BOOKS

Physical Chemistry, G. H. Duffey, McGraw-Hill, New York (1962). 544 pages. $8.95.

According to the author this undergraduate physical chemistry textbook is intended "for students who have had calculus and who have followed a modern approach in their elementary chemistry courses. Thus, it contains much advanced material not ordinarily presented in introductory physical chemistry texts. To make room for this material, I have omitted conventional topics that, in my opinion, are less important."

Chapters 1 to 6 (184 pages) are devoted to atomic and molecular theory presented from a simplified quantum mechanical viewpoint. This discussion goes as far as selection rules in molecular spectra, the Franck-Condon principle, the hydrogen atom, hybridization of valence orbitals, and use of variational methods for improving approximate molecular wave functions.

Chapters 7 to 14 (about 200 pages) deal with thermodynamics, elementary statistical mechanics, and introductory kinetic theory—the three subjects being interwoven according to applications, rather than being discussed as three separate theoretical disciplines.

Chapter 15 is more or less separate, dealing with the conventional topics in electrochemistry—electrode reactions, conductance, transference numbers, and e.m.f.

Chapters 16 through 19 give a brief (85 pages) introduction to chemical kinetics, including the usual topics: rate laws, mechanisms, catalysis, and photochemistry.

The main departure from the traditional physical chemistry textbooks is the moving of the material on atomic and molecular structure to the front of the book, and the omission of material on polarity of molecules, optical rotation, surface chemistry, macromolecules, colloid chemistry, diffusion, and the periodic table. The omission of these subjects can be defended on the ground that some of them are not amenable to detailed mathematical description; on the other hand many such topics are of considerable importance to chemical engineers and others in the chemical industry. The placement of the atomic and molecular material at the beginning of the course will meet with strong opposition by many instructors who will insist, and perhaps rightly so, that the average college junior is not ready to cope with text material involving vectors, quantum mechanical operators, variational procedures, orthogonality relations, and eigenvalue problems.

This reviewer feels that the book has several major shortcomings. First, the book lacks a good introduction for the student, in which the scope, aims, and organization are described; the introductory paragraphs for the various chapters are not nearly adequate to motivate, orient,

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K_1 = a constant = k_1L/B
K_2 = a constant = k_2L/B
n = constant, see Equation (4)
r = radial position
R = tube radius
Y = modified dimensionless concentration ratio
Y_m = dimensionless concentration ratio across the reactor exit
v_m = $\frac{V}{A}$ = integral mean velocity
V = volumetric flow rate
θ = contact time
σ = dimensionless position variable = $\frac{r}{R}$

Subscripts

o = initial value
pf = plug flow value
m = mean value
c = a particular radial position $\leqq 1$

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and challenge the student. Second, the arrangement of topics in the book in many places does not reflect the logical organization of the subject material: in Chapter 1 we find "Scalar Product" as a section heading under "Matter and its Atomic Nature"; in Chapter 13, we find "Third Law of Thermodynamics" as a section heading under "Thermodynamic Changes in Chemical Reaction." Third, many topics are introduced with no word to the reader as to the possible application; for example, three pages are devoted to quantum mechanical "tunneling" with no mention of the physical applications (for example alpha-particle decay). Four, too often derivations are given without proper words of caution as to the restrictions which are inherent in the procedure; for example, in Chapter 6 in the discussion of the LCAO methods far too little is said about the assumptions involved, and in Chapter 9, the reader is not told under what conditions the factorization of the polyatomic molecule partition function might not be allowable. These faults will make the book difficult to use for self-study, and will require that instructors be particularly careful in helping their students interpret some of the material.

This book has kept up the tradition of its predecessors by having many illustrative examples in the text and a large collection of homework problems. Answers to many of the latter are given at the back of the book.

The reviewer does not agree with the way the quantum mechanical discussion is presented; he would have preferred a postulational approach with a minimum of historical background. Also the reviewer has reservations about the mode of presentation of the material on kinetic

INFORMATION RETRIEVAL

Continuous propagation of microorganisms, Fredrickson, A. G., and H. M. Tsuchiya, **A.I.Ch.E. Journal, 9,** No. 4, p. 459 (July, 1963).

Key Words: A. Propagation-8, Stability-8, Microorganisms-2, Fermenters-10, Continuous-, Steady State-, Analysis-. B. Analysis-8, Processes-1, Stochastic-Multiplication-, Cells-, Microorganisms-, Propagation-2, Cultures-, Microorganisms.

Abstract: The growth of a pure culture of microorganisms in a steady state fermentor is studied analytically. Processes involved in the life cycle of a single microbial cell form the basis of the treatment. Equations are developed which relate stochastic growth and reproductive processes on the cellular level to the behavior of the cell population. These equations are used to predict culture age distribution and metabolic rates in the steady state. The stability of the steady state is considered finally.

Gas-liquid kinetics: the absorption of carbon dioxide in diethanolamine, Nunge, Richard J., and William N. Gill, **A.I.Ch.E. Journal, 9,** No. 4, p. 469 (July, 1963).

Key Words: Diethanolamine-1, Carbon Dioxide-1, Mixing-6, Temperature-6, Reaction Rate-7, Kinetics-8, Absorption-8, Reaction Order-9, Mechanism-9, Reactor-10, Ethanolamines-, Henry's Law-, Stirred-.

Abstract: The absorption of carbon dioxide in pure diethanolamine was studied in a gas-liquid stirred reactor at 85°, 95°, and 105°F. Experimental data were consistent and reproducible.

The experimental data were correlated with the simplified equation by both integral and differential methods and indicate that the reaction follows a third-order rate equation: first order in carbon dioxide and second order in diethanolamine. A mechanism explaining the observed order is described.

Effects of solute purity, temperature, and surfactants on solid-liquid mass transfer, Ghosh, D. N., and D. D. Perlmutter, **A.I.Ch.E. Journal, 9,** No. 4, p. 474 (July, 1963).

Key Words: Mass Transfer-8, Coefficients-7, Solute Purity-6, Temperature-6, Surfactant Concentration-6, Cinnamic Acid-1, Water-5, Correlations-9, Stirred Transfer Cell-10, Solid-Liquid-9.

Abstract: The mass transfer coefficients for a process of solid dissolution vary with solute purity. The Reynolds and Schmidt number exponents which are used in the usual dimensionless group correlations also depend on solute purity, even over a narrow range of only several percent. The effect of temperature on the mass transfer process may be attributed to Schmidt-number variation. Surfactants may increase or decrease the transfer rate or leave it unchanged; specific behavior depends on the solute purity as well as the concentration and ionic nature of the surfactant.

Performance of packed columns VII. The effect of holdup on gas-phase mass transfer rates, Shulman, H. L., C. G. Savini, and R. V. Edwin, **A.I.Ch.E. Journal, 9,** No. 4, p. 479 (July, 1963).

Key Words: Mass transfer-8, Absorption-8, Vaporization-8, Liquid Holdup-6, Water-5, Packings-10, Column/Packed-10, Methanol-5, Mass Transfer-7.

Abstract: To account for the differences in the gas-phase mass transfer coefficients obtained by the use of vaporization and absorption techniques, data were obtained for ring and saddle packings in a 12-in. diam. column employing water vaporization and methanol absorption. The ratio of the vaporization to absorption coefficient, corrected for differences in diffusivity, is found to be directly proportional to the ratio of the total holdup to the operating holdup thus confirming the proposed model in which the effective interfacial area for each type of operation is proportional to the holdup of the liquid active for that operation.

INFORMATION RETRIEVAL

Diffusion resistances in alumina and silica catalysts, Rao, M. Raja, and J. M. Smith, **A.I.Ch.E. Journal, 9,** No. 4, p. 485 (July, 1963).

Key Words: Ortho Hydrogen-1, Hydrogen-1, Para Hydrogen-2, Nickel Oxide-4, Alumina-5, Silica-5, Liquid Nitrogen-5, Particle Diameter-6, Pore Resistance-6, Diffusion Resistance-6, Effectiveness Factor-7, Reaction Rate-7, Pore Diffusion-8, Para Hydrogen-9, Fixed Bed Reactor-10, Catalysts-10, Reactors-10.

Abstract: Reaction rate measurements were made for the ortho-para hydrogen conversion at —196°C. and 1 atm. pressure with nickel oxide catalysts using alumina and silica gel as carriers. Data were obtained for fine particles and for larger particles and pellets where pore diffusion resistances were significant. From these data experimental effectiveness factors were evaluated.

Theoretical effectiveness factors were predicted from measured properties of the pores in the catalysts and a previously developed theory. Comparison between experimental and theoretical results indicated good agreement.

A high resolution resistivity probe for determination of local void properties in gas-liquid flow, Neal, L. G., and S. G. Bankoff, **A.I.Ch.E. Journal, 9,** No. 4, p. 490 (July, 1963).

Key Words: Gas-Liquid Flow-8, Void fraction-7, Liquid Metal-5, Resistivity Probe-10, Gas Flow Rate-6, Bubble Frequency-7, Bubble Size Distribution-7.

Abstract: An electrical resistivity probe has been developed which permits high-order resolution of local void fraction, bubble frequency, and bubble size distribution function in gas-liquid flow. Illustrative results are reported for a co-current mercury-nitrogen upward flow system, which is particularly advantageous because of the fast break from the probe, owing to high mercury surface energy. The resistivity probe and a newly developed impact probe have permitted a detailed exploration of mercury-nitrogen flow structure which will be reported elsewhere.

Diffusion in ion exchange resins, Hering, Burton, and Harding Bliss, **A.I.Ch.E. Journal, 9,** No. 4, p. 495 (July, 1963).

Key Words: Dowex-1, Ion Exchange-8, Solid Diffusion-8, Diffusivity-8, Diffusion Coefficients-8, Resins-1, Cross-Linkage-6, Fick's Law-10, Nernst-Planck-10, Sodium-1, Zinc-1, Silver-1, Aluminum-1, Cerium-1, Copper-1.

Abstract: Measurements of the rates of exchange in Dowex 50W under conditions assuring that solid diffusion was the governing phenomenon are reported for the six pairs of ions: sodium-zinc, sodium-silver, silver-aluminum, zinc-copper, zinc-aluminum, and aluminum-cerium (trivalent).

Interpretation with a Fick's law model yielded diffusion coefficients greatly dependent on the direction of exchange.

Interpretation with a Nernst-Planck model was made possible by numerical solution of the flux equations for valence ratios of 1/3, 2/3, 3, and 3/2, each with three diffusivity ratios. Resulting values of diffusivities for each ion were dependent on the nature of the second ion in most cases.

Activation energies were 4 to 6 kcal. Increasing resin cross-linkage from 4 to 12% decreased the diffusion values by about 80%.

An analysis of slug flow heat transfer in an eccentric annulus, Snyder, William T., **A.I.Ch.E. Journal, 9,** No. 4, p. 503 (July, 1963).

Key Words: Annulus-6, Eccentric-6, Slug Flow-10, Temperature-7, Heat Transfer-7, Nusselt Number-7, Liquid Metal-9, Heat Transfer Coefficient-7.

Abstract: A solution is presented for the temperature distribution in a fluid flowing in an eccentric annulus formed with circular cylinders under the assumption of slug flow. The flow is assumed to be fully developed thermally with constant thermophysical properties. The outer surface is assumed to be adiabatic and the inner surface temperature is assumed to be independent of circumferential position. General expressions and numerical results for a typical set of conditions are presented for the quantities, local heat flux, local heat transfer coefficient, adiabatic surface temperature distribution, and average Nusselt number. The application of the present results to the prediction of turbulent heat transfer to liquid metals is indicated, and a comparison with other liquid metal heat transfer analyses is presented.

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theory and elementary statistical mechanics; he feels that much more emphasis needs be placed on the physical significance of the "molecular models" and their consequences.

In conclusion, it would seem that this physical chemistry text has less "chemistry" in it than its competitors. This is unfortunate for chemical engineering students, who really need to understand as much as possible about complex chemical systems. The average chemical engineering student would be better off to have a good qualitative understanding of the macroscopic chemical aspects of high polymers, colloids, surfaces, and ionic solutions than to have a faltering introduction to quantum and statistical physics.

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Entropy, J. D. Fast, McGraw-Hill, New York (1962). 313 pages. $10.75.

This is a fine book, which in my view should admirably fulfill its stated purpose: "to reach all of those students and researchers to whom thermodynamics and statistical mechanics seem a little frightening, although a certain knowledge of these subjects is indispensable to them." J. D. Fast is chief metallurgist at the Philips Research Laboratories and professor at the Technical University at Eindhoven in the Netherlands. The first edition of this book appeared in Dutch in 1947. It is the good fortune of those not fluent in Dutch that the present edition is being published in English, French, German, Spanish, and Polish.

The entropy concept is presented first from the classical point of view. This is done thoroughly and well, though in a completely conventional way. Thus, while the first chapter may serve a useful purpose as an introduction to the subject and as a review, it is not here that the chemical engineer should find the primary benefit from this book.

Chapter 2 is quite another matter. Here the author in forty lucidly written pages lays bare the essence of the statistical concept of entropy. I have long looked in vain for such a chapter. Here the reader is led very slowly and logically from the very beginning, guided firmly from one essential point to the next, so that with relative ease he should come to appreciate the statistical significance of entropy. Professor Fast says exactly what needs to be said. He admits to the sacrifice of absolute rigor, concentrating on the presentation of basic and essential ideas. One does not get lost in jargon or in complex mathematical symbolism. This chapter and the fourth on quantum mechanics and statistics, are well worth the price of the book.