Reviews

OCR A level Further Mathematics Mechanics (A) by Jean-Paul Muscat, pp. 362, £24, ISBN 978-1-5104-1451-8, Hodder Education (2018)

As its title implies, this book covers the mechanics part of the FM syllabus for the OCR examination. No assumptions are made about prior knowledge apart from some algebra and calculus. In particular, students are assumed not to be using the textbook which covers Mathematics for Year 2 and includes a limited amount of mechanics.

Beginnings are always important. I was pleased to see that the first chapter, on kinematics, gives a list of five 'suvat' equations rather than the usual four by including $s = vt - \frac{1}{2}at^2$. Of course, you can get away with fewer such equations, but I have always felt that this particular one must feel unfairly neglected.

I was very interested to see what was said about assumptions, such as strings being light and inextensible, pulleys smooth (and perhaps weightless), tension uniform, and so on. Surely there is plenty of time to address these issues given the extra lesson time available for pupils studying FM. On page 63 there is the classic diagram of a mass on a horizontal table connected to a second mass hanging vertically by a string which passes over a pulley. Why is the tension in the string constant throughout? Does it matter if the pulley is massive? What is meant by the pulley being smooth? What would happen if the strings were heavy chains? There are many opportunities here to discuss which of Newton's three laws and which assumptions are being used, and it is disappointing that this book does not address this issue at all. With good pupils, I have even tackled problems where there is, say, a suspended moving pulley which carries a second string with masses at either end. They are obviously not going to turn up in any exam, but I feel that the extra understanding (even if the algebra becomes rather unpleasant) is worth the effort. Mind you, my grimmest memory from mechanics teaching was a physics teacher who tackled the standard problem with a single pulley and two weights by using 'Newton's 2nd law round the corner'. There is no danger of finding that in this text.

The next chapter introduces moments of forces. It is done clearly and competently, and it introduces the notion of a couple. The exercises here are excellent. It is actually possible to derive this concept from first principles using some nice geometry of forces, but I have only ever seen one textbook which did this.

The book proceeds to cover all of the topics in the mechanics required for the examination, including work, energy, power, impulse and momentum, circular motion (both horizontal and vertical), centres of mass, elasticity and dimensional analysis. Calculus becomes essential when variable forces are introduced, and here too I feel that the author might have discussed why various principles – such as impulse equals change of momentum – are derived from Newton's second law by taking the space and time integrals. However, any teacher who, like me, enjoys worrying about the hidden assumptions in mechanics, treating is almost as a branch of pure mathematics, is perfectly free to discuss this in the classroom. In the meantime, when it comes to preparing pupils for the examination, they can certainly rely on this textbook as a first-rate resource.

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