students
- If students are considering computer science, the Informatics Olympiad is the computing equivalent of the maths challenge/olympiad: <u>https://olympiad.org.uk</u>
- Students considering physics or engineering may want to look at: <u>https://isaacphysics.org;</u> the site has lots of challenging, conceptual problems for physics and also resources for chemistry and computer science
- MEI has lots of links to problem-solving resources, including links to NRICH, the UKMT and the AMSP resources. MEI also has a guide to problem solving: <u>https://mei.org.uk/problem-solving-guide</u>
- The AMSP, managed by MEI, has a number of problem-solving courses for students to attend: <u>https://amsp.org.uk/students/university-admission-tests/step-mat-tmua</u>.
 - \circ $\;$ This link also has links to all the official admissions testing websites $\;$
- Underground Maths has an excellent, searchable collection of questions, and discussions of solutions: <u>https://undergroundmathematics.org/browse</u>



