

NEERAJ[®]

CHEMISTRY

N-313

**Chapter wise Reference Book
Including Many Solved Sample Papers**

Based on

N.I.O.S. Class – XII
National Institute of Open Schooling

By :
Raksha Nagdeva, M.Sc.



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Based on: NATIONAL INSTITUTE OF OPEN SCHOOLING – XII

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**Sample Preview
of the
Solved
Sample Question
Papers**

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Solved Sample Paper - 1

Based on NIOS (National Institute of Open Schooling)

Chemistry - XII

Time : 3 Hours]

[Maximum Marks : 100

- Note :** (i) All questions are compulsory.
 (ii) Marks allotted are indicated against each question.
 (iii) Each question from Question Nos. 1 to 10 has four alternatives: (A), (B), (C) and (D) out of which one is most appropriate. Choose the correct answer among the four alternatives and write it in your answer-book against the number of the question. No separate time is allotted for attempting multiple choice questions.

Q. 1. The shape of the orbital with value $l = 0$ is:
 (a) Spherical (b) Dumb-bell
 (c) Cloverleaf (d) Square planar

Ans. (a) Spherical.

Q. 2. A cricket ball of 0.5 kg is moving with a velocity of 100 ms^{-1} . The wavelength associated with its motion is:

(Given : $h = 6.6 \times 10^{-34} \text{ kg m}^2\text{s}^{-1}$)
 (a) $1/100 \text{ cm}$ (b) $6.6 \times 10^{-34} \text{ m}$
 (c) $1.32 \times 10^{-35} \text{ m}$ (d) $6.6 \times 10^{-28} \text{ m}$

Ans. (c) $1.32 \times 10^{-35} \text{ m}$.

Q. 3. The internal resistance to flow of the liquid is called is:

(a) Viscosity (b) Surface tension
 (c) Compressibility (d) Refraction index

Ans. (a) Viscosity.

Q. 4. The compressibility factor of an ideal gas is:

(a) 0 (b) 1
 (c) 2 (d) 4

Ans. (b) 1.

Q. 5. The highest pH value is of:

(a) 0.1 M NaCl (b) 0.1 M NH_4Cl
 (c) 0.1 M CH_3COON (d) 0.1 M $\text{CH}_2\text{COONH}_4$

Ans. (c) 0.1 M CH_3COON .

Q. 6. The standard electrode potential E° for the half reaction are as:



(a) -0.35 V (b) $+0.35 \text{ V}$
 (c) $+1.17 \text{ V}$ (d) -1.17 V

Ans. (b) $+0.35 \text{ V}$.

Q. 7. Which one of the following is the strongest acid?

(a) HClO_1 (b) HClO_2
 (c) HClO_3 (d) HClO_4

Ans. (d) HClO_4 .

Q. 8. Which of the following is not coloured?

(a) Mn^{3+} (b) Cr^{3+}
 (c) Se^{3+} (d) Tl^{3+}

Ans. (c) Se^{3+} .

Q. 9. Among the following compounds, the most reactive towards electrophilic nitration is:

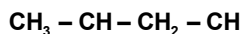
(a) Benzoic acid (b) Nitrobenzene
 (c) Toluene (d) Benzene

Ans. (c) Toluene.

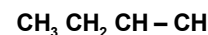
Q. 10. The aldol condensation of acetaldehyde results in the formation of:



(a) $\begin{array}{c} \parallel \quad | \\ \text{O} \quad \text{OH} \end{array}$

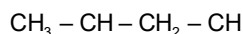


(b) $\begin{array}{c} | \quad \quad \parallel \\ \text{OH} \quad \quad \text{O} \end{array}$



(c) $\begin{array}{c} | \quad \quad \parallel \\ \text{OH} \quad \quad \text{O} \end{array}$

(d) $\text{CH}_3 \text{ CH}_2 \text{ OH} + \text{CH}_3 \text{ COOH}$



Ans. (b) $\begin{array}{c} | \quad \quad \parallel \\ \text{OH} \quad \quad \text{O} \end{array}$

Q. 11. In an experiment 5.0g of CaCO_3 on heating gave 2.8g CaO 2.2 g CO_2 . Show that these results are in accordance with the law of conservation of mass.

Solved Sample Paper - 2

Based on NIOS (National Institute of Open Schooling)

Chemistry – XII

N-313

Time : 3 Hours

Maximum Marks : 100

Note : (i) This question paper consists of 43 questions in all. (ii) All questions are compulsory. (iii) Marks are given against each question. (iv) Use log tables if necessary. (v) Section-A consists of: (a) Question Nos. 1 to 16 – Multiple Choice Type Questions (MCQs) carrying 1 mark each. Select and write the most appropriate option out of the four options given in each of these questions. An internal choice has been provided in some of these questions. You have to attempt only one of the given choices in such questions. (b) Question Nos. 17 to 28 – Objective Type Questions carrying 2 marks each. Attempt these questions as per the instructions given for each. (vi) Section-B consists of: (a) Question No. 29 to 37 – Very Short Answer Type Questions carrying 2 marks each and to be answered in the range of 30 to 50 words. (b) Question No. 38 to 41 – Short Answer Type Questions carrying 3 marks each and to be answered in the range of 50 to 80 words. (c) Question No. 42 and 43 – Long Answer Type Questions carrying 5 marks each and to be answered in the range of 80 to 120 words.

SECTION-A

Q. 1. How many particles are there in one mole?

- (a) 6.023×10^{23} (b) 6.023×10^{21}
(c) 6.023×10^{22} (d) 6.023×10^{23}

Ans. (d) 6.023×10^{23} .

Q. 2. (a) Who proposed the model of the atom that describes a nucleus surrounded by electrons?

- (a) Maxwell (b) Bohr
(c) Rutherford (d) De Broglie

Ans. (c) Rutherford.

OR

A cricket ball of 0.5 kg is moving with a velocity of 100 ms^{-1} . The wavelength associated with its motion is:

(Given: $h = 6.6 \times 10^{-34} \text{ kg m}^2\text{s}^{-1}$)

- (a) $1/100 \text{ cm}$ (b) $6.6 \times 10^{-34} \text{ m}$
(c) $1.32 \times 10^{-35} \text{ m}$ (d) $6.6 \times 10^{-28} \text{ m}$

Ans. (c) $1.32 \times 10^{-35} \text{ m}$.

Q. 3. (a) How many vertical columns (groups) were there in Mendeleev's periodic table?

- (a) 7 (b) 8
(c) 9 (d) 10

Ans. (c) 9.

OR

The highest pH value is of:

- (a) 0.1 M NaCl (b) 0.1 M NH_4Cl
(c) 0.1 M CH_3COON (d) 0.1 M $\text{CH}_2\text{COONH}_4$

Ans. (c) 0.1 M CH_3COON .

Q. 4. What are the conditions favourable for the formation of an ionic bond?

- (a) Low ionization energy, high electron affinity, and large lattice energy

(b) High ionization energy, low electron affinity, and small lattice energy

(c) High ionization energy, high electron affinity, and large lattice energy

(d) Low ionization energy, low electron affinity, and large lattice energy

Ans. (a) Low ionization energy, high electron affinity, and large lattice energy.

Q. 5. What determines whether a substance is considered a gas at room temperature?

- (a) Its melting point (b) Its boiling point
(c) Its density (d) Its volume

Ans. (b) Its boiling point.

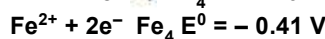
Q. 6. What is polymorphism in solids?

- (a) The ability of a solid to conduct electricity.
(b) The existence of a solid in one or more crystalline forms.
(c) The ability of a solid to change into a gas.
(d) The process of a solid melting into a liquid.

Ans. (b) The existence of a solid in one or more crystalline forms.

OR

The standard electrode potential E° for the half reaction are as:



- (a) -0.35 V (b) $+0.35 \text{ V}$
(c) $+1.17 \text{ V}$ (d) -1.17 V

Ans. (b) $+0.35 \text{ V}$.

Q. 7. What does Raoult's law state for a solution of volatile liquids?

Sample Preview of The Chapter

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CHEMISTRY

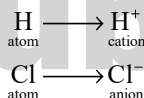
MODULE-I: SOME BASIC CONCEPTS OF CHEMISTRY

1

Atoms, Molecules and Chemical Arithmetic

INTRODUCTION

As we are aware, that atoms and molecules are so small that we cannot see them with our naked eyes or even with the help of a microscope. Atom is the smallest portion of an element which takes part in chemical reaction and it may or may not exist independently. Atoms having positive or negative charge is called ion. If the atom carries positive charge, it is called cation. If the atom carries negative charge it is called anion.



Molecule is the smallest portion of a substance which can exist independently.

In chemical reactions, atoms or molecules combine with one another in a definite number ratio. Therefore it would be pertinent if we could specify the total number of atoms or molecules in a given sample of substance.

We are aware that substances are composed of atoms, molecules or ions. Atoms and molecules are extremely small in size and mass such that one gram of substance contains many billion atoms, molecules and ions. Therefore it is not possible to count the actual number of atoms ions or molecules which take part in chemical reactions. Hence chemists decided to choose a number which can denote the number of atoms, molecules or ions in a certain quantity of the substance.

Mole can be expressed in terms of number. Just as a dozen stands for a bundle of 12 particles, in the

same way 'mole' stands for 6.023×10^{23} particles which may be atoms, molecules or ions. Since the number 6.023×10^{23} is called Avogadro number (N).

So, 1 mole = 6.023×10^{23} particles

Mole is also related to the mass of a substance. It has been found that one mole atom of any substance weight is equal to gram atomic weight, i.e. atomic weight expressed in grams.

Mole is also related to the volume of gaseous substances. It has been found out that one mole molecule of any gas occupy gram molar volume, under N.T.P. conditions i.e. 22.4 litres.

Every measurement compares a physical quantity to be measured with some fixed standard, known as the unit of measurement. In different countries different systems of measurement units have gradually developed. Every quantity needs a measurement to measure. That's why we express distance in kilometres, weight in kilograms, and time in hours. In earlier times many different units were used for the same quantities. For example, distance was expressed in mile, feet, furlong etc., weight was measured in pounds, seers, chataks, etc.

In 1960, the 'General Conference of Weight and Measures', the international authority on units proposed a new system which was based upon metric system. This system is called the 'international system of units' which is abbreviated as SI from its French name, 'Le System International' units.

Another useful quantity in chemistry is the molar mass which is the mass of one mole. The molar mass in grams of any atom is numerically equal to its relative atoms mass in 'amu'. In other words, the molar mass, in grams, is the mass of 6.01×10^{23} atoms.

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From this information it is easy to calculate the absolute mass of one atom. The molar mass in grams of any molecule is numerically equal to its relative molecular mass in amu. In this case the molar mass in grams is the mass of 6.02×10^{23} molecules. Ionic compounds can also be expressed in terms of molar masses. Molar mass of an ionic compound is the mass of its 6.023×10^{23} formula units. It can be obtained by adding the molar masses of ions present in the formula unit of the substance. If the molar mass of the substance is known, then the amount of substance present in a sample having definite mass can be calculated. Molar volume is the volume of one mole of a substance which depends upon temperature and pressure.

We know that hydrogen and oxygen atoms combine in the ratio of 1:8 and form water. From this example, we come to know that for the formation of molecules there is a combination of simple whole number ratios. For the study of chemical compounds and reactions in the laboratory, it is important to study **Stoichiometry**, that is quantitative relationship among compounds.

This is used to refer to all quantitative aspects of chemical compounds and reactions.

In this chapter, we will study about molecular and empirical formulae. Molecular formula shows the actual no. of atoms of different elements in a molecule of a compound. Empirical formula gives us relative no. of atoms of different elements. Empirical formulae is also called as simplest formulae. Molecular formula of a substance is always an integral multiple of its empirical formula for example, Empirical formula of glucose consists of carbon, hydrogen and oxygen in the ratio of 1:2:1. Molecular formula of a substance is always an integral multiple of its empirical formula. For example, fructose, $C_6H_{12}O_6$ contains atoms 6 times its empirical formula. Thus we come to know that molecular formula gives us actual no. of atoms of each element while empirical formula gives us only a ratio of atoms. For example, empirical formula of ethane is CH_3 and molecular formula is C_2H_6 .

To study a compound it is important to determine its formula. This can be done by analysing the compound in given mass for the amount of element, i.e. mass percentage in each compound.

Mass percentage of an element in a compound

$$= \frac{\text{Total mass of element}}{\text{Molar mass}} \times 100\%$$

One mole is the amount of a substance that contains as many particles or entities as there are atoms in exactly 12 g or (0.12 kg) of the ^{12}C isotope. The mass of one mole of substance in grams is called its molar mass.

i.e. molar mass of water = 18 g

Molar mass of sodium chloride = 58.5 g

We will read about microscopic and macroscopic quantitative information. 4 atoms of iron react with 3 molecules of oxygen to form two moles of iron oxide. This is the example of macroscopic quantitative reaction.

Microscopic information can be converted into macroscopic with the help of mole concept.

We know that one mole of any gas occupies. Volume of 22.7 L at STP. This can be used to know the volume relationship between gaseous substances.

When 2 molecules of hydrogen remove of and one of oxygen are mixed, water is formed. From this we come to know that substances which react with each other are not in the same proportion. Hydrogen is limiting reagent in this reaction as its no. becomes zero and reaction stops before the other reactant i.e. oxygen is utilized completely.

INTEXT QUESTIONS 1.1

Q. 1. Chemistry plays a vital role in many areas of science and technology. What are those areas?

Ans. Chemistry plays an important role in all aspects of our life. These all are health and medicine, energy and the environment, materials and technology and food and agriculture.

Q. 2. Who proposed the particulate nature of matter?

Ans. Leucippus and his student Democritus proposed the particulate nature of matter.

Q. 3. What is law of conservation of mass?

Ans. In every chemical reaction total masses of all the reactants is equal to the masses of all the products.

Q. 4. What is an atom?

Ans. An atom is extremely non-divisible small particles of matter and retains its identity during chemical reactions. Atom of one element is different from other element in its size and mass.

Q. 5. What is a molecule?

Ans. Molecule is an aggregate of at least two atoms in a definite arrangement held together with its chemical forces.

Q. 6. Why is the symbol of sodium Na?

Ans. The symbol of sodium Na is derived from the Latin name of sodium i.e. Natrium.

Q. 7. How is an element different from a compound?

Ans. An element comprises of atoms of one type only while a compound comprises atoms of two or more types combined in a simple but fixed ratio.

INTEXT QUESTIONS 1.2

Q. 1. Name the SI Unit of mass.

Ans. The SI unit of mass is kilogram (kg.)

Q. 2. What symbol will represent 1.0×10^{-6} g?

Ans. The symbol μg represent 1.0×10^{-6} g.

Q. 3. Name the prefixes used for

(i) 10^2 and (ii) 10^{-9}

Ans. (i) The prefix for 10^2 is *h*

(ii) The prefix for 10^{-9} is *n*

Q. 4. What do the following symbols represent?

(i) Ms (ii) ms

Ans. (i) Megasecond, 10^6 s

(ii) Millisecond, 10^{-3} s

INTEXT QUESTIONS 1.3

Q. 1. A sample of nitrogen gas consists of 4.22×10^{23} molecules of nitrogen. How many moles of nitrogen gas are there?

Sol. Moles of N_2 gas

$$= \frac{4.22 \times 10^{23} \text{ molecules}}{6.022 \times 10^{23} \text{ molecules mol}^{-1}}$$

$$= 0.70 \text{ mol}$$

Q. 2. In a metallic piece of magnesium, 8.46×10^{24} atoms are present. Calculate the amount of magnesium in moles.

Sol. Amount of magnesium (moles)

ATOMS, MOLECULES AND CHEMICAL ARITHMETIC / 3

$$= \frac{8.46 \times 10^{24} \text{ atoms}}{6.022 \times 10^{23} \text{ atoms mol}^{-1}}$$

$$= 14.05 \text{ mol}$$

Q. 3. Calculate the number of Cl_2 molecules and Cl atoms in 0.25 mol of Cl_2 gas.

$$\begin{aligned} \text{Sol. No. of } \text{Cl}_2 \text{ molecules in 0.25 mol of } \text{Cl}_2 \\ &= 0.25 \times 6.022 \times 10^{23} \text{ molecules} \\ &= 1.5055 \times 10^{23} \text{ molecules} \end{aligned}$$

Since each Cl_2 molecule has 2 Cl atoms, the number of Cl atoms

$$= 2 \times 1.5055 \times 10^{23}$$

$$= 3.011 \times 10^{23} \text{ atoms}$$

INTEXT QUESTIONS 1.4

Q. 1. Calculate the molar mass of hydrogen chloride, HCl.

$$\begin{aligned} \text{Sol. Molar mass of hydrogen chloride} \\ &= \text{molar mass of HCl} \\ &= 1 \text{ mole of H} + 1 \text{ mol of Cl} \\ &= 1.0 \text{ g mol}^{-1} + 35.5 \text{ g mol}^{-1} \\ &= 36.5 \text{ g mol}^{-1} \end{aligned}$$

Q. 2. Calculate the molar mass of argon atoms given that the mass of single atom is 6.634×10^{-26} kg.

$$\begin{aligned} \text{Sol. Molar mass of argon atom} \\ &= \text{mass of 1 mole of argon.} \\ &= \text{mass of } 6.022 \times 10^{23} \text{ atoms of argon} \\ &= 6.634 \times 10^{-26} \text{ kg} \times 6.022 \times 10^{23} \text{ mol}^{-1} \\ &= 39.95 \times 10^{-3} \text{ kg mol}^{-1} \\ &= 39.95 \text{ g mol}^{-1} \end{aligned}$$

Q. 3. Calculate the mass of 1.0 mol of potassium nitrate KNO_3 (atomic masses: K = 39 amu; N = 14 amu, O = 16 amu).

Sol. Molar mass of KNO_3 = mass of 1 mol of K + mass of 1 mol of N + mass of 3 mol of O.

Since molar mass of an element is numerically equal to its atomic mass, but has the unit of g mol^{-1} in place of amu.

$$= 39.1 \text{ g} + 14.0 \text{ g} + 3 \times 16.0 \text{ g}$$

\therefore Molar mass of KNO_3

$$= 39.1 \text{ g} + 14.0 \text{ g} + 48.0 \text{ g}$$

$$= 101.1 \text{ g mol}^{-1}$$

Q. 4. The formula of sodium phosphate is Na_3PO_4 . What is the mass of 0.146 mol of Na_3PO_4 ?

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(atomic masses: Na = 23.0 amu, P = 31.0 amu;
O = 16.0 amu)

Sol. Mass of 1 mole of Na_3PO_4
 $= 3 \times (\text{mass of 1 mol of Na}) + \text{mass of 1 mole of P} + 4 \times (\text{mass of 1 mol of oxygen})$
 $= 3 (23.0 \text{ g}) + 31.0 \text{ g} + 4 (16.0 \text{ g})$
 $= 69.0 \text{ g} + 31.0 \text{ g} + 64.0 \text{ g}$
 $= 164.0 \text{ g}$
 \therefore Mass of 0.146 mole of $\text{Na}_3\text{PO}_4 = 0.146 \times 164.0 \text{ g}$
 $= 23.94 \text{ g}$

INTEXT QUESTIONS 1.5

Q. 1. How many moles of Cu atoms are present in 3.05 g of copper (Relative atomic mass of Cu = 63.5).

Sol. Moles of Cu atoms in 3.05 g copper

$$= \frac{3.05 \text{ g}}{63.5 \text{ g mol}^{-1}}$$

$$= 0.048 \text{ mol}$$

Q. 2. A piece of gold has a mass of 12.6 g. How many moles of gold are present in it?

(Relative atomic mass of Au = 197)

Sol. Moles of gold,

$$\text{Au} = \frac{12.6 \text{ g}}{197 \text{ g mol}^{-1}}$$

$$= 0.064 \text{ mol}$$

Q. 3. In a combustion reaction of an organic compound, 2.5 mol of CO_2 were produced. What volume would it occupy at STP (273 K, 1 bar)?

Sol. Molar volume of any gas at STP

(273 K, 1 bar) = 22.7 L

\therefore Volume occupied by 2.5 mol CO_2 at

$$\text{STP} = 2.5 \times 22.7 \text{ L}$$

$$= 56.75 \text{ L}$$

INTEXT QUESTIONS 1.6

Q. 1. For the compound Fe_3O_4 , calculate percentage of Fe and O.

Sol. Molar mass of $\text{Fe}_3\text{O}_4 = 3 \times 56 + 4 \times 16$
 $= (168 + 64)$
 $= 232 \text{ g mol}^{-1}$

$$\text{Percentage of Fe} = \frac{168}{232} \times 100 = 72.41\%$$

$$\text{Percentage of O} = \frac{64}{232} \times 100 = 27.59\%$$

Q. 2. State per cent compositions of each of the following:

(a) C in SrCO_3 (b) SO_3 in H_2SO_4

Sol. (a) Molar mass of SrCO_3
 $= 87.6 + 12.0 + 48.0$
 $= 147.6 \text{ g mol}^{-1}$

Percentage of carbon C in SrCO_3

$$= \frac{12}{147.6} \times 100 = 8.13\%$$

(b) Molar mass of H_2SO_4

$$= 2.0 + 32.1 + 64.0$$

$$= 98.1 \text{ g mol}^{-1}$$

Molar mass of $\text{SO}_3 = 32.1 + 48.0$

$$= 80.1 \text{ g mol}^{-1}$$

Percentage of SO_3 in H_2SO_4

$$= \frac{80.1 \times 100}{98.1} = 81.65\%$$

Q. 3. What are the empirical formulae of substances having the following molecular formula?

H_2O_2 , C_6H_{12} , Li_2CO_3 , $\text{C}_2\text{H}_4\text{O}_2$, S_8 , H_2O , B_2H_6 , O_3 , S_3O_9 , N_2O_3 .

Ans.

Substance	Empirical Formula
H_2O_2	HO
C_6H_{12}	CH_2
Li_2CO_3	Li_2CO_3
$\text{C}_2\text{H}_4\text{O}_2$	CH_2O
S_8	S
H_2O	H_2O
B_2H_6	BH_3
O_3	O_3
S_3O_9	SO_3
N_2O_3	N_2O_3

Q. 4. A compound is composed of atoms of only two elements, carbon and oxygen. If the compound contain 53.1% carbon, what is its empirical formula?

Sol. Percentage of carbon = 53.1%
 Percentage of oxygen = 46.9%