According to the Latest Syllabus

Sanjiv®

Chemistry

Class-11 (Part-I)

For the Students of Rajasthan Board of Secondary Education

By

Dr. K. B. Bansal
M.Sc., M.Phil., Ph.D.
Assistant Professor,
Department of Chemistry
Govt. P.G. College, Dausa

Nidhi Agrawal
M.Sc., B.Ed.

Price : ₹ 440/-

Sanjiv Prakashan, Jaipur

- Publisher :
  Sanjiv Prakashan
  Dhamani Market, Chaura Rasta,
  Jaipur-3
  email : sanjeevprakashanjaipur@gmail.com
  website : www.sanjivprakashan.com

- Laser Typesetting :
  Sanjiv Prakashan (DTP Department), Jaipur

- Printer :
  Manohar Art Printer, Jaipur
  *****

Preface

We are extremely pleased to present this book according to latest syllabus of NCERT. The book has been written in easy and simple language so that students may assimilate the subject easily. We hope that students will get benefitted from it and teachers will appreciate our efforts. In comparison to other books available in market, this book has many such features which make it a unique book :

1. Theoretical subject-material is given in adequate and accurate description along with pictures.
2. The latest syllabus of NCERT is followed thoroughly.
3. Complete solutions of all the questions given at the end of the chapter in the textbook are given in easy language.
4. Topic wise summary is also given in each chapter for the revision of the chapter.
5. In every chapter, all types of questions that can be asked in the exam (Objective, Fill in the blanks, Very short, Short, Numerical and Long answer type questions) are given.
6. At the end of every chapter, multiple choice questions asked in various competitive exams are also given with solutions.

Valuable suggestions received from subject experts, teachers and students have also been given appropriate place in the book.

We wholeheartedly bow to the Almighty God, whose continuous inspiration and blessings have made the writing of this book possible.

We express our heartfelt gratitude to the publisher – Mr. Pradeep Mittal and Manoj Mittal of Sanjiv Prakashan, all their staff, laser type center and printer for publishing this book in an attractive format on time and making it reach the hands of the students.

Although utmost care has been taken in publishing the book, human errors are still possible, hence, valuable suggestions are always welcome to make the book more useful.

In anticipation of cooperation!

Authors
Dr. K. B. Bansal
Nidhi Agrawal

Contents

SOME BASIC CONCEPTS OF CHEMISTRY

CHAPTER 1

Chapter Overview

Introduction : Chemistry is related to the composition structure of matter and its properties, which can be understood well through the constituent fundamental particles (atoms and molecules) of matter. For this reason, chemistry is considered to be the science of atoms and molecules. Can particles be seen, their mass determined and their presence felt? Can the number of atoms and molecules in a certain amount of a substance be determined or not and is there any quantitative relationship between the number of particles and their mass? We will find answers to all these questions in this chapter. Apart from this, here we will also explain how to represent the physical properties of a substance quantitatively with the help of appropriate units.

1.1 Importance of Chemistry

Due to the inquisitive nature of man, he has always been trying to know about the environment around him and the mysteries of nature, due to which his knowledge continuously increased. Therefore, it became necessary to study knowledge in a systematic manner. The systematization of knowledge available to man to understand and describe the mysteries of nature is called science.

For convenience, science has been classified into branches like physics, chemistry, biology, medical science and geology etc. The role of chemistry is more important in science, which is essentially linked to other branches of science. Chemistry plays an important role in daily life also. Chemistry is that branch of science in which the structure, properties and interactions of substances are studied.

The English translation of the word chemistry has been taken from the Greek word Chemia (Alchemy), because scientists working in the field of chemistry were called Chemiagar (Alchemists) in Arabic. Chemistry is mainly classified into the following branches :

(i) Inorganic Chemistry
(ii) Organic Chemistry
(iii) Physical Chemistry
(iv) Analytical Chemistry
(v) Industrial Chemistry

In organic chemistry, methods of making various inorganic compounds, methods of extraction of elements from ores and their properties and uses are studied.

Organic chemistry is the chemistry of hydrocarbons and their derivatives, whereas physical chemistry studies

the structure of matter and its physical properties. Chemistry is used in various fields, which are as follows :

(i) Agriculture : In the field of agriculture, the production of various fertilizers, pesticides and bactericides used to get good crops and seeds is the contribution of chemistry.

(ii) Medicine and Health : Various types of medicines used in medicine for human health have been obtained only through chemistry. Effective drugs used in the treatment of cancer like Cisplatin and Taxol and many life-saving drugs like Azidothymidine (AZT), used in the treatment of AIDS patients, have been obtained or synthesized from plant and animal sources through chemical veganism. The function of the thyroid gland is studied with the isotope of iodine.

(iii) In Daily Life : Chemistry plays an important role in providing food and other items of convenience to raise the standard of living of humans.

(iv) In the industries : Development of textile industry, dye and paint industry, soap industry, leather industry, sugar industry, plastic industry, glass and cement industry etc. has been possible only with the knowledge and use of chemistry. Similarly, the principles of chemistry are also used in manufacturing of alloys, electroplating, extraction of metals, photography etc.

(v) In the manufacture of specific materials : After knowing the principles of chemistry well, it has now become possible to synthesize materials with specific magnetic, electrical and optical properties, as a result of which materials like superconducting ceramics, conductive polymers and optical fibers can be synthesized.

(vi) In purification of the environment : In the last few years, with the help of science, some serious problems related to environmental pollution have been controlled to a great extent. For example, alternatives to substances like chlorofluoro carbons (CFCs) that deplete ozone in the stratosphere and are environmental pollutants have been synthesized, but many problems still pose a serious challenge to chemists. Similarly, management of greenhouse gasses like CH_4, CO_2 etc. is also a problem. The use of compressed natural gas to reduce air pollution caused by motor cars, buses and two–wheelers is also a contribution of chemistry.

(vii) For Biology : The principles of chemistry are used in various areas of biology, such as the functioning of the brain and the upward movement of minerals absorbed by the roots of plants, etc.

(viii) In the field of war : Materials necessary for war like – T.N.D., dynamide, atomic bomb, hydrogen bomb, cobalt bomb and poisonous gasses like mustard gas and chloropicrin are the gifts of chemistry but this is a destructive use of chemistry.

(ix) Other uses : Apart from the above areas, there are many areas in which the knowledge of chemistry is used. Such as meteorology, operation of computers, construction of aircraft, rockets and satellites etc.

Apart from various important uses of chemistry, it also has many distorted forms, which are harmful for human life. Like water and air pollution, due to which various diseases spread. An important problem in Rajasthan is the high amount of fluoride present in water, which causes many diseases related to bones and teeth. Chemistry is also used to remove this air and water pollution. Therefore, in summary it can be said that chemistry is helpful in the all-round development of man, but its misuse can also lead to man's destruction. So it depends on mankind as to how he uses it.

Understanding of biochemical processes, use of enzymes for industrial production of various chemicals and production of new exotic substances are some of the intellectual challenges for the future generations of chemists. To face these challenges, a developing country like India needs brilliant and creative chemists.

1.2 Nature of Matter

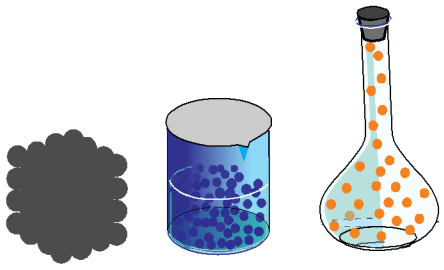
All the objects around us are made of matter, hence the things which have mass and which occupies space is called matter. **Example :** Pen, pencil, book, air, animals etc. Matter is formed up of small particles.

Classification of Matter : Matter is classified by two ways :

(i) On basis of physical state

(ii) On basis of composition

(i) On basis of physical state : On basis of physical state, matter is of three types—solid, liquid and gas. The constituents particles in these three states can be represented as follows :



Solid **Liquid** **Gas**

Fig. 1.1 : Arrangement of particles in solid, liquid and gaseous state

Solid : In solid state of matter, particles are held very close to each other and are arranged in orderly fashion and there is not much freedom of movement. Solids have definite volume and definite shape. They are generally hard and rigid having more density. **Example :** Common salt, wood, pen, pencil etc.

Liquid : In liquids, the constituent particles, are some far away in comparison to solid and they can move. The volume of liquid is definite but their shape is not definite and they obtain the shape of that container in which they are placed. The density of liquid is less than that of solid and the intermolecular force in them is less. Liquid also possess character of fluid and their molecules are not arranged. In liquids the kinetic energy of molecules is more than solids. **Example :** Oil, water, milk and alcohol.

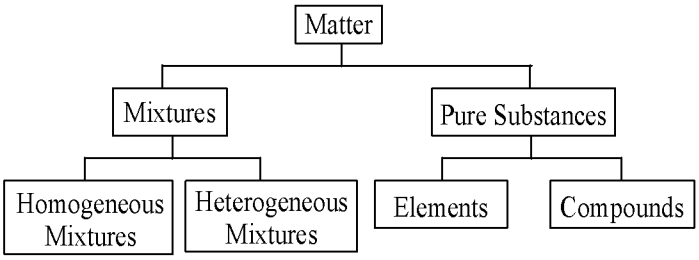
Gases : In comparison to solid and liquids the constituent particles are far away. They can move easily and fast. The shape and volume of gases are not definite and it can spread in that volume of container in which it is placed. Due to which the space between particles is more, hence their compressibility is high. In gases the molecular force between molecules is more and the kinetic energy between molecules is high. **Example :** Oxygen, nitrogen, carbon dioxide and air.

The physical state of matter is not definite, and by change in temperature and pressure its physical state can be changed. On heating solid it converts to liquid and on heating liquid it get converted to gaseous state. Oppositely on cooling gas it get converted to liquid and on cooling liquid it get converted to solid. **Example :**

$$\text{Solid} \underset{\text{cool}}{\overset{\text{heat}}{\rightleftharpoons}} \text{Liquid} \underset{\text{cool}}{\overset{\text{heat}}{\rightleftharpoons}} \text{gas}$$

$$\underset{\text{(solid)}}{\text{ice}} \underset{\text{cool}}{\overset{\text{heat}}{\rightleftharpoons}} \underset{\text{(liquid)}}{\text{water}} \underset{\text{cool}}{\overset{\text{heat}}{\rightleftharpoons}} \underset{\text{(gas)}}{\text{water vapour}}$$

(ii) On basis of composition : On basis of composition, matter is classified in mixture and pure substances, but again they are classified in sub groups which can be represented as follows :



Pure Substances : Constituent particles of pure substances have fixed composition and their constituents can't be separated by general physical methods. **Example :** Gold, silver, iron, water, sugar and glucose. In glucose, carbon, hydrogen and oxygen are in certain ratio. Pure substances can further be classified to elements and compounds.

Elements : Particles of an element consist of only one type of atoms. **Example :** Sodium, hydrogen, oxygen, silver and copper etc. These particles can have atom of same types but atoms of different elements are different from each other. Some of the elements like sodium or copper have single atom in it while other elements or more atom combine to form molecule. **Example :** In Hydrogen, Nitrogen and oxygen gases, molecules are present as they are formed from two atoms. Elements can be metal or non–metal.

Compounds : When two or more atoms of different elements combine together in a definite ratio, the molecule of a compound is obtained. Moreover, the constituents of a compound cannot be separated into simpler substances by physical methods. They can be separated by chemical methods. Examples of some compounds are water, ammonia, carbon dioxide, sugar, etc.

A water molecule comprises two hydrogen atoms and one oxygen atom. Similarly, a molecule of carbon dioxide contains two oxygen atoms combined with one carbon atom.

The properties of a compound are different from those of its constituent elements. For example, hydrogen and oxygen are gases, whereas, the compound formed by their combination i.e., water is a liquid. It is interesting to note that hydrogen burns with a pop sound and oxygen is a supporter of combustion, but water is used as a fire extinguisher.

Mixtures : Mixtures are the substances in which two or more than two substances can be present in any ratio and their composition can be different. Most of the products around us are mixtures.

Different constituents of mixture can be separated by different physical process, *i.e.* filtration, distillation, crystallisation etc. **Example :** Air, mixture of water and sugar, mixture of salt and sugar.

Mixture are of two types : Homogenous and Heterogenous.

Homogenous mixture : The constituents of homogenous mixture are completely miscible with each other and the composition of whole mixture is similar. **Example :** Solution of sugar in water, air and mixture of alcohol and water.

Heterogenous mixture : The composition of heterogenous mixture is not similar in whole mixture *i.e.* their composition is unequal and sometimes we can see their constituents separately.

Example : Salt and sugar, pulses and stone and mixture of oil and water.

1.3 Properties of Matter and their Measurement

Every substance has unique or characteristic properties. These properties can be classified in two categories : (i) Physical properties and (ii) Chemical properties.

(i) Physical properties : The properties which can be measured or observed without changing the identity or composition of the substance are called physical properties. **Example :** Colour, smell, melting point, boiling point, freezing point, viscocity and density etc.

(ii) Chemical properties : The measurement or observation of chemical properties requires a chemical change to occur and these properties are called chemical properties. **Example :** Acidity, Basicity, Combustion etc.

Many properties of matter such as length, area volume etc. have quantitative nature.

Measurement : Any quantitative observation or measurement is represented by a number followed by units in which it is measured. For example, length of a room can be represented as 5 m; here, 5 is the number and m denotes metre, the unit in which the length is measured.

Similarly for measuring weight we use kilogram and volume is measured in litre. The standard required to measure any quantity is the tendency of that quantity which is called the units. Earlier units were measured in three categories :

(i) CGS unit (cm. gram second) : In this unit, length is measured in centimetre, mass in gram and time in second.

(ii) MKS unit (meter kilogram second) : In this unit of measurement, length is measured in meter, mass in kilogram and time in second.

(iii) FPS unit (foot pound second) : In this unit of measurement foot is used for length, pound for mass and second for time.

Before 1960, two different systems of measurement were used in different parts of world. (i) English system and (ii) The metric system.

The metric system, which originated in France in late eighteenth century, was more convenient as it was based on the decimal system. Late, need of a common standard system was felt by the scientific community. Such a system was established in 1960 and is known as SI unit of measurement.

1.3.1 The international system of units (SI)

The international system of units was established by the 11th General Conference on weights and measures (CGPM from Conference Generale des poios et measures) which in French known as Lesystem international d' units.

The SI system has seven base units. These units pertain to the seven fundamental scientific quantities. The other physical quantities, such as speed, volume, density, etc., can be derived from these quantities.

Table : Base Physical Quantities and their Units

Base Physical Quantity	Symbol for Quantity	Name of SI Unit	Symbol for SI Unit
Length	l	metre	m
Mass	m	kilogram	kg
Time	t	second	s
Electric current	I	ampere	A
Thermodynamic temperature	T	kelvin	K
Amount of substance	n	mole	mol
Luminous intensity	I_v	candela	cd

Table : Derived SI Units

S.No.	Physical quantity	Unit	Symbol	SI Unit
1.	Pressure	Pascal	Pa	Nm^{-2} (newton per meter^2)
2.	Power	Watt	W	Js^{-1} (Joule per second)
3.	Work or energy	Joule	J	Nm or kgm^2s^{-2}
4.	Force	Newton	N	Nm or kgm^2s^{-2}
5.	Frequency	Hertz	υ	Hz or s^{-1}
6.	Electric resistance	Ohm	Ω	$kgm^2s^{-3}A^2$ or VA^{-1} (Volt per ampere)
7.	Electric voltage	Volt	V	$kgm^2s^{-3}A^{-1}$ or JC^{-1}
8.	Electric charge	Coulomb	C	As (ampere second)
9.	Area	Square meter	A	m^2
10.	Volume	Meter cube	V	m^3
11.	Density	Mass per unit volume	d	kgm^{-3}
12.	Velocity	Meter per second	v	ms^{-1}
13.	Acceleration	Velocity per second	a	ms^{-2}

To represent multiples or submultiples in SI system, prefixes are also used, by which any unit can be increased or decreased.

Multiple	Prefix	Symbol	Multiple	Prefix	Symbol
10	deca	da	10^{-1}	deci	d
10^2	hecto	h	10^{-2}	centi	c
10^3	kilo	k	10^{-3}	milli	m
10^6	mega	M	10^{-6}	micro	μ
10^9	giga	G	10^{-9}	nano	n
10^{12}	tera	T	10^{-12}	pico	p
10^{15}	peta	P	10^{-15}	femto	f
10^{18}	exa	E	10^{-18}	ato	a
10^{21}	zeta	Z	10^{-21}	zepto	z
10^{24}	yota	Y	10^{-24}	yokto	y

While using the SI units and symbols, following rules are followed :

(i) While representing any unit by a name of person its symbol is shown by capital letters. **Example :** 8 newton = 8N

(ii) After symbol of any unit, dot is not used. **Example :** 10 kg, not 10 kg

(iii) The unit is always written in singular form. **Example :** 5 second, not 5 seconds.

(iv) Never leave space between symbol of unit and prefixes.

(v) The units of derived quantities can be written in negative power. **Example :** Instead of meter/second (m/s), ms^{-1} is more appropriate to use.

Definitions of SI Base Units

(i) Length : Meter (m) is used as the unit of length. The distance covered by light in vaccum in a time of $\frac{1}{299,792,458}$ seconds is one meter (seventeenth CGPM 1983).

(ii) Mass : The unit of mass is kilogram (kg). It is considered equal to the international standard kilogram mass (3rd CGPM 1901).

(iii) Time : The unit of time is second (s). One second is the duration of 91 92 631 770 cycles of radiation corresponding to the transition between two hyperfine levels of ground states of cesium – 133 atom. (Thirteenth CGPM 1967).

(iv) Electric current : The unit of electric current is ampere (A). An ampere is a constant electric current which when flow between two straight parallel conductors of infinite length and negligible circular cross section, located at distance of 1 meter in vaccum, produces a force of 2×10^{-7} newton per meter length 9th (CGPM 1948).

(v) Thermodynamic temperature : The SI unit of temperature is Kelvin (K). The thermodynamic temperature $\frac{1}{273.16}$ part of triple point of water is called Kelvin. (Thirteenth C.G.P.M. 1967).

(vi) Amount of substance : The unit of amount of substance is mole. The amount of substance in a system is equal to one mole, in which number of fundamental particles is same as number of atoms present in 0.012 kg of carbon–12. Its symbol is mole. When mole is used, the fundamental particles (atoms, molecules, ions and electrons etc) should be indicated. (Fourteenth CGPM 1971)