

TEXTBOOK OF

PHYSICAL CHEMISTRY



P.L. Soni
O.P. Dharmarha
U.N. Dash

24th
Revised
Edition

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Textbook of PHYSICAL CHEMISTRY

“Chemistry is concerned with substances, with kinds of matter the materials of which things are made. It is concerned with wood but not the log, with glass but not the bottle, with copper but not the coin, with clay but not the brick. Chemistry is concerned with identifying or characterising properties of substances...[and] with the processes in which substances are transformed into other substances.”

—*I.H. Hildebrand & R.E. Powell*

How to get the best out of this book?

You can get the best out of this book if you start reading a chapter with pen and paper in your hand. Go on reading a para and jotting down the *** points side by side. Sentences printed in italics or bold type require for particular attention. Your reading should not be passive, but active and ***. Reading is raising questions and removing doubts. So keep looking for important details and answers to questions that arise in your mind as you and on.

The second step in your plan of reading should be restatement of what you read. Put the book down at intervals, say, after a paragraph or a page, and *** yourself what you have read, what appears important to you and what does do. This is necessary to ensure that you have grasped correctly. An eminent English writer describes this is 'double take'. You must have formed some impression in your first reading. Read again. Since your aim is effective learning, you *** ignore recalling or restating and verifying. Reading, restating and verifying should constitute a simultaneous process. Reading in the specialised way has been found to be thrice as beneficial as ordinary reading.

The third step in your strategy of reading should be writing down briefly what you have studied. Go through the whole chapter reading one paragraph after the other and jotting down the main points that emerge from your reading. Now go through the questions at the end and find out how many of these you can answer without any difficulty. If you are unable to answer any question, don't get disheartened. Look for its answer in the book.

One of the common complaints of Chemistry students is that they go through a chapter, grasp it at the time of reading but forget it completely after a few days. This leads them to think that their effort has been a sheer wastage of time. Therefore, they try to postpone reading it till a few days before the examination.

But if you postpone the first reading to the examination day, you can learn only two chapters in one days and not even two since you get nervous and the grasp is faulty and you give up the attempt altogether.

Hence your motto should be **reading regularly** and then **revising at regular intervals**. In this way most of the important points will get permanently added to your vocabulary and you will never forget them.

This is extremely essential in the study of Physical Chemistry since, here, various chapters are interrelated. Concepts in the first few chapters are to be constantly applied in the study of subsequent chapters. So each chapter should be properly grasped before proceeding to study the next chapter. **Your effort must be regular and persistent with a lot of self-confidence and determination.**

AUTHORS

Textbook of
PHYSICAL CHEMISTRY
incorporating SI Units

P. L. SONI

*Formerly Head of Department of Chemistry
Hand Raj College, Delhi University, Delhi*

O.P. DHARMARHA

*Head of the Department of Chemistry
Rajdhani College, Delhi University, Delhi*

U.N. DASH

*Retired Professor of Chemistry
Utkal University, Bhubaneswar, Odisha*



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Phones : 011-23281876, 23266105, 23277843 (*Showroom & Shop*)

011-40234454, 23247051 (*Office*)

E-mail : sultanchand74@yahoo.com; info@sultanchandandsons.com

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Preface to the Twenty-fourth Edition

In the twenty-fourth Revised and Enlarged edition we have, retained all that in previous edition, incorporated new subject materials and all chapters have been updated catering to the needs of the students of the B.Sc (Hons) and M.Sc courses of all the Indian Universities. All chapters received a major revision, especially to include more solved problems and numerous questions. Latest University questions are given at the end of each chapter. A new type of Question Banks has been included. Step-by-step answers are provided for the in-chapter problems. This is the book which the examiners use.

The present edition incorporates the New Education Policy/CBCS guidelines. It is our proud privilege to acknowledge to a number of authors whose works have been freely consulted while revising this book. Thanks are due to M/s Sultan Chand & Sons for their active co-operation in bringing out this edition in New look at the earliest.

We shall be highly grateful to the readers, if the errors and omissions are detected in this present edition are brought to our notice. It is our belief that this edition will continue to maintain the very high standards, and be of substantial value in the teaching and reading the Text Book of Physical Chemistry.

Authors

Preface to the Twenty-third Edition

The major improvements in the latest edition are:

- Thorough revision of first ten chapters of Part I of the book, that is, up to page 1.360.
- Addition of two new chapters namely, Irreversible Thermodynamics and Statistical Thermodynamics at the end of the Part II of the book.

The chapters have been improved by making suitable additions, and modifications to facilitate understanding of the subject-matter. The solved numerical problems in the relevant chapters have been dealt with in SI units.

Other Salient features of the book are as under :

- Emphasis on correlation of various properties of elements and their compounds with their electronic structure and other modern concepts.
- Lucid and elegant style.
- Simple language.
- Dependable information about all concepts of Physical Chemistry.
- Clarity of concepts through problems, solved examples, and objective type questions with answers. Difficult concepts illustrated by a large number of examples, solved problems and diagrams.
- Revised in the light of latest syllabi of various Indian Universities.

Question papers of recent years examinations of various Universities/Institutes have been incorporated at the end of each chapter. Objective Type and Multiple Choice Questions, and numerical problems with answers incorporated at the end of each chapter are of great help to the candidates preparing for the competitive examinations like JEE/IIT, Medical Entrance Test and Civil Services examinations.

The authors hope that this revised, improved, modified and updated edition would be helpful to the students and the teachers alike.

The authors will greatly appreciate helpful specific suggestions from teachers of the subject to enhance the usefulness of the book for the students.

Authors

Extracts from Preface to Earlier Edition

The first edition of this book was received with welcome for its novel approach. Instead of dealing the subject in a routine descriptive manner, the fundamental concepts of chemistry laying emphasis on the underlying physics, were enunciated by which the reader could understand the conceptual basis of the subject. These were extended and further developed mathematically in order that they could apply them to chemical problems. It has been our faith that any introductory course in physical chemistry must have as one of its objectives the effective presentation of a wide variety of topics. It must introduce to its readers the current theories and unifying concepts of the subject. The theory of atomic structure which has been developed by the application of quantum theory and wave mechanics to explain the behaviour of electrons is now generally accepted and it is impossible for a student of chemistry at any level to remain unaware of the influence of the new outlook.

It is our firm conviction that for a clear understanding of the fundamental principles the treatment must be lucid and detailed. We have tried in our writing to avoid gross over-simplification which often leads to misunderstanding about chemical principles.

Some of the special features of the book are as follows:

- The atomic structure has been developed from Rutherford model to wave mechanical treatment in a lucid manner in Chapters 2 and 3. The Schrodinger wave equation and its significance has been amply illustrated through diagrams and analogies making the abstract concept more comprehensive.
- The latest form of Periodic Table with newly adopted group numbers has been exhaustively dealt with correlating the variation of periodic properties with the electronic configuration in chapter 4.
- In the light of the wave mechanical picture of orbitals, the covalent bond theory and molecular orbital theory of bonding have been treated in a simple illustrative manner so that the students can easily follow this rather difficult idea in Chapters 7 and 8.
- With the introduction of new problems and simplified mathematical treatment and illustrations, the chapters on gaseous state, liquid state and solid states have been revised fairly exhaustively. The basic concepts involved have been elucidated most adequately in Chapters 9, 10, 11, 12.
- Chemical Thermodynamics is the foundation of chemistry, Chapters 13, 14, 15, 16 and 17 have been revised with particular stress on the basic principles and their application through solved examples and mathematical build-up. New topic incorporated in revised syllabi of restructured Honours courses in chemistry have been introduced at appropriate places. This would help the readers to recapitulate the fundamental principles discussed in these chapters and apply them accordingly.
- Chapters on chemical equilibrium, Nernst distribution law and phase rule have been revised with emphasis on the basis of thermodynamic principles to make them more comprehensive.

Question papers of Universities and Institutes provide an index of the quantum and quality of the chemical knowledge imparted to the students in our country and also of the areas being recognised as important. After scanning these papers, the text is revised and made up-to-date accordingly. Important questions, such as essay type and short answer type, have been given at the end of every chapter for the student's guidance. Keeping this in view, the numerical problems and questions from latest University/Institute papers have been put in place of the old ones.

We are thankful to a large number of students and colleagues from Institutes, Colleges and Universities all over the country, who in response to our Publishers Feedback Programme, have very kindly made valuable suggestions for improvement of the text by incorporating new topics recently introduced in their syllabi. Many of them have liked our simple way of developing basic concepts, illustrated by large number of solved examples. They have especially made a mention of our collection and framing of Objective Type Questions with key at the end of each chapter. They found them very useful for competitive examinations like Civil Services, JEE/IIT and Medical Entrance Tests and have suggested a lot more of such questions to be framed. We thankfully acknowledge their participation in the programme. To meet their demand, Question Banks at the end of each unit and in all about 1000 multiple choice questions have been inserted at the end of each chapter.

It is our earnest hope that we shall continue to receive such criticism and encouragement from all concerned in future also.

We sincerely hope that the method of presentation in this book will enable the readers to read the subject with pleasure and through understanding. If it does that, we shall feel amply rewarded for the pains taken.

Authors

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- The Book incorporates the New Education Policy/CBCS guidelines.
- The entire subject matter has been presented with proper sub-headings to facilitate readers to understand the subject matter in a more systematic manner.
- SI units are used throughout.
- In few chapters, some subject materials have been added catering to the need of M. Sc. Syllabi.
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