Physical refreshment

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Physical Chemistry, 3rd Edn. By P.W. Atkins. Oxford University Press/W.H. Freeman:1986. Pp.857. Hbk £35, \$37.95; pbk £14.95.

THE FIRST impression of the new edition of this best-selling textbook is that it is shorter than its immediate predecessor; indeed, it has almost 240 pages fewer. Closer inspection reveals that this has been achieved by the use of a changed page format, and comparison of equivalent passages suggests that any real difference in length is slight. The altered layout, with figures mostly in the wide margins, gives a fresh and attractive look to the material, which has been extensively revised.

Several new topics have been introduced in this edition, reflecting the continuing development of the subject. Applications of lasers are seen in discussions of laser isotope separation and of the Lamb dip technique (the spectroscopist's, not the sheep farmer's), and the phenomenon of oscillating reactions is now also described. The level both of the quantum mechanics and of the reaction kinetics has been increased, and several changes have been made to the sequence of presentation, most notably in the chapters on thermodynamics.

The latter section also sees the introduction of the recently recommended revision of thermodynamic standard states to a pressure of 1 bar, rather than 1 atmosphere. Though this has only a small or negligible effect on the values of tabulated thermodynamic functions and standard electrode potentials, it will require a change in teaching practice which will distress those who have yet to accept fully the use of SI units. The newly recommended symbol $\bar{r}$ for 298.15K will take some time to be assimilated, as will the adoption of the IUPAC recommendation that we write $\Delta_r H^\circ$ rather than ΔH° . The reappearance of the concentration unit M in place of mol dm^{-3} , though not officially recommended, leads to a simplification of composite units, and will be welcomed by many.

Another new feature is the provision of sets of relatively straightforward applications of the principles and equations introduced in each chapter, on top of the wide range of problems found in earlier editions; a solutions manual, covering both of these collections of problems, is also available, and is a valuable complement to the main text. In addition, most of the longer tables of data formerly distributed throughout the book have been collected together in an appendix to give a useful data section of more than 20 pages.

No book describing such a range of material can hope to escape criticism completely, and some students may find the notational complexity of parts of the text to be rather intimidating. This, however, is a problem common to almost all degree-level books on physical chemistry, and forces one to wonder whether the use of a single comprehensive text is ideal, especially in the early stages of a course. This question apart, Atkins has again compiled an impressive survey of modern physical chemistry, one which seems certain to enjoy the popularity of the earlier editions. □

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Science by numbers

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Solving Equations with Physical Understanding. By John R. Acton and Patrick T. Squire. Adam Hilger: 1985. Pp.219. Hbk £24, \$36; pbk £12.95, \$19.

Introduction to Physical Mathematics. By P.G. Harper and D.L. Weaire. Cambridge University Press:1985. Pp.260. Hbk £20, \$42.50; pbk £6.95, \$14.95.

Partial Differential Equations for Scientists and Engineers, 3rd Edn. By G. Stephenson. Longman: 1985. Pp.161. Pbk £6.95, \$9.95.

Worked Examples in Mathematics for Scientists and Engineers. By G. Stephenson. Longman: 1985. Pp.239. Pbk £4.95, \$10.95.

MATHEMATICAL textbooks, even those aimed at scientists and engineers, used almost invariably to be impenetrable but impeccably rigorous and complete treatises, devoid of illustrations and written in a very formal style. Many still are. In some instances and for some students this is appropriate. More often than not, however, what is needed is less rigour and more explanation, less formality and more insight, and a lot of sketches. To the great benefit of today's students, more and more authors are aware of this, and are writing about mathematics for scientists and engineers without burying physical insight beneath a mountain of proofs of existence and the like.

Acton and Squire's *Solving Equations with Physical Understanding* embodies the notion that formal mathematics is an obstacle rather than an aid to understanding, and introduces and makes much of the "qualitative solution — trial function" method (QSTF). This feedback approach is fine in principle, but is dangerously over-reliant on solving by physical intuition, which works well only if your physical intuition is already keenly developed. Moreover the technique is dependent

upon everything being smooth and well-behaved, with a serious risk of missing interesting and important singular behaviour. As the authors admit, QSTF augments standard methods, it does not replace them. The risk is that the approach is only safe in the hands of those who know well enough what they are about not to need it.

Acton and Squire's wholly laudable emphasis on qualitative understanding and practical methods of solution is shared by the splendid *Introduction to Physical Mathematics* by Harper and Weaire. Written in a pleasant, informal style, in 34 short chapters, each ending with an excellent summary, it covers at a basic level many essential applications of mathematics in the physical sciences; the only serious flaw is a totally inadequate index. Not least among the book's delights is the account taken of the impact of modern computers.

This impact has been considerable on the solution of differential equations, and it is good to find a new edition of Stephenson's *Introduction to Partial Differential Equations for Science Students* repackaged as *Partial Differential Equations for Scientists and Engineers*, with an entirely new chapter on finite difference and finite element methods. A proper understanding of the underlying mathematics is essential if the common folly of applying numerical methods inappropriately is to be avoided. Such an understanding can be gained from this book, whose emphasis is unashamedly on methods of solution rather than the solutions themselves: it is a fairly formal text on linear partial differential equations, and the inclusion of numerical methods has given it a new lease of life.

The most effective and efficient way of learning scientific mathematics is not to struggle endlessly with a problem, but to consult a similar worked example. To this end, many textbooks include worked examples, and there are books which give a brief revision of theory followed by a wide selection of solved problems. Stephenson's *Worked Examples in Mathematics for Scientists and Engineers* is at the further end of this spectrum. With not even the briefest revision of theory, and with a complete lack of sub-headings, it is an indifferent example of the genre. Whilst it might be suitable for a student revising an entire course, it is much less useful to the reader who wishes to find an example of a particular sort; and, contrary to the assertion in the preface and on the cover, the book is almost useless for the postgraduate scientist wishing to recall his knowledge of a particular topic: he needs both methods and meaning. □

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