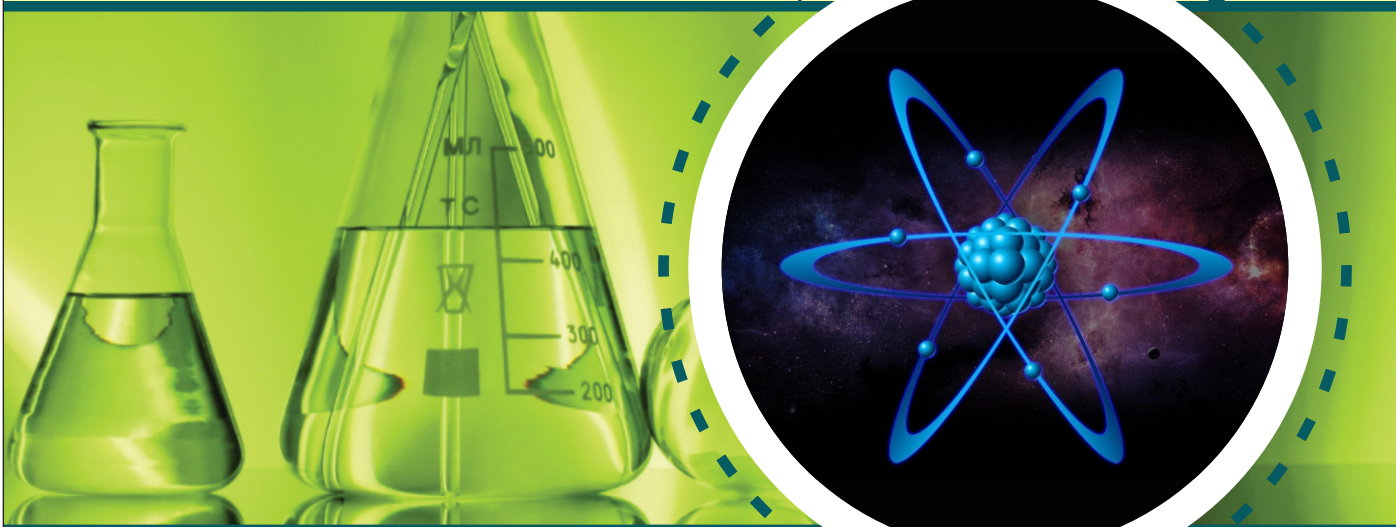


TEXTBOOK OF

PHYSICAL CHEMISTRY



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

24th
Revised
Edition

Sultan Chand & Sons

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 main points side by side. Sentences printed in italics or bold type require for particular attention. Your reading should not be passive, but active and critical. 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 ask 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 cannot 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 day 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

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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 (NEP-2020)/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 cooperation 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 *Textbook of Physical Chemistry*.

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 20.32.
- 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 state 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 1,000 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

Contents

PART-I

UNIT-I: CHEMICAL PRINCIPLES

1. Introduction.....1.3	
1.1. Physical Chemistry1.3	
1.1.1. Importance of Physical Chemistry ..1.3	
1.2. Symbols and Units1.4	
1.2.1. Derived Physical Quantities and Units1.4	
1.2.2. Prefixes for SI Units1.5	
Questions.....1.8	
2. Structure of Atom.....2.1	
2.1. Discovery of Electron2.1	
2.1.1. Mass of Electron2.2	
2.1.2. Charge on Electron.....2.2	
2.2. Discovery of Proton2.4	
2.3. Atomic Models.....2.4	
2.3.1. Nuclear Structure2.5	
2.3.2. Effective Radius of the Nucleus.....2.5	
2.4. Discovery of Neutrons2.6	
2.4.1. Moseley's Experiment and Atomic Number.....2.6	
2.4.2. Mass Number2.7	
2.5. Drawbacks in Rutherford Model2.7	
2.6. Nature of Electromagnetic Radiations2.7	
2.7. Bohr's Model of Atom2.8	
2.8. Atomic Spectra – A Clue to Atomic Structure.....2.10	
2.9. Bohr's Quantum Theory of Hydrogen like Atom.....2.12	
2.9.1. Bohr's Theory and the Line Spectra2.14	
2.9.2. Deviation of Energy of an Electron2.15	
2.10. The Bohr-Sommerfeld Theory2.17	
Questions.....2.18	
Objective Type.....2.19	
Problems2.19	
Examination Questions2.20	
3. Structure of Atom (Modern Picture)3.1	
3.1. Wave Particle Dualism of Radiation.....3.1	
3.1.1. Photoelectric Effect.....3.1	
3.2. Compton Effect or Compton Scattering.....3.3	
3.3. Wave-Particle Dualism of Matter-De Broglie Wave equation.....3.3	
3.3.1. Experimental Proof of de Broglie's Equation3.5	
3.3.2. De Broglie (Matter) Waves and Electromagnetic Waves3.5	
3.4. The Uncertainty Principle3.5	
3.5. Quantum Mechanical Model of Atom3.9	
3.5.1. Quantum Mechanical Operators3.9	
3.5.2. Schrodinger Wave Equation3.24	
3.5.3. Solution of Schrodinger Wave Equation3.26	
3.6. The Schrodinger Equation for Hydrogen Atom.....3.38	
3.7. Probability and Electron Density — Visualizing the Orbitals.....3.40	
3.8. Quantum Numbers3.41	
3.8.1. Significance of Quantum Numbers3.43	
3.8.2. Principal Quantum Number (n).....3.43	
3.8.3. Subsidiary Quantum Numbers or Azimuthal Quantum Number3.44	
3.8.4. Magnetic Quantum Number (m or m_l)3.44	
3.8.5. The Spin Quantum Numbers (m_s)3.44	
3.9. Radial Distribution Functions and Radial Probability Distribution Curves.....3.46	
3.10. The Number of Electrons in a Given Orbit — Pauli's Exclusion Principle3.49	
3.11. Many Electron Atoms3.50	
3.12. Occupation of Orbitals by Electrons — Aufbau Principle3.51	
3.12.1. A Handy Method to Write Electronic Configuration of Atoms.....3.52	
3.12.2. Exception to the Rule3.52	
3.12.3. Violation of Aufbau Principle3.52	
3.13. Hund's Rule of Maximum Multiplicity3.52	
3.13.1. Explanation of Hund's Rule3.53	
3.14. Cause of Stability of Half-filled and Completely-filled Energy Levels3.53	
3.15. nl^x Notation.....3.55	
3.15.1. Box Representation for Electron Distribution3.57	
Questions.....3.57	
Objective Type.....3.59	
Problems3.62	
Examination Questions3.63	

4. Classification of Elements.....4.1	
4.1. Historical Background.....4.1	
4.1.1. Mendeleev's Periodic Table.....4.1	
4.2. Modern Periodic Law.....4.2	
4.2.1. Periodic Law and Electronic Configuration of Elements.....4.2	
4.3. Modern Periodic Table.....4.3	
4.3.1. Superiority of the Modern Periodic Table.....4.4	
4.4. Periodic Variation of Properties of Elements.....4.6	
4.5. Size of Atoms and Ions.....4.6	
4.5.1. The Crystal Radius (<i>atomic or metallic radius</i>).....4.6	
4.5.2. The Van der Waal's Radius (<i>collision radius</i>).....4.7	
4.5.3. Covalent Radius.....4.7	
4.5.4. The Ionic Radius.....4.8	
4.5.5. The Bragg-Slater Atomic Radius...4.8	
4.5.6. Atomic Volumes.....4.9	
4.6. Ionization Energy.....4.9	
4.6.1. Factors on which Ionization Energy Depends.....4.10	
4.6.2. The Variation of Ionization Energies with Increase in Atomic Number.....4.12	
4.7. Electron Affinity.....4.12	
4.8. Electronegativity (χ).....4.13	
4.8.1. Pauling Scale of Electronegativity.....4.14	
4.8.2. Mulliken Scale of Electronegativity.....4.14	
4.8.3. Allred and Rochow Scale of Electronegativity.....4.14	
4.9. Metallic Character.....4.15	
4.10. Density, Melting Point and Boiling Point.....4.15	
<i>Questions</i>4.17	
<i>Objective Type</i>4.20	
<i>Multiple Choice</i>4.21	
<i>Examination Questions</i>4.22	
5. Nuclear Chemistry.....5.1	
5.1. Introduction.....5.1	
5.2. Composition of Nucleus.....5.1	
5.3. Nuclear Properties—Nuclear Mass.....5.2	
5.3.1. Nuclear Size and Nuclear Density...5.2	
5.3.2. Nuclear Forces.....5.3	
5.4. Binding Energy or Separation Energy.....5.3	
5.5. Structure of Nucleus.....5.6	
5.6. Theories Regarding Nuclear Stability.....5.7	
5.6.1. Nuclear Binding Energy Theory.....5.7	
5.6.2. Meson Theory of Nuclear Forces.....5.7	
5.6.3. Nuclear Fluid Theory.....5.8	
5.7. Isotopes.....5.8	
5.7.1. The Detection and Study of Isotopes.....5.8	
5.8. Isotopic Constitution of Elements.....5.10	
5.9. Separation of Isotopes.....5.12	
5.9.1. Gaseous Diffusion Method.....5.12	
5.9.2. Electromagnetic Method.....5.13	
5.9.3. Thermal-Diffusion Method or Soret's Method.....5.13	
5.9.4. Distillation Method.....5.14	
5.9.5. The Centrifugal Method.....5.14	
5.9.6. Electrolytic Method.....5.14	
5.9.7. Chemical-exchange Method.....5.14	
5.10. The Whole-Number Rule and Packing Fraction.....5.15	
5.11. Atomic Weights.....5.16	
5.11.1. Deviation of Atomic Weights from Whole Numbers.....5.16	
5.11.2. Some Conclusions from the Study of Isotopes.....5.16	
5.12. Isobars, Isotones and Isomers.....5.17	
<i>Questions</i>5.18	
<i>Objective Type</i>5.18	
<i>Multiple Choice Type</i>5.18	
<i>Problems</i>5.19	
<i>Examination Questions</i>5.20	
6. Radioactivity and Nuclear Transformation.....6.1	
6.1. Discovery of Radioactivity.....6.1	
6.2. Nature of Radiations from Radioactive Substances.....6.1	
6.2.1. Alpha Particles.....6.1	
6.2.2. Beta Particles.....6.2	
6.2.3. Gamma Rays.....6.2	
6.2.4. Detection of Radioactivity.....6.3	
6.3. Nuclear Reactions and Nuclear Equations...6.3	
6.4. Classification of Nuclear Reactions.....6.5	
6.4.1. Those Induced by Protons.....6.6	
6.4.2. Those Induced by Deuterons.....6.6	
6.4.3. Those Induced by Alpha Particles...6.6	
6.4.4. Those Induced by Neutrons.....6.6	
6.5. Measurement of Activity of Radioactive Substances.....6.6	
6.5.1. Unit of Radioactivity Measurement.....6.7	
6.6. Why do Radioactive Substances Emit Radiation?.....6.7	

6.7. Modes of Decay6.8	7.9. Polarity of Bonds7.9
6.7.1. Alpha Particle Emission.....6.8	7.10. Characteristics of Covalent Compounds.....7.11
6.7.2. Beta Particle Emission6.9	7.11. Fajan's Rules.....7.13
6.8. Group Displacement Law6.9	7.12. Deviations from the Octet Rule7.14
6.9. Rate of Disintegration	7.13. Molecular Geometry
(Law of Radioactive Decay)6.11	(The VSEPR Theory).....7.14
6.9.1. Half-life Period.....6.12	7.14. Electron Pair Donation or
6.9.2. Average Life Period6.13	Coordinate Valence7.16
6.9.3. Radioactive Equilibrium6.14	7.15. The Hydrogen Bond.....7.18
6.10. Radioactive Disintegration Series.....6.14	7.16. The Van der Waals Attraction7.19
6.10.1. The Geiger-Nuttall Rule.....6.16	<i>Questions</i>7.20
6.11. Nuclear Transformation6.16	<i>Objective Type</i>7.22
6.12. Artificial Transmutation of Elements.....6.17	<i>Problems</i>7.26
6.13. Nuclear Fission6.18	
6.13.1. Atom Bomb.....6.18	
6.13.2. Nuclear Reactors6.19	
6.14. Nuclear Fusion6.20	
6.14.1. Hydrogen Bomb6.21	
6.15. Hazards of Radiations6.22	
6.16. Applications of Radioisotopes6.23	
6.17. The Synthetic Elements6.25	
6.18. Nuclear Coulombic Barrier.....6.26	
6.19. Radiation Chemistry6.27	
6.19.1. Radiolysis of Water6.27	
<i>Questions</i>6.28	
<i>Objective Type</i>6.31	
<i>Problems</i>6.33	
<i>Examination Questions</i>6.36	
7. Chemical Bonding (i)—	8. Theory of Chemical Bonding (ii)—
Classical Approach.....7.1	Modern Approach.....8.1
7.1. Introduction.....7.1	8.1. Introduction.....8.1
7.2. Why are Chemical Bonds Formed?7.1	8.2. The Valence Bond Approach.....8.1
7.2.1. The Lewis and Langmuir Concept	8.3. Energy Changes During Bond Formation.....8.2
of Stable Configuration7.1	8.3.1. The Wave Mechanical Explanation
7.2.2. Lewis Symbols.....7.2	of Energy Changes8.2
7.3. Ionic Bond or Electrovalent Bond7.2	8.4. Sigma and Pi Bonds8.5
7.4. Lattice Energy7.2	8.5. Hybridization of Orbitals8.5
7.4.1. Energetics of Formation of Ionic	8.5.1. <i>sp</i> -Hybridization.....8.6
Substances7.4	8.5.2. <i>sp</i> ² -Hybridization8.6
7.4.2. Formation of Ions with Higher	8.5.3. <i>sp</i> ³ -Hybridization8.7
Charges.....7.4	8.5.4. <i>sp</i> ³ <i>d</i> -Hybridization8.10
7.5. Characteristics of Electrovalent	8.5.5. <i>sp</i> ³ <i>d</i> ² -Hybridisation.....8.11
Compounds7.5	8.5.6. Hybridization and Shapes of
7.6. Variable Electrovalency7.6	Some Simple Molecules.....8.12
7.7. Inert Pair Effect.....7.7	8.6. Bond Lengths8.15
7.8. Covalent Bond	8.6.1. Correlation of Bond Distances
(by Mutual Sharing of Electrons)7.8	and Hybridization.....8.15
7.8.1. Lewis Bonding of H ₂7.8	8.7. Bond Dissociation Energy (D).....8.16
7.8.2. Lewis Diagrams of some other	8.8. Resonance – A Modification of the
Molecules and Ions7.8	Valence Bond Concept.....8.16
	8.8.1. Electron Delocalization.....8.18
	8.9. Molecular Orbital Theory8.19
	8.9.1. Bonding and Antibonding
	Orbitals.....8.19
	8.9.2. Linear Combination of
	Atomic Orbitals (LCAO)8.19
	8.9.3. Combination of <i>s</i> Orbitals8.22
	8.9.4. Combination of <i>p</i> Orbitals.....8.22
	8.10. Energy Diagrams for Molecular Orbitals
	(in cases when 2 <i>s</i> and 2 <i>p_z</i> Orbitals have
	Energies that are not closer).....8.23
	8.10.1. M.O. Diagram of Fluorine8.24
	8.10.2. M.O. Diagram of Oxygen8.24
	8.11. Energy Diagrams for M.O.'s
	(in case of Molecules Consisting of
	Elements in which 2 <i>s</i> and 2 <i>p</i> Orbitals lie
	Close to each other)8.25

8.11.1.	M.O. Diagram of N_2	8.26	8.13.4.	M.O. Diagram of Hydrogen Fluoride, HF	8.32
8.11.2.	M.O. Diagrams of some simple Diatomic Molecules	8.26	8.14.	Comparative Study of VB and MO Theories	8.32
8.11.3.	M.O. Diagram of Helium.....	8.27	8.15.	Metallic Bond.....	8.33
8.11.4.	Electronic Configuration of Diatomic Molecules	8.27	8.15.1.	Electron Sea Model.....	8.33
8.12.	Relationship between Electronic Configuration and Molecular Behaviour ...	8.28	8.15.2.	Resonance Theory.....	8.33
8.12.1.	Bond Order.....	8.28	8.15.3.	The Molecular Orbital Theory	8.34
8.13.	M.O. Diagrams of Heteronuclear Diatomic Molecules	8.30	8.16.	Summary of the Three Main Types of Bonds	8.35
8.13.1.	Molecular Orbital Diagram of Carbon Monoxide, CO	8.31		<i>Questions</i>	8.35
8.13.2.	M.O. Diagram of Nitrosyl Ion, NO^+	8.31		<i>Objective Type</i>	8.37
8.13.3.	M.O. Diagram of Nitric Oxide, NO.....	8.32		<i>Examination Questions</i>	8.40
				Appendix to Unit I.....	8.43

UNIT-II: STATES OF MATTER

9.	The Gaseous State.....	9.3	9.7.3.	Graham's Law of Gaseous Diffusion.....	9.21
9.1.	The Gaseous State.....	9.3	9.7.4.	Avogadro's Law	9.21
9.2.	Gas Laws.....	9.3	9.7.5.	Dalton's Law of Partial Pressures.....	9.22
9.2.1.	Boyle's Law	9.3	9.7.6.	Kinetic Energy of an Ideal Gas	9.22
9.2.2.	Charles' Law	9.3	9.7.7.	Calculation of Molecular Velocities	9.23
9.2.3.	Avogadro's Law	9.4	9.8.	Collision Diameter, Mean Free Path and Collision Number.....	9.26
9.3.	Ideal Gas Law or the Gas Equation	9.5	9.8.1.	Collision Number (Z_1)	9.26
9.3.1.	Nature of Gas Constant	9.6	9.8.2.	Mean Free Path	9.28
9.3.2.	Numerical Value of R.....	9.6	9.9.	Collision Frequency	9.29
9.3.3.	Effusion and Diffusion	9.7	9.10.	Collisions in a Mixture of Gases.....	9.29
9.3.4.	Dalton's Law of Partial Pressure.....	9.9	9.11.	The Barometric Formula.....	9.32
9.4.	Kinetic Theory of Gases	9.10	9.12.	Viscosity of Gases.....	9.33
9.4.1.	Postulates of Kinetic Theory of Gases.....	9.11	9.12.1.	The Coefficient of Viscosity.....	9.34
9.4.2.	Validity of the Postulates of the Kinetic Theory of Gases.....	9.11	9.12.2.	Effect of Temperature and Pressure on Viscosity of Gases.....	9.36
9.5.	Distribution of Molecular Speeds	9.12	9.13.	Degrees of Freedom.....	9.36
9.5.1.	Maxwell-Boltzmann Law of Distribution of Molecular Velocities	9.13	9.13.1.	Translational Degrees of Freedom.....	9.36
9.5.2.	Calculation of Molecular Velocities of Gaseous Molecules	9.14	9.13.2.	Rotational Degrees of Freedom	9.37
9.5.3.	Average Velocity	9.14	9.13.3.	Vibrational Degrees of Freedom	9.37
9.5.4.	Most Probable Velocity	9.15	9.14.	Principle of Equipartition of Energies	9.39
9.5.5.	Root Mean Square Velocity (RMS Velocity)	9.16	9.15.	Specific Heats and Molar Heats of Gases.....	9.40
9.6.	Kinetic Equation for Gases	9.18	9.15.1.	Molar Heats of Gases and Kinetic Theory.....	9.41
9.7.	Derivation of the Gas Laws from Kinetic Equation	9.20	9.15.2.	Ratio of heat Capacities \bar{C}_p / \bar{C}_v and its Variance with Molar Complexity	9.42
9.7.1.	Boyle's Law	9.20			
9.7.2.	Charles's Law.....	9.20			

9.15.3. Comparison of Theoretical and Experimental Heat Capacity Values	9.43	10.11.1. Importance of the Law of Corresponding States	10.23
<i>Questions</i>	9.45	10.12. Liquefaction of Gases—	
<i>Objective Type</i>	9.46	Introductory and Historical	10.23
<i>Problems</i>	9.48	10.12.1. Methods of Liquefaction of Gases	10.24
<i>Examination Questions</i>	9.49	10.12.2. Uses of Liquefied and Compressed Gases	10.26
10. Real Gases.....10.1		<i>Questions</i>	10.26
10.1. Introduction—Ideal and Real Gases.....	10.1	<i>Objective Type</i>	10.28
10.2. Deviation from Ideal Behaviour.....	10.1	<i>Problems</i>	10.29
10.2.1. Deviation from Ideal Behaviour	10.1	<i>Examination Questions</i>	10.31
10.2.2. Deviations from Boyle's Law	10.1	11. Properties of Liquids11.1	
10.2.3. Deviations from Charles' or Gay-Lussac's Law.....	10.2	11.1. The Liquid State	11.1
10.2.4. Deviations from Avogadro's Law	10.2	11.2. The Intermolecular Forces.....	11.1
10.3. The Cause of Deviations of Real Gases from Ideal Behaviour.....	10.2	11.3. The Structures of Liquid.....	11.3
10.4. Van der Waals' Equation.....	10.4	11.4. General Properties of Liquids.....	11.3
10.4.1. Nature of Van der Waals' Constant	10.5	11.5. Evaporation	11.4
10.5. Explanation of Real Gas Behaviour by Van der Waals' Equation.....	10.7	11.6. Vapour Pressure.....	11.5
10.6. Calculation of Boyle Temperature.....	10.9	11.7. Measurement of Vapour Pressure	11.7
10.7. Limitation of the Van der Waals' Equation.....	10.11	11.8. Boiling Point.....	11.8
10.7.1. Clausius Equation	10.11	11.9. Freezing Point.....	11.8
10.7.2. Kammerlingh-Onnes Virial Equations	10.12	11.10. Surface Tension	11.9
10.7.3. Berthelot Equations.....	10.12	11.11. Measurement of Surface Tension	11.11
10.7.4. Dieterici Equation.....	10.12	11.12. Parachor.....	11.14
10.7.5. Applications of Equations of State	10.12	11.13. Viscosity and Fluidity.....	11.16
10.8. Relative Molecular Mass Values in Gases	10.14	11.14. Measurement of Viscosity	11.17
10.8.1. Limiting Density Method for Determination of Molecular Mass of Gases	10.14	11.15. Factors Affecting Viscosity	11.18
10.9. Critical Phenomena	10.15	11.16. Viscosity in Everyday Life	11.20
10.9.1. Experimental Measurement of the Critical Constants of a Gas	10.16	11.17. Viscosity and Constitution.....	11.21
10.9.2. The Critical Phenomena and Andrews' Experiments.....	10.17	11.18. Optical Activity	11.23
10.9.3. The Van der Waals' Equation and Critical State.....	10.18	<i>Questions</i>	11.27
10.10. Calculation of Critical Constants	10.19	<i>Objective Type</i>	11.28
10.11. Law of Corresponding States and Reduced Equation of State	10.21	<i>Problems</i>	11.30
		<i>Examination Questions</i>	11.31
		12. The Solid State12.1	
		12.1. Introduction	12.1
		12.2. Characteristics of Solids.....	12.1
		12.3. Structure of Crystals	12.3
		12.4. Crystal Systems	12.4
		12.5. Lattice Planes and their Designation.....	12.7
		12.6. Symmetry in Crystals	12.10
		12.7. Crystallography	12.13
		12.8. X-ray Diffraction and Crystal Structure	12.14
		12.9. Determination of Crystal Structure	12.16
		12.10. Indexing of Planes and Structure of NaCl and KCl	12.18
		12.11. Number of Atoms per Unit Cell, Formula and Density of Solids	12.20

12.12. Packing of Constituent Particles in Crystals	12.22	12.17. Void Space in Closed Packing of Spheres	12.32
12.13. Types of Three-dimensional Packing	12.25	12.18. Types of Crystals	12.34
12.14. Packing of Crystals and Coordination Number.....	12.26	12.19. Imperfections or Defects in Solids	12.37
12.15. Structure of Simple Ionic Compounds— Close Packed Arrangements	12.27	12.20. Properties of Solids	12.40
12.15.1. Ionic Compounds of the Types AX_1	12.28	12.21. Superconductivity	12.42
12.15.2. Ionic Compounds of the Type AX_2	12.29	12.22. Amorphous Solids	12.43
12.15.3. Limiting Radius Ratio and the Geometry of the Crystal.....	12.30	12.23. Liquid Crystals	12.44
12.16. Lattice Energy	12.30	12.24. Polymorphism	12.46
		12.24.1. Types of Allotropy (Transition Temperature)	12.46
		<i>Questions</i>	12.47
		<i>Objective Type</i>	12.48
		<i>Problems</i>	12.50
		<i>Examination Questions</i>	12.51

UNIT-III: THERMODYNAMICS-I

13. Introduction to Chemical

Thermodynamics..... 13.3

13.1. Introduction	13.3
13.2. Thermodynamic Variables or State Variables	13.4
13.3. State Functions and Path Functions.....	13.5
13.4. Thermal Equilibrium	13.6
13.4.1. Quasiequilibrium Process	13.6
13.5. Zeroth Law of Thermodynamics	13.6
13.5.1. Derivation of the Zeroth Law of Thermodynamics	13.7
13.6. Thermodynamic Process	13.8
13.7. Exact and Inexact Differentials	13.10
13.8. More Properties of Exact Differentials.....	13.12
<i>Exercise</i>	13.16
<i>Questions</i>	13.16
<i>Objective Type</i>	13.17
<i>Problems</i>	13.18
<i>Examination Questions</i>	13.18

14. The First Law of Thermodynamics.. 14.1

14.1. Work and Heat.....	14.1
14.2. First Law of Thermodynamics	14.2
14.3. Work done in Isothermal and Adiabatic Changes	14.4
14.4. Heat Content or Enthalpy	14.4
14.5. Molar Heat at Constant Volume C_v	14.5
14.6. Thermodynamic Changes in Compression and Expansion of an Ideal Gas	14.8
14.7. Work done on the System in Reversible Adiabatic Compression of Ideal Gases	14.10

14.8. Comparison of Work done in Adiabatic Reversible and Isothermal Reversible Expansion of an Ideal Gas.....	14.13
14.9. The Joule-Thomson Effect	14.21
<i>Questions</i>	14.24
<i>Objective Type</i>	14.25
<i>Problems</i>	14.26
<i>Examination Questions</i>	14.27

15. Thermochemistry 15.1

15.1. Introduction	15.1
15.2. Conventions used in Thermochemistry	15.1
15.3. Enthalpy of Reaction	15.2
15.3.1. Measurement of Enthalpy of Reaction.....	15.3
15.3.2. Relation of Enthalpy of Reaction to Physical Conditions	15.3
15.4. Variation of ΔH with Temperature — Kirchhoff's Equation	15.4
15.5. Relation between Heat of Reaction at Constant Pressure (ΔH) and at Constant Volume (ΔU)	15.7
15.6. Enthalpy of Combustion.....	15.8
15.6.1. Experimental Determination of Enthalpy of Combustion (ΔH).....	15.8
15.7. Enthalpy of Formation.....	15.10
15.8. Enthalpy of Solution.....	15.12
15.8.1. Integral Enthalpy of Solution	15.12
15.8.2. Differential Enthalpy of Dilution and Solution.....	15.13

15.8.3. Enthalpy of Formation of Ions.....	15.13	16.24. Clapeyron – Clausius Equation.....	16.39
15.8.4. Experimental Determination of Enthalpy of Solution.....	15.14	16.25. Variation of Chemical Potential with Temperature.....	16.41
15.9. Enthalpy of Neutralization	15.15	16.26. Chemical Potential of an Ideal Gas	16.42
15.9.1. Experimental Determination of Enthalpy of Neutralization.....	15.15	16.27. Free Energy of Mixture	16.43
15.10. Enthalpy of Hydration.....	15.17	16.28. Gibbs-Duhem Equation.....	16.43
15.11. Enthalpy of Transition.....	15.17	16.29. Chemical Potential of Solvent in Binary Ideal Liquid Solution.....	16.44
15.12. Thermochemical Laws	15.17	16.30. The Application of Chemical Potential.....	16.45
15.13. Bond Dissociation Enthalpies	15.21	<i>Questions</i>	16.45
<i>Questions</i>	15.24	<i>Objective Type</i>	16.46
<i>Objective Type</i>	15.25	<i>Problems</i>	16.48
<i>Problems</i>	15.26	<i>Examination Questions</i>	16.50
<i>Examination Questions</i>	15.28		
16. The Second Law of Thermodynamics.....	16.1	17. The Third Law of Thermodynamics.....	17.1
16.1. Spontaneous or Natural Processes.....	16.1	17.1. Entropy at the Absolute Zero.....	17.1
16.2. Limitations of First Law of Thermodynamics	16.1	17.2. Development of Third Law	17.4
16.3. Second Law of Thermodynamics.....	16.2	17.3. Unattainability of Absolute Zero.....	17.5
16.4. Conversion of Heat into Work (the Carnot Cycle).....	16.3	17.4. Thermodynamic Properties at Absolute Zero	17.5
16.5. Refrigerators	16.8	17.5. Tables of Entropies at 298 K	17.6
16.6. Carnot Theorems	16.8	17.6. Exceptions to the Third Law : The Concept of Residual Entropy	17.9
16.7. Kelvin Scale of Temperature.....	16.9	17.7. Molecular Basis of Residual Entropy	17.9
16.8. Entropy and Carnot Cycle	16.11	<i>Questions</i>	17.10
16.9. Entropy Change of the Universe in Reversible Processes	16.13	<i>Objective Type</i>	17.11
16.10. Entropy – A Measure of Disorder.....	16.14	<i>Problems</i>	17.12
16.11. Entropy Calculations	16.17	<i>Examination Questions</i>	17.12
16.12. Free Energy	16.19		
16.13. Condition of Equilibrium and Spontaneous Change	16.20	18. Chemical Equilibrium.....	18.1
16.14. Variation in ΔH and ΔS and the Spontaneity or Equilibrium of a Reaction or Process	16.21	18.1. Rate of Reaction	18.1
16.15. Change in Standard Free Energy (ΔG°) of the Reactions	16.22	18.2. Factors which Affect the Rate of a Reaction.....	18.1
16.16. The Helmholtz Function (Work Function)	16.24	18.3. Reversible Reactions	18.2
16.17. The Maxwell Equations.....	16.27	18.4. The Equilibrium	18.3
16.18. Thermodynamic Equation of State.....	16.29	18.5. Stable and Metastable Equilibrium	18.3
16.19. The Joule – Thomson Inversion Temperature	16.32	18.6. Criteria of Equilibrium	18.3
16.20. Gibbs-Helmholtz Equations	16.32	18.7. Law of Mass Action	18.4
16.21. Free Energy Changes in Chemical Reaction – Van't Hoff Isotherm.....	16.35	18.8. The Equilibrium Constant	18.4
16.22. Thermodynamic Equation for Open Systems – Partial Molar Quantities	16.36	18.9. Activity.....	18.8
16.23. Partial Molal Free Energy or Chemical Potential.....	16.37	18.10. Fugacity.....	18.10
		18.11. Free Energy and Chemical Equilibrium.....	18.11
		18.12. Standard Free Energy and Equilibrium Constant	18.12
		18.13. Relationship between K_c , K_p and K_x	18.13
		18.14. Variation of Equilibrium Constant with Temperature, the Reaction Isochore.....	18.15
		18.15. Usefulness of the Equilibrium Constant.....	18.16
		18.16. Experimental Determination of Equilibrium Constants.....	18.17

18.17. Gaseous Reactions of Type I	18.17	20. The Phase Rule	20.1
18.18. Gaseous Reactions of Type II.....	18.19	20.1. Equilibrium between Phases	20.1
18.19. Calculation of the Degree of Dissociation from the Vapour Density Measurements	18.19	20.2. Definitions of Terms Used.....	20.1
18.20. Homogeneous Equilibria in Liquid State	18.22	20.3. Phase Rule.....	20.3
18.21. Heterogeneous Equilibria	18.23	20.4. Phase Diagrams	20.4
18.22. Le Chatelier Principle.....	18.24	20.5. The Water System: A One-component System	20.4
18.23. Effect of Addition of Inert Gas.....	18.25	20.6. The Carbon Dioxide System	20.7
<i>Questions</i>	18.25	20.7. The Sulphur System (One-Component System Showing Solid-solid Transformations)	20.8
<i>Objective Type</i>	18.28	20.8. Two-Component System	20.12
<i>Problems</i>	18.29	20.9. Types of Two-Component Systems involving Solid-Liquid Equilibrium	20.12
<i>Examination Questions</i>	18.30	20.10. The Lead-Silver System	20.12
19. Nernst Distribution Law	19.1	20.11. Potassium Iodide-Water System.....	20.14
19.1. Nernst Distribution Law.....	19.1	20.12. Freezing Point Diagram with Compound Formation.....	20.15
19.2. Thermodynamics of Solutions.....	19.1	20.13. Ferric Chloride-Water System.....	20.16
19.3. Thermodynamical Derivation of Distribution Law.....	19.4	20.14. Applications of Eutectics.....	20.18
19.4. Calculation of the Partition Coefficient	19.5	20.15. Systems Involving Formation of Compounds with Incongruent Melting Points (<i>i.e.</i> , showing Peritectic Change)	20.18
19.5. Deviation from Distribution Law due to Molecular Complexity.....	19.6	20.16. Sodium Chloride-Water System.....	20.19
19.6. Other Limitations of Distribution Law	19.10	20.17. Sodium Sulphate-Water System.....	20.20
19.7. Applications of Distribution Law.....	19.11	20.18. Gas-Solid Equilibria— Salt Hydrate System	20.24
19.8. Extraction of Substances from Solutions	19.12	<i>Solved Problems</i>	20.25
19.9. Distribution Law and Henry's Law	19.15	<i>Questions</i>	20.28
<i>Questions</i>	19.15	<i>Objective Type</i>	20.28
<i>Objective Type</i>	19.16	<i>Examination Question</i>	20.30
<i>Problems</i>	19.18		
<i>Examination Questions</i>	19.19		

PART-II

UNIT-IV: SOLUTIONS

21. Solutions.....	21.3	21.4.1. Solutions of Gases in Liquids....	21.9
21.1. Solution—A Homogeneous Mixture.....	21.3	21.4.2. How the Solubility of a Gas is Measured	21.11
21.1.1. Solvent and Solute	21.3	21.5. The Ideal Solutions.....	21.12
21.1.2. Solution.....	21.3	21.5.1. Raoult's Law of Ideal Solutions	21.12
21.2. Why do Substances Dissolve?.....	21.4	21.5.2. Solutions of Liquids in Liquids.....	21.13
21.2.1. Temperature and Solubility.....	21.4	21.5.3. Miscible Liquids	21.13
21.2.2. Why does a Substance have Different Solubilities in Different Solvents?	21.4	21.5.4. Boiling Point-Composition Curves.....	21.13
21.2.3. Solubility of Gases in Liquids.....	21.5	21.5.5. Relation between the Mole- fractions of the Components in the Liquid and Vapour Phases.....	21.14
21.3. Composition of Solutions.....	21.5		
21.4. Gaseous Solutions (Solution of Gas in Gas).....	21.8		

21.5.6.	Ideal Solution in Terms of Activity	21.15	21.12.	Solid Solutions	21.30
21.6.	Non-ideal Solutions: Activity Coefficients.....	21.16		<i>Questions</i>	21.31
21.7.	Thermodynamics of Ideal Solutions.....	21.17		<i>Objective Type</i>	21.32
21.7.1.	Gibbs Free Energy Change of Mixing (ΔG_{mix}).....	21.17		<i>Problems</i>	21.33
21.7.2.	Enthalpy Change of Mixing (ΔH_{mix}).....	21.18		<i>Examination Questions</i>	21.34
21.7.3.	Volume Change of Mixing (ΔV_{mix})	21.19	22. Theory of Dilute Solutions	22.1	
21.7.4.	Entropy Change of Mixing (ΔS_{mix}).....	21.19	22.1.	Colligative Properties of Dilute Solutions.....	22.1
21.7.5.	Relationship between the Composition of the Solution in the Liquid Phase and Partial Vapour Pressures in Gas Phase (Gibbs-Duhem-Margules Equation).....	21.21	22.1.1.	What Happens when the Solute Undergoes Dissociation.....	22.1
21.7.6.	Application of Gibbs-Duhem-Margules Equation to Ideal Solutions	21.21	22.1.2.	What Happens when the Solute Undergoes Association.....	22.1
21.7.7.	Application of Gibbs-Duhem-Margules Equation to Non-ideal Solutions	21.22	22.2.	Relative Lowering of Vapour Pressure.....	22.2
21.8.	Theory of Fractional Distillation.....	21.22	22.2.1.	Raoult's Law of Relative Lowering of Vapour Pressure..	22.3
21.8.1.	Fractional Distillation of Liquid Pairs of Type I	21.23	22.2.2.	Relative Lowering of Vapour Pressure and Molality of the Solution	22.4
21.8.2.	Fractional Distillation in Industry	21.24	22.2.3.	Molecular Mass of Solute from Relative Lowering of Vapour Pressure	22.4
21.8.3.	Fractional Distillation of Non-ideal Solutions	21.24	22.2.4.	Thermodynamic Derivation of Relative Lowering of Vapour Pressure	22.6
21.8.4.	Fractional Distillation of Liquid Pairs of Type II (<i>Minimum B.P. Mixtures</i>)	21.24	22.3.	Osmosis	22.8
21.8.5.	Fractional Distillation of Liquid pairs of Type III (<i>Maximum B.P. Mixtures</i>)	21.25	22.3.1.	Preparation of Semi-permeable Membrane	22.9
21.8.6.	Azeotropic Distillation.....	21.25	22.3.2.	Theories of Semi-permeability.....	22.9
21.8.7.	The Nature of Azeotropic Mixtures	21.25	22.3.3.	Function of the Semi-permeable Membrane.....	22.10
21.9.	Partially Miscible Liquids	21.26	22.3.4.	Osmotic Pressure	22.10
21.9.1.	Critical Solution Temperature (C.S.T.).....	21.26	22.3.5.	Kinetic Molecular Theory of Osmotic Pressure	22.11
21.9.2.	Mixtures with Lower C.S.T.....	21.28	22.3.6.	Reverse Osmosis.....	22.11
21.9.3.	Mixtures with both Lower and Upper C.S.T.s	21.28	22.3.7.	Measurement of Osmotic Pressure	22.12
21.10.	Completely Immiscible Liquids	21.28	22.3.8.	Theory of Dilute Solutions.....	22.14
21.11.	Solutions of Solids in Liquids	21.30	22.3.9.	Thermodynamic Derivation of the Relation between Osmotic Pressure and Concentration of Solute (van't Hoff Equation).....	22.15
			22.3.10.	Comparison of Osmotic Pressures	22.17
			22.3.11.	Osmotic Pressure of Electrolytes	22.19

22.3.12.	Osmotic Coefficient	22.19	22.5.2.	Experimental Determination of the Depression of Freezing Point	22.32
22.3.13.	Number-Average Molar Mass and Mass-Average Molar Mass	22.20	22.6.	Abnormal Behaviour of Solutions.....	22.33
22.3.14.	Relation between Osmotic Pressure and Relative Lowering of Vapour Pressure	22.21	22.6.1.	Abnormal Behaviour of Solutions of Electrolytes	22.34
22.4.	Elevation of Boiling Point.....	22.22	22.6.2.	Abnormal Behaviour of Solutions of Solutes undergoing Association in Solution	22.35
22.4.1.	Thermodynamic Derivation of Elevation of Boiling Point	22.23		<i>Questions</i>	22.36
22.4.2.	Experimental Determination of Elevation of Boiling Point	22.26		<i>Objective Type</i>	22.39
22.5.	Depression in Freezing Point	22.29		<i>Problems</i>	22.41
22.5.1.	Thermodynamic Derivation of Depression of Freezing Point	22.29		<i>Examination Questions</i>	22.43

UNIT-V: SURFACE CHEMISTRY

23. ADSORPTION	23.3	23.7.3.	Three Types of Mechanical Adsorption from Solutions....	23.26
23.1. Introduction	23.3	23.7.4.	How to Calculate x/m from Experimental Data due to Adsorption from Solutions?	23.26
23.1.1. How does Adsorption Differ from Absorption	23.3	23.8.	Liquid Surfaces.....	23.27
23.1.2. Adsorption and Absorption Occur One after the Other	23.4	23.8.1.	Surface Tension and Surface Energy	23.27
23.1.3. Examples of Adsorbents and Adsorbates	23.4	23.8.2.	Capillary Action	23.27
23.2. Adsorption of Gases	23.4	23.8.3.	Pressure Difference Across Curved Surface (Laplace Equation).....	23.28
23.2.1. Physical Adsorption	23.5	23.8.4.	Vapour-Pressure of Droplets (Kelvin Equation).....	23.29
23.2.2. Chemisorption.....	23.5	23.8.5.	Extent of Adsorption Depends on the Surface Tension of the Solvent	23.30
23.2.3. Distinction between Physical Adsorption and Chemisorption.....	23.6	23.8.6.	Surface Catalyzed Oxidation of CO to CO ₂	23.30
23.3. What Changes the Adsorbed Molecules Suffer in the Process of Adsorption ?	23.6	23.8.7.	Surface Equation of State and Applications.....	23.31
23.4. Adsorption Isotherms	23.7	23.8.8.	Surface Equation of State for Ionized Surfactants.....	23.31
23.4.1. Freundlich Adsorption Isotherm	23.7	23.8.9.	Electrokinetic Phenomena	23.32
23.4.2. Langmuir Adsorption Isotherm	23.9	23.8.10.	Formation of Surface Films	23.37
23.4.3. Types of Adsorption Isotherms.....	23.11	23.9.	The Gibbs Adsorption Theorem	23.37
23.4.4. BET Theory.....	23.13	23.10.	Emulsifiers.....	23.40
23.5. Experimental Determination of Gas Adsorption	23.20	23.11.	Applications of Adsorption	23.41
23.5.1. Volumetric Method	23.20		<i>Questions</i>	23.43
23.5.2. Gravimetric Method.....	23.21		<i>Objective Type</i>	23.45
23.6. Effect of Temperature on Adsorption	23.22		<i>Examination Questions</i>	23.46
23.7. Adsorption from Solution.....	23.24	24. The Colloidal State	24.1	
23.7.1. Adsorption of Solutes from Solutions Depends on the Nature of the Adsorbent	23.25	24.1.	Introduction	24.1
23.7.2. A Competition between the Solute and Solvent Molecules takes place in Adsorption from Solutions.....	23.25	24.2.	Characteristics of True Solutions, Colloidal Solutions and Suspensions	24.2

24.3. Colloidal State	24.2	24.15.1. Characteristics of Surfactants ..	24.28
24.4. Preparation of Colloidal Solution.....	24.4	24.15.2. Classification of Surface	
24.4.1. Condensation Method.	24.5	Active Agents.....	24.29
24.4.2. Dispersion Methods	24.5	24.16. Micelles	24.30
24.5. Purification of Colloidal Solution.....	24.7	24.16.1. Kraft Temperature	24.32
24.6. Properties of Colloidal Solution.....	24.7	24.16.2. Structure of Micelles.....	24.32
24.6.1. Physical Properties.....	24.7	24.16.3. Ionic Micelles and their	
24.6.2. Optical Properties.....	24.8	Different Types.....	24.34
24.6.3. Electrical Properties	24.12	24.16.4. Micellization in Non-aqueous	
24.7. The Stability of Colloids	24.16	Media	24.34
24.8. The Precipitation (Coagulation) of		24.16.5. Counter Ion Binding to	
Colloids	24.17	Micelles.....	24.34
24.8.1. Protection	24.19	24.16.6. Mechanism of Micellization ..	24.35
24.8.2. Imbibition.....	24.19	24.16.7. Determination of Critical	
24.8.3. Adsorption.....	24.20	Concentration of	
24.9. Emulsions	24.20	Micellization	24.36
24.9.1. Emulsifying Agents and		24.16.8. Factors Affecting the Critical	
Preparation of Emulsion	24.21	Concentration of Micelles of	
24.9.2. Properties and Uses of		Surfactant	24.36
Emulsions.....	24.21	24.16.9. Thermodynamics of	
24.9.3. Microemulsion	24.22	Micellization	24.37
24.10. Gels.....	24.23	24.16.10. Solubilization in	
24.11. Size of Colloidal Particles	24.23	Surfactant Solutions	24.39
24.12. Molecular Mass of Macromolecules ..	24.24	24.16.11. Reverse Micelles.....	24.40
24.13. Applications of Colloid Chemistry.....	24.26	24.17. Donnan Membrane Equilibrium.....	24.40
24.14. Colloidal Electrolytes	24.27	<i>Questions</i>	24.46
24.15. Surface Active Agents (Surfactants).....	24.28	<i>Objective Type</i>	24.48
		<i>Examination Questions</i>	24.49

UNIT-VI: RATES AND MECHANISMS

25. Chemical Kinetics	25.3	25.5.1. Hydrolysis of an Ester by	
25.1. The Rates of Chemical Reactions	25.3	an Alkali.....	25.17
25.1.1. The Concept of Reaction Rate ..	25.3	25.5.2. Some other Examples of	
25.1.2. Units Employed	25.4	Second Order Reactions.....	25.19
25.1.3. Variation of Reactant		25.6. Third Order Rate Equation	25.19
Concentration with Time.....	25.4	25.7. Rate Law for n th Order Reaction	25.19
25.1.4. Rate Laws and Rate		25.8. Fractional Order Reactions.....	25.20
Constants.....	25.5	25.9. Reactions with Negative Order	25.21
25.1.5. Factors Influencing Reaction		25.10. Determination of the Order of a	
Rates.....	25.6	Reaction.....	25.21
25.2. Molecularity and Order of Reaction.....	25.7	25.11. The Effect of Temperature on	
25.2.1. Relation between Molecularity		Reaction Rate	25.25
and Order of Reaction.....	25.7	25.11.1. Significance of Activation	
25.2.2. Order and Molecularity of		Energy	25.26
Complex Reactions	25.8	25.11.2. Temperature Coefficient of	
25.3. Zero-Order Reactions	25.9	Reaction Rates	25.27
25.4. First Order Rate Equations	25.10	25.12. Complex Reactions.....	25.27
25.4.1. Half-change Time.....	25.12	25.13. Reaction Mechanism	25.38
25.4.2. Some Typical First Order		25.13.1. Mechanisms of	
Reactions.....	25.13	Chemical Reactions	25.40
25.5. Second Order Rate Equation	25.16	25.14. Theories of Reaction Rates:	
		Collision Theory.....	25.42

25.14.1. Collision Theory	25.43	26.2.5. Use of Catalysts in Industry ..	26.29
25.14.2. The Transition State Theory or Theory of Absolute Reaction Rate	25.49	<i>Questions</i>	26.30
25.15. Chemical Kinetics in Solutions	25.65	<i>Objective Type</i>	26.31
25.15.1. Reactions in Ideal Solutions..	25.65	<i>Examination Questions</i>	26.32
25.15.2. Reaction between Ions in Solution	25.67	27. Photochemistry	27.1
25.15.3. Diffusion-Controlled Reactions in Solution	25.71	27.1. Introduction	27.1
25.15.4. Kinetics of Fast Reactions	25.73	27.1.1. What Does Photochemistry Tell Us?	27.1
25.15.5. Kinetics of Slow Reactions ..	25.82	27.1.2. Chemical Effects Produced by Light Radiations	27.1
25.16. Molecular Reaction Dynamics	25.89	27.1.3. Acquaintance with Photochemical Reactions	27.2
25.16.1. Reactions in Molecular Beams..	25.89	27.1.4. Differences between Thermal and Photochemical Reactions ..	27.2
25.16.2. Potential Energy Surfaces	25.93	27.2. The Whole of Incident Radiation is not Absorbed: The Laws of Absorption	27.3
25.16.3. Transition State Theory in Terms of Statistical Mechanics ..	25.96	27.2.1. Why does the Intensity of Incident Light Change?	27.3
<i>Questions</i>	25.99	27.2.2. The Laws of Absorption.....	27.3
<i>Objective Type</i>	25.103	27.3. Effect of Radiation on Chemical Reactions	27.7
<i>Problems</i>	25.104	27.3.1. Laws of Photochemistry	27.7
<i>Examination Questions</i>	25.106	27.3.2. Deviations in the Law of Photochemical Equivalence ..	27.10
26. Catalysis	26.1	27.3.3. Factors Affecting the Quantum Efficiency	27.11
26.1. Substances Alter the Speed of a Chemical Reaction.....	26.1	27.3.4. Experimental Procedure.....	27.12
26.1.1. Types of Catalysis	26.1	27.3.5. Photochemical Reactions	27.14
26.1.2. Function of a Catalyst	26.5	27.4. Emission of Radiations.....	27.19
26.1.3. Characteristics of Catalytic Action.....	26.6	27.4.1. Luminescence	27.19
26.2. Theories of Catalysis	26.8	27.4.2. Fluorescence	27.20
26.2.1. Theory of Homogeneous Catalysis.....	26.8	27.4.3. Phosphorescence	27.21
26.2.2. Theory of Heterogeneous Catalysis: Modern Adsorption Theory (Surface Reactions) ..	26.10	27.4.4. Flash Photolysis	27.21
26.2.3. Quantitative Treatment of Adsorption Theory of Heterogeneous Catalysis on Reactants (Kinetics of Surface Reactions)	26.15	27.5. Application of Photochemistry.....	27.21
26.2.4. Kinetics of Homogeneous Catalysis.....	26.21	27.5.1. Photography	27.21
		27.5.2. Photoelectric Effect in Wireless.....	27.22
		<i>Questions</i>	27.22
		<i>Problems</i>	27.25
		<i>Examination Questions</i>	27.25

UNIT-VII: ELECTROCHEMISTRY

28. Electrolysis and Electrical Conductivity.....	28.3	28.3. Electrolysis	28.6
28.1. Electrolyte Solutions		28.3.1. Products of Electrolysis	28.7
Conduct Electricity	28.3	28.3.2. Faraday's Laws of Electrolysis..	28.8
28.1.1. Ions in Solution	28.3	28.3.3. Theoretical Importance of the Second Law	28.9
28.1.2. Formation of Ions in Solution ..	28.4	28.4. Conductance of Solution	28.10
28.2. Substances that Conduct Electricity	28.5	28.4.1. Electrolytic Conductivity or Specific Conductance.....	28.11
28.2.1. Metallic Conductance	28.5	28.4.2. Molar Conductivity (Λ_m)	28.12
28.2.2. Electrolytic Conductance	28.6		

28.4.3.	Equivalent Conductivity	28.13	29.3.2.	Application of Kohlrausch's Law	29.25
28.4.4.	Relation between Equivalent Conductivity and Molar Conductivity	28.14	29.3.3.	Conductometric Titrations	29.30
28.4.5.	Measurement of Electrolytic Conductivity	28.15		<i>Questions</i>	29.32
28.4.6.	Effect of Dilution on Equivalent Conductivity	28.18		<i>Objective Type</i>	29.34
28.5.	Theories of Weak and Strong Electrolytes	28.20		<i>Problems</i>	29.35
28.5.1.	Arrhenius Theory	28.20		<i>Examination Questions</i>	29.37
28.5.2.	Degree of Dissociation	28.21	30. Ionic Equilibria	30.1	
28.5.3.	Drawbacks of the Arrhenius Theory	28.22	30.1.	Introduction	30.1
28.5.4.	Theory of Strong Electrolytes	28.23	30.1.1.	Dynamic Equilibrium between Ions and the Unionised Molecules	30.1
28.5.5.	Derivation of Debye-Hückel- Onsager Conductance Equation	28.25	30.1.2.	Dissociation Constant and Ostwald's Dilution Law	30.2
28.6.	Conductance at High Frequencies and High Voltages	28.29	30.1.3.	Dissociation of Pure Water	30.5
28.6.1.	Wien Effect	28.29	30.1.4.	Logarithmic or p-scale : pH, pOH and pK	30.6
28.6.2.	Debye-Falkenhagen Effect	28.29	30.2.	Solution of Acids and Bases	30.12
28.7.	Interionic Attraction Theory: Debye-Hückel Theory of Strong Electrolytes	28.29	30.2.1.	Ionic Equilibria in Solutions of a Monobasic Acid (HA)	30.13
28.7.1.	Activity Co-efficients of Electrolytes	28.30	30.2.2.	Ionic Equilibria in Solutions of Monoacid Bases	30.19
28.7.2.	Debye-Hückel Theory	28.34	30.3.	Multiple-stage Equilibria	30.22
	<i>Questions</i>	28.44	30.3.1.	Equilibria in Dibasic (or Diprotic) Acid H ₂ A	30.22
	<i>Objective Type</i>	28.45	30.3.2.	Ionic Equilibria in Diacid Bases	30.25
	<i>Problems</i>	28.46	30.3.3.	Dissociation in Polybasic Acids and Polyacid Bases	30.27
	<i>Examination Questions</i>	28.47	30.4.	Common Ion Effect	30.30
29. Migration of Ions	29.1			<i>Questions</i>	30.32
29.1.	Migration of Ions	29.1		<i>Objective Type</i>	30.33
29.1.1.	Experiment	29.2		<i>Problems</i>	30.35
29.1.2.	The Drift Speed and Mobility of Ions	29.2		<i>Examination Questions</i>	30.36
29.1.3.	Current carried by Ions and Ionic Speeds	29.5	31. Acids and Bases	31.1	
29.2.	Speeds of Ions and Amounts Liberated at the Electrodes	29.6	31.1.	Classical Definition of Acids and Bases	31.1
29.2.1.	Hittorf's Theoretical Device	29.6	31.1.1.	Proton Concept or Bronsted-Lowry Theory of Acids and Bases	31.1
29.2.2.	Transference Number or Transport Numbers	29.7	31.1.2.	The Lewis Concept of Acids and Bases	31.4
29.2.3.	Transference Number of Some Ions in Aqueous Medium	29.14	31.1.3.	Relative Strengths of Acids	31.4
29.2.4.	Zero and Negative Transference Numbers	29.14	31.1.4.	Relative Strengths of Bases	31.7
29.2.5.	Factors on which Transport Number Depends	29.15	31.1.5.	Isohydric Solution	31.7
29.3.	Ionic Conductance	29.16	31.2.	The Control of the Concentration of H ⁺ ions – Buffer Solutions	31.8
29.3.1.	Kohlrausch Law of Independent Migration of Ions	29.16	31.2.1.	Composition of Buffer Solutions	31.9

31.2.2.	Mathematical Expression for the pH of Acidic Buffers and Basic Buffers – Henderson-Hasselbalch Equation	31.9			
31.2.3.	Buffer Capacity	31.13			
31.2.4.	Methods for the Determination of pH	31.15			
31.3.	Theories of Indicators.....	31.19			
31.3.1.	The Acid-Base Concept of Indicators – Ostwald’s Theory	31.19			
31.3.2.	Quinonoid Theory	31.19			
31.3.3.	pH Changes During Acid-base Titrations	31.20			
31.3.4.	Choice of Indicators and Acid-Base Titrations	31.25			
31.3.5.	Indicators and Acid-Base Titrations	31.25			
	<i>Questions</i>	31.27			
	<i>Objective Type</i>	31.29			
	<i>Problems</i>	31.30			
	<i>Examination Questions</i>	31.31			
32.	Solubility Product and Hydrolysis...32.1				
32.1.	Solubility Product.....	32.1			
32.1.1.	Equilibrium between a Solid Salt and its Ions in Solution, the Solubility Product	32.1			
32.1.2.	Relation between Solubility and Solubility Product of a Sparingly Soluble Salt	32.2			
32.1.3.	Application of Solubility Product	32.3			
32.1.4.	Application of Solubility Product in Qualitative Analysis of Cations	32.4			
32.2.	Hydrolysis	32.6			
32.2.1.	Degree of Hydrolysis and Hydrolysis Constants	32.7			
32.2.2.	Relation between the Hydrolysis Constant and Dissociation Constant	32.8			
32.2.3.	Methods for Determination of Degree of Hydrolysis	32.14			
	<i>Questions</i>	32.17			
	<i>Objective Type</i>	32.19			
	<i>Problems</i>	32.20			
	<i>Examination Questions</i>	32.22			
33.	Electromotive Force.....33.1				
33.1.	Concept of Electrochemical Cells	33.1			
33.1.1.	Half Cells	33.1			
33.1.2.	Electrode Potential and Electrolytic Concentration:				
	The Nernst Equation of Electrode Potential.....	33.2			
33.1.3.	Cell Diagrams and Terminology	33.3			
33.1.4.	Factors on which Electrode Potential Depends	33.4			
33.1.5.	Thermodynamic Explanation of the Electrochemical Potential	33.4			
33.1.6.	Thermodynamic Explanation of the Potential Difference at the Interfacial Boundaries.....	33.5			
33.1.7.	Thermodynamic Explanation of Electrode Potential.....	33.5			
33.1.8.	Single Electrode Potentials	33.6			
33.1.9.	Sign of Electrode Potential	33.7			
33.1.10.	Reversible and Irreversible Cells	33.8			
33.1.11.	Types of Electrodes.....	33.10			
33.2.	Standard Electrode Potential and <i>E.M.F.</i> of Cell	33.13			
33.2.1.	Determination of Standard Electrode Potential	33.13			
33.2.2.	Thermodynamic Concept of Electrode Potential	33.14			
33.2.3.	Standard Half-Cell Reduction Potentials at 25°C in Aqueous Solution	33.15			
33.2.4.	Some Uses of Electrode Potentials.....	33.19			
33.2.5.	Standard <i>E.M.F.</i> of the Cell	33.19			
33.2.6.	Measurement of <i>E.M.F.</i> : Poggendorff’s Compensation Method	33.22			
33.2.7.	The Standard Cell.....	33.22			
33.2.8.	Calculation of <i>E.M.F.</i> of Cell	33.23			
33.3.	Types of Electrochemical Cells.....	33.25			
33.3.1.	Chemical Cells	33.27			
33.3.2.	Concentration Cells.....	33.30			
33.3.3.	Applications of Concentration Cells.....	33.39			
33.4.	Applications of <i>E.M.F.</i> Measurements.....	33.40			
33.5.	Electrochemical Cells – The Source of Energy	33.63			
33.5.1.	Some Commonly Used Batteries	33.63			
33.5.2.	Fuel Cells	33.64			
33.6.	Irreversible Electrode Processes.....	33.65			
33.6.1.	Polarization	33.66			
33.6.2.	Decomposition Potential	33.67			
33.6.3.	Overvoltage.....	33.67			
33.6.4.	Corrosion.....	33.75			
33.6.5.	Passivity of Metals.....	33.79			

33.6.6. Polarography.....	33.79	<i>Objective Type</i>	33.102
33.6.7. Amperometric Titrations.....	33.94	<i>Problems</i>	33.104
<i>Questions</i>	33.97	<i>Examination Questions</i>	33.105

UNIT-VIII: STRUCTURE OF MOLECULES

34. Physical Properties and Chemical Constitution	34.3	34.4.4. Applications of Magnetic Susceptibilities	34.45
34.1. What are the Physical Properties.....	34.3	<i>Questions</i>	34.46
34.1.1. Four Classes of Physical Properties	34.3	<i>Objective Type</i>	34.48
34.1.2. Physical Properties and Chemical Constitution	34.4	<i>Problems</i>	34.49
34.1.3. Influence of Pressure and Temperature on Physical Properties	34.5	<i>Examination Questions</i>	34.51
34.2. Some Important Physical Properties Elucidating Molecular Structure	34.5	35. Spectroscopy	35.1
34.2.1. Molar Volumes.....	34.5	35.1. The Electromagnetic Spectrum	35.1
34.2.2. Parachor	34.6	35.1.1. Electromagnetic Radiations	35.1
34.2.3. Refractive Index.....	34.11	35.1.2. Different Regions in Electromagnetic Spectrum	35.3
34.2.4. Viscosity and Constitution	34.17	35.1.3. Absorption Spectroscopy	35.3
34.2.5. Optical Activity and Chemical Constitution	34.18	35.1.4. Molecular Energies	35.5
34.3. Electric Properties Elucidating the Molecular Structure	34.20	35.1.5. Measurement of the Amount of Light Absorbed	35.6
34.3.1. Dipole Moments.....	34.20	35.1.6. Mechanism of Interaction of Radiation with Materials.....	35.6
34.3.2. Electrical Polarization of Molecules.....	34.22	35.2. Molecular Spectra.....	35.8
34.3.3. Dipole Moments and Dielectric Constant.....	34.23	35.2.1. Molecular Rotation	35.9
34.3.4. Dielectric Polarization and Dielectric Constant.....	34.24	35.2.2. Types of Molecular Spectra	35.9
34.3.5. Determination of Dielectric Constant, ϵ_r	34.30	35.2.3. Rotational Spectra of Diatomic Molecules (Microwave Spectra) – Rigid Rotator.....	35.11
34.3.6. Determination of Dipole Moments	34.31	35.2.4. Vibrational Spectra (Near Infrared Spectra)	35.24
34.3.7. Molar Refraction and Molar Polarization : Dependence of Polarizability on Frequency	34.31	35.2.5. Simultaneous Rotation and Vibration in Molecules – Diatomic Vibrating Rotator.....	35.37
34.3.8. Bond Moments and the Molecular Dipole Moment	34.33	35.2.6. Electronic Spectra	35.48
34.3.9. Dipole Moments and Molecular Structure	34.35	35.2.7. Light Scattering and Raman Spectroscopy	35.53
34.3.10. Group Moments	34.36	35.2.8. Magnetic Resonance Spectroscopy	35.60
34.4. Magnetic Properties of Molecules.....	34.37	<i>Questions</i>	35.93
34.4.1. Magnetic Permeability	34.37	<i>Objective Type</i>	35.98
34.4.2. Theories of Diamagnetism and Paramagnetism.....	34.39	<i>Problems</i>	35.99
34.4.3. Measurement of Magnetic Susceptibility.....	34.44	<i>Examination Questions</i>	35.100
		36. Macromolecules	36.1
		36.1. Macromolecules – A Class of Molecular Colloids	36.1
		36.1.1. Polymers – A Class of Macromolecules.....	36.1
		36.1.2. Bio-polymers or Bio-colloids.....	36.10
		36.1.3. Association Colloids	36.12

36.2. Macromolecules in Solutions36.13	36.2.3. Stereochemistry of Macromolecules in Solution36.39
36.2.1. Molar Masses of Macromolecules36.13	36.2.4. Functional Polymers36.47
36.2.2. Determination of Molar Masses of Macromolecules36.16	<i>Questions</i>36.52
	<i>Objective Type</i>36.53
	<i>Problems</i>36.54
	<i>Examination Questions</i>36.55

UNIT-IX: THERMODYNAMICS-II

37. Irreversible Thermodynamics.....37.3	38. Statistical Thermodynamics38.1
37.1. From the Equilibrium to the Non-Equilibrium Thermodynamics.....37.3	38.1. From Microscopic Properties to Macroscopic Properties38.1
37.1.1. Thermodynamic- Phenomenological Theory of Irreversible Processes37.4	38.1.1. Statistical Mechanics: Postulates38.2
37.1.2. Looking Back to Look Forward : Fundamentals of Thermodynamics.....37.4	38.1.2. Statistical Probability38.2
37.2. Laws of Thermodynamics37.5	38.1.3. Phase Space.....38.3
37.2.1. Energy and Heat (First Law of Thermodynamics)37.5	38.1.4. What do the Microstate and Macrostate tell us?38.4
37.2.2. Entropy and Absolute Temperature (Second Law of Thermodynamics)37.10	38.1.5. System, Assembly and Ensemble.....38.4
37.3. Equilibrium and Stationary States.....37.21	38.1.6. Liouville's Theorem38.6
37.3.1. Equilibrium in Homogeneous Systems37.23	38.1.7. Statistical Equilibrium38.9
37.3.2. Equilibrium in Heterogeneous Systems37.24	38.1.8. Entropy and Probability38.9
37.3.3. Equilibrium in Continuous Systems37.25	38.1.9. Entropy is a Function of the Probability of the Thermodynamic State38.10
37.4. From the Equilibrium to the Non-Equilibrium States.....37.27	38.2. Distribution of Particles Among Energy States38.12
37.4.1. Conservation of Energy in Open System37.29	38.2.1. Classical Distribution Law : Maxwell-Boltzmann Statistics38.12
37.4.2. Entropy Flow and Entropy Production in Open Systems...37.31	38.2.2. Partition Functions and Thermodynamic Functions ...38.31
37.4.3. Phenomenological Equations.....37.35	38.2.3. Solved Problems38.41
37.4.4. Entropy Production due to Diffusion in Systems at Uniform Temperature.....37.43	38.3. Looking Back to Look Forward : Quantum Statistics.....38.43
37.4.5. Entropy Production due to Diffusion in Systems at Non-uniform Temperature37.45	38.3.1. Bose-Einstein Statistics.....38.44
37.4.6. Entropy Production due to Viscosity.....37.47	38.3.2. Fermi-Dirac Statistics38.51
37.4.7. Electrokinetic Effects.....37.48	38.3.3. Comparison Amongst Maxwell- Boltzmann, Bose-Einstein and Fermi-Dirac Statistics38.62
<i>Questions</i>37.51	38.3.4. Solved Problems38.63
<i>Examination Questions</i>37.53	<i>Questions</i>38.64
	<i>Objective Type</i>38.68
	<i>Problems</i>38.70
	<i>Examination Questions</i>38.71
	Appendix A.1-A.6
	Index I.1-I.12

Salient Features of the Revised Edition of the Book

- ❑ The book has been designed to incorporate the guidelines of the New Education Policy (NEP) - 2020 and the Choice-Based Credit System (CBCS) to ensure that the content aligns with the latest educational standards.
- ❑ The subject matter has been organized to enhance the understanding and enable the readers to navigate through the concepts easily.
- ❑ To ensure uniformity and accuracy, International System of Units has been used throughout the book.
- ❑ Emphasis is placed on explaining the fundamental concepts, principles and applications to develop strong foundation in the topic.
- ❑ The book includes a number of solved examples integrated into the text to provide students multiple opportunities to apply the topics.
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