OCR A level Mathematics (A) for Year 2 by Sophie Goldie, Val Hanrahan, Cath Moore, Jean-Paul Muscat and Susan Whitehouse, pp. 600, £29.99, ISBN 978-1-4718-5307-4, Hodder Education (2018)

This textbook covers the content of the new OCR Syllabus A for Mathematics, first examined in 2019, for the second year of A level study in English schools. It presupposes familiarity with the work in the first year of study, which is covered by a companion volume from Hodder. Explicit changes from the old modular system include an increased focus on problem solving and proof, an extended use of ICT, an emphasis on modelling in mechanics, and, in the statistics element, several new topics, including large data sets. Understanding and interpretation rather than routine calculation are emphasised, although the exercises cover all these aspects of study.

What exactly is required in a review of a textbook—and particularly one which is linked to a public examination? This largely depends how the book is to be used. The main thrust of learning is going to be delivered by lessons in school (now that the Covid crisis is over) and presumably pupils are encouraged to take notes and practise answering questions both in the classroom and for homework. The textbook should serve as a reminder of how various problems are solved and, perhaps, indicate alternative approaches to those used by the teacher.

Looking through the text, I was impressed by the clarity of the exposition along with an emphasis on rigour and an appreciation of the need to relate different parts of the syllabus to one another. Results from the first year of A level study are reviewed without any fuss but in sufficient detail to avoid the need to refer to the old textbook. New concepts, techniques and results are introduced in a way which respects the intelligence of pupils. Throughout, mathematics is not reduced to a box of tricks which happens to provide correct results.

There is also a willingness to confront issues which are often ignored. An example of this is the discussion of transforming an inequality by taking logarithms to a base which is less than 1. This is related to the fact that the inequality $a < b$ becomes $f(a) > f(b)$ if the function is decreasing. Maybe it might also have been mentioned that, for a function which is not monotonic, nothing can be said. Another instance where the temptation to rely on an algebraic sleight-of-hand is avoided is in the solution of differential equations by separating variables.

There are other things I would like to have seen, such as the concept of codomain, the fact that $|x| = \sqrt{x^2}$, the characterisation of an inflexion as a point where a curve crosses its tangent and that the fact that integration by substitution can be considered as a transformation of the axes. However, these are minor cavils and a good teacher can always introduce them with an able class of students.

The commitment to focus on proof and problem solving is signalled from the outset, in an excellent introductory chapter. The implication $A \Rightarrow B$ is rephrased in different language, first as '*A* only if *B*' and then as '*A* is a sufficient condition for *B*'. There is enormous scope here for further work, maybe looking at geometry: for instance, how many necessary and sufficient conditions can you find for a quadrilateral to be a paralleogram? Nor does the text shy away from discussing the *converse* of a result – a concept which is notably absent from the National Curriculum for GCSE. This first chapter also looks at different proof strategies and the use of counter-examples, and the ideas in it are revisited throughout the book.

The second half of the book deals with statistics and mechanics, which are now both compulsory. The former section begins with a review of what has been learnt in the first year of study, and describes methods of data collection, measures of central tendency and spread, and types of data. Probability, including conditional, and of the

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binomial distribution, are reviewed, and there is is a very useful discussion of working with a large data set—another new feature of the syllabus.

I am a little concerned that the concept of random variable is treated as intuitive, almost as something which 'turns up' when you start working with data. As it is immediately followed by various calculations involving data sets, there is a danger that these might be conflated with probability distributions. However, it is clearly essential to distinguish between $E(X)$ for a random variable X and the mean $\bar{x}$ of a sample of values of this random variable. This is going to be important later in connection to the Central Limit Theorem.

The statistics part of the new syllabus differs from that in the former OCR modular syllabus in requiring familiarity with the Normal distribution and statistical hypothesis testing. It is entirely understandable why these topics—and particularly the first—have been included, and the section on various calculations with the Normal curve is excellent. Teaching hypothesis testing, however, is not easy, since one needs to be very precise, and one of the important distinctions is that between a population and a sample. I am not sure where in the book the first term appears: the index seems to give a spurious indication. However, the use of null and alternative hypotheses in binomial testing, and the procedure in carrying out 1-tailed and 2-tailed tests, is described carefully. For Normal tests, the CLT is described but not named as such, and there is an adequate description of how to carry out one-tailed and two-tailed tests for Normal populations with known standard deviation. Inevitably, there is vagueness in dealing with the case when the standard deviation is estimated from the sample, but this is a notoriously difficult idea to teach and I am not surprised that there is no attempt to do so apart from referring to different buttons on a calculator. The final section, which is about bivariate data and correlation, is good. The thorny question of whether correlation implies causation is addressed.

I have less to say about the mechanics section of the syllabus, which includes kinematics, Newton's laws, moments and projectiles. Personally I would have appreciated some more discussion of what assumptions are being made (given the book's explicit commitment to discussing modelling), especially in the very brief mention of the third law, which is never used explictly. Why (and when) is the tension in a string constant? What is meant by a smooth light pulley, and why is this important? In fact, does a pulley really have to turn? However, these are all things which a good teacher will address with a class, and few textbooks, in my experience, really concern themselves with them..

In summary, this book seems to me to be excellent in doing what it says, with plenty of worked examples, a sufficiency of exercises (which any good teacher will top up as required) and a mature form of presentation which treats the readers as intelligent and inquisitive students. In particular, I applaud its commitment to explaining issues carefully, including difficult cases, and to emphasising throughout that mathematics is a subject which relies both on its logical integrity and its relation to the real world.

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