Vol. 3 Iss.5 ISSN 1430-4171
The Chemical Educator http://journals.springer-ny.com /chedr

S 1430-4171 (98) 05238-6

Book Review

Beginning Calculations in Physical Chemistry by Barry R. Johnson and Stephen K. Scott

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Beginning Calculations in Physical Chemistry, by Barry R. Johnson and Stephen K. Scott. New York: Oxford University Press, 1997. x + 166 pp. Appendix.

This book is one in the *Workbooks in Chemistry* series edited by Stephen K. Scott. This specific book is a companion to the physical chemistry textbook and classroom, but is not linked to any specific textbook or teaching style. It is designed to build student confidence by allowing them to practice the mathematical skills necessary for the subject. This workbook is divided into eight sections:

1. *Revision: Powers of 10*
2. *Calculating Masses of Atoms and Molecules*
3. *Units: Dimensional Analysis*
4. *Calculating Frequencies, Wavelengths and Energies*
5. *Pressure, Volume, Temperature, Concentration and Density*
6. *Graph Craft*
7. *Kinetic Theory of Gases*
8. *Chemical Thermodynamics*

Each section has a number of systematically worked example calculations and exercises, with the answers given. The writing is sparse and to the point, the point being practicing the calculations (this is a workbook after all). The examples and exercises are relevant to chemistry, but the necessary equations are simply given with no theoretical derivation and little interpretation; this is left to the course textbook and the classroom.

The authors state that the early sections are a review of material students might be expected to know when they enter physical chemistry. To my way of thinking, the first five sections of this book are indeed appropriate for general (freshman) chemistry students. The section on dimensional analysis is particularly good, both at explaining how to use dimensional analysis and at why it is important to do so. The explanation of Guggenheim notation here is one of the best I have seen. Section 6, *Graph Craft,* certainly deals with a skill needed by general chemistry students, but it is presented here with examples from physical chemistry. Only the last two sections present calculations specifically drawn from physical chemistry (at least as it is taught on the west side of the pond).

What is missing from this book is calculus. There is no review of calculus nor any use of it, except in the thermodynamics section where the knowledge is assumed but infrequently used. There are no examples of multiple-variable calculus. To be fair, this may be a result of differences in the positioning of physical chemistry in the curriculum as it is taught in Great Britain and in the United States, a point on which I have little knowledge.

What I would like to see in a book such as this, and what those of my students who would be likely to use such a book really need, is a review of problem-solving skills and a review of calculus, with heavy emphasis on the physical interpretation. Some of my students need practice in thinking about and setting up a problem. Once they have the equation, they can all "plug and chug" to the answer, but the heart of the problem is in finding or deriving the correct equation. Some of my students also need a review of calculus, including multiple-variable calculus. They all need a refresher on the physical interpretation of calculus: that derivatives are slopes of lines and slices through surfaces that tell us how one physical quantity changes as another is varied; and that integrals are areas or volumes under curves or surfaces, or within boundaries, and these can have physical meaning as well, such as entropy or probability.

Johnson and Scott's workbook is first rate, as far as it goes. Students completing it will have met the objectives laid out by the authors, to build confidence that they can solve explicit quantitative problems. But their book doesn't go far enough. I would use the first sections in general chemistry, but the title of the book would scare off the students most in need of it. I would use this book in physical chemistry, where it would give a sound mathematical foundation for part of the course, but it does not cover what my students seem most in need of reviewing. In short, this book misses the mark. I would not use it, nor recommend it, given the way physical chemistry is taught in American colleges and universities.
