PREFACE

"No happy phrase of ours is ever quite original with us; there is nothing of our own in it except some slight change born of our temperament, character, environment, teachings and associations."

Mark Twain

This textbook is designed for chemical engineering students from the sophomore level to the first year of graduate school. The approach blends molecular perspective with principles of thermodynamics to build intuitive reasoning regarding the behavior of species in chemical engineering processes and formulations. The molecular perspective is represented by descriptions encompassing: the relation of kinetic energy to temperature; the origin and consequences of intermolecular potentials; molecular acidity and basicity; methods used to incorporate molecular properties into molecular simulations; and the impact of molecular properties on macroscopic energy and entropy. This text is distinctive in making molecular perspectives accessible at the introductory level and connecting properties with practical implications.

This second edition offers enhanced coverage of biological, pharmaceutical, and electrolyte applications including osmotic pressure, solid solubility, and coupled reactions. Throughout the text, topics are organized to implement hierarchical instruction with increasing levels of detail. Content requiring deeper levels of theory is clearly delineated in separate sections and chapters. Less complex empirical model approaches have been moved forward to provide introductory practice with concepts and to provide motivation for understanding models more fully. The approach also provides more instructor flexibility in selecting topics to cover. Learning objectives have been clearly stated for each chapter along with chapter summaries including "important equations" to enhance student focus. Every chapter includes practice problems with complete solutions available online, as well as numerous homework problems. Online supplements include practice tests spanning many years, coursecasts describing difficult concepts or how to use computational tools, ConcepTests to quickly check comprehension, and objective lists that can be customized for greater detail. We also recommend the related resources available at the www.learncheme.com.

Unique features of the text include the level of pedagogical development of excess function models and electrolytes. For mixture models, the key assumptions and derivation steps are presented, stimulating readers to consider how the molecular phenomena are represented. For electrolytes and biological systems, the text makes connections between pH and speciation and provides tools for rapidly estimating concentrations of dissociated species. We emphasize speciation and problem solving in this introduction, instead of focusing on advanced theories of electrolyte activity. The material is written at an intermediate level to bridge students from the introductions in chemistry to the more complex models of electrolytes provided by process simulators.

We have created a number of homework problems with many variants, intending that different parts can be assigned to different classes or groups, not intending that each student work all parts.

NOTES TO STUDENTS

Thermodynamics is full of terminology and defined properties. Please note that the textbook provides a glossary and a summary of notation just before Unit I. Also consider the index a resource.

We consider the examples to be an integral part of the text, and we use them to illustrate important points. Examples are often cross-referenced and are therefore listed in the table of contents. We enclose important equations in boxes and we use special notation by equation numbers: (*) means that the equation assumes temperature-independent heat capacity; (ig) means the equation is limited to ideal gases. We include margin notes to highlight important concepts or supplemental information.

Computer programs facilitate the solutions to homework problems, but they should not be used to replace an understanding of the material. Computers are tools for calculating, not for thinking. To evaluate your understanding, we recommend that you know how to solve the problem by hand calculations. If you do not understand the formulas in the programs it is a good indication that you need to do more studying before using the program so that the structure of the program makes sense. It is also helpful to rework example problems from the text using the software.

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