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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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Mob.: 8510009872, 8510009878 E-mail: info@neerajbooks.com
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CHEMISTRY

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

(a) 1/100 cm *(b)* 6.6×10^{-34}m
(c) 1.32×10^{-35} m *(d)* 6.6×10^{-28}m

Ans. *(c)* 1.32×10^{-35}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 CH_2COONH_4

Ans. *(c)* 0.1 M CH_3COON.

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

$Zn^{2+} + 2e^- \rightarrow ZN_4$ $E^0 = -0.76$ V

$Fe^{2+} + 2e^- \rightarrow Fe_4$ $E^0 = -0.41$ V

(a) – 0.35 V *(b)* + 0.35 V
(c) + 1.17 V *(d)* – 1.17 V

Ans. *(b)* + 0.35 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) Mu^{3+} *(b)* Cr^{3+}
(c) Se^{3+} *(d)* Ti^{3+}

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

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

(a) Benzoie acid *(b)* Nitrobenzene
(c) Toluene *(d)* Benzene

Ans. *(c)* Toluene.

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

(a) $CH_3 - \underset{\underset{O}{\|}}{C} - \underset{\underset{OH}{|}}{CH} - CH_3$

(b) $CH_3 - \underset{\underset{OH}{|}}{CH} - CH_2 - \underset{\underset{O}{\|}}{CH}$

(c) $CH_3\ CH_2\ \underset{\underset{OH}{|}}{CH} - \underset{\underset{O}{\|}}{CH}$

(d) $CH_3\ CH_2\ OH + CH_3\ COOH$

Ans. *(b)* $CH_3 - \underset{\underset{OH}{|}}{CH} - CH_2 - \underset{\underset{O}{\|}}{CH}$.

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.

Ans. $CaCO_3 \rightarrow CaO + CO_2$
(5.0g) (2.8g) (2.2g)
2.8 + 2.2 = 5gm

Since the total mass of reactant and product is sum (= 5gm). It verifies the law of conservation of mass.

Q. 12. An oxide of Chromium is found to have the following % composition: 68.4% Cr and 31.6% Oxygen. Determine the empirical formula of the compound.

(Atomic mass of Cr = 52g mol^{-1} and O = 16 g mol^{-1}).

Ans. 68.4% = 68.4 g Cr.
31.6% = 31.6 gO

Given that Atomic mass of Cr = 52g/mol
Atomic mass of O = 16g/mol

$$\text{Moles of Cr} = \frac{68.4\text{ gm}}{52\text{ g/mol}} = 1.32 \text{ moles}$$

$$\text{Moles of O} = \frac{31.6\text{ gm}}{16\text{ g/mol}} = 1.98 \text{ moles}$$

For obtaining mole ratio, we divide each values of moles by smallest number of moles calculated

$$\text{For Cr} = \frac{1.32}{1.32} = 1$$

$$\text{For O} = \frac{1.98}{1.32} = 1.5$$

By converting the ratio into whole number ratio, we get

Cr : O = 2 : 3

$\therefore$ Empirical Formula = Cr_2O_3.

Q. 13. Calculate the uncertainty in position of an electron if the uncertainty in velocity is 5.7 × 10^5 ms^{-1}.

(h = 6.6 × 10^{-34} kg m^2 s^{-1})

Ans. Here, we are given: Δv = 5.7 × 10^{5}ms^{-1}
= 9.1 × 10^{-31} kg, h = 6.6 × 10^{-34} kgm^{2}s^{-1}

Substituting these values in the equation for uncertainty principle, i.e., $\Delta x \times (m \times \Delta v) = \frac{h}{4\pi}$, we have,

$$\Delta x = \frac{h}{4\pi \times m \times \Delta v}.$$

$$= \frac{6.6 \times 10^{-34}\ \text{kgm}^2\text{s}^{-1}}{4 \times \frac{22}{7} \times 9.1 \times 10^{-31}\text{kg} \times 5.7 \times 10^5 \text{ms}^{-1}}$$

$$= 1.0 \times 10^{-10}\text{m}$$

i.e., Uncertainty in position = $\pm$ 10^{-10}m.

Q. 14. Define half life period of a reaction. Express $t_{1/2}$ in terms of rate constant for first order reaction.

Ans. Ref.: See Chapter-14, Page No. 122, Q. No. 6.

Q. 15. Define standard enthalpy of formation. How is it different from standard enthalpy of reaction?

Ans. Standard Enthalpy of Formation: The enthalpy change when one mole of a pure compound is formed from its elements in their most stable states is called the enthalpy of formation. When the reacting elements and the products formed are all in their standard states, the enthalpy change accompanying the chemical reaction is called the standard enthalpy of formation and is denoted by $\Delta_f H^0$.

Standard Enthalpy of Reactions: Let as denote total enthalpy of reactants as $H_{reactants}$ and total enthalpy of products as $H_{products}$. The difference between these enthalpies, ΔH, is the enthalpy of the reaction

$\Delta_r H = H_{products} - H_{reactants}$

When substances are in their standard states, we call the enthalpy of reaction as standard enthalpy of reaction. It is defined as the enthalpy change for a reaction, when the reactants and the products are in their standard states. It is denoted by:

$\Delta_r H^0$.

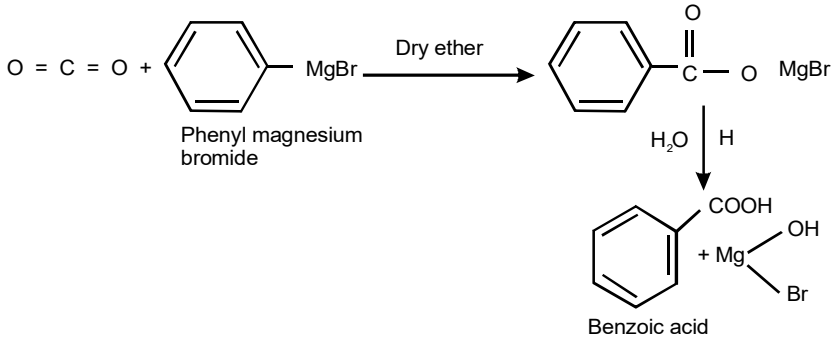
Q. 16. Which one is more stable Li_2CO_3 or Na_2CO_3? Justify your answer.

Ans. Lithium carbonate is less stable than sodium carbonate as L_i is less electropositive than sodium. As lithium carbonate is not stable to heat, it decomposes at lower temperature. Small sized L_i polarizes large carbonate ion which leads to formation of Li_2O and CO_2. Since, sodium carbonate is very stable, it decomposes at high temperature.

Q. 17. How will you carry out the following conversions:

***(i)* Phenyl magnesium bromide to benzoic acid**

Ans.



Sample Preview of The Chapter

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CHEMISTRY

MODULE-I: SOME BASIC CONCEPTS OF CHEMISTRY

Atoms, Molecules and Chemical Arithmetic

1

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.

$$\underset{\text{atom}}{H} \longrightarrow \underset{\text{cation}}{H^+}$$

$$\underset{\text{atom}}{Cl} \longrightarrow \underset{\text{anion}}{Cl^-}$$

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. Thats 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.

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 imporatant 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 farmula 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 mircroscopic 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 elements 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

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

$= 0.70$ 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)

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

$= 14.05$ mol

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

Sol. No. of Cl_2 molecules in 0.25 mol of Cl_2
$= 0.25 \times 6.022 \times 10^{23}$ molecules
$= 1.5055 \times 10^{23}$ molecules

Since each Cl_2 molecule has 2 Cl atoms, the number of Cl atoms
$= 2 \times 1.5055 \times 10^{23}$
$= 3.011 \times 10^{23}$ atoms

INTEXT QUESTIONS 1.4

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

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

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

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

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?

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

Sol. Mass of 1 mole of Na_3PO_4
= 3 × (mass of 1 mol of Na) + mass of 1 mole of P + 4 × (mass of 1 mol of oxygen)
= 3 (23.0 g) + 31.0 g + 4 (16.0 g)
= 69.0 g + 31.0 g + 64.0 g
= 164.0 g
∴ Mass of 0.146 mole of Na_3PO_4 = 0.146 × 164.0 g
= 23.94 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 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 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
∴ Volume occupied by 2.5 mol CO_2 at STP = 2.5 × 22.7 L
= 56.75 L

INTEXT QUESTIONS 1.6

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

Sol. Molar mass of Fe_3O_4 = 3 × 56 + 4 × 16
= (168 + 64)
= 232 g mol^{-1}

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

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 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 g mol^{-1}
Molar mass of SO_3 = 32.1 + 48.0
= 80.1 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, $C_2H_4O_2$, 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
$C_2H_4O_2$	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%