Class XI Session 2024-25
Subject - Chemistry
Sample Question Paper - 3

Time Allowed: 3 hours **Maximum Marks: 70**

General Instructions:

1. There are 33 questions in this question paper with internal choice.
2. SECTION A consists of 16 multiple-choice questions carrying 1 mark each.
3. SECTION B consists of 5 very short answer questions carrying 2 marks each.
4. SECTION C consists of 7 short answer questions carrying 3 marks each.
5. SECTION D consists of 2 case-based questions carrying 4 marks each.
6. SECTION E consists of 3 long answer questions carrying 5 marks each.
7. All questions are compulsory.
8. The use of log tables and calculators is not allowed

Section A

1. Which one of the following depends upon variations in temperature? **[1]**

   a) Both Normality and Molarity b) Normality

   c) Molarity d) Molality

2. According to quantum mechanics, $|\psi|^2$ (r) the wave function squared gives: **[1]**

   a) probability of finding an electron b) probability density of finding an electron

   c) probability density of finding a proton d) probability of finding a neutron

3. Which of the following always has a negative value? **[1]**

   a) Heat of reaction b) Heat of solution

   c) Heat of formation d) Heat of combustion

4. The electrons are ejected from the metal surface when the light of certain frequencies strikes the surface is called _____. **[1]**

   a) Faraday's cathode ray discharge model b) Thomson model for electron

   c) Photoelectric effect d) Planck's quantum theory

5. Choose the correct answer. A thermodynamic state function is a quantity: **[1]**

   a) used to determine pressure volume work. b) whose value depends on temperature only.

   c) used to determine heat changes. d) whose value is independent of path.

6. Give the number of electrons in the species, O_2 and O_2^+. **[1]**

   a) 32 and 16 b) 16 and 14

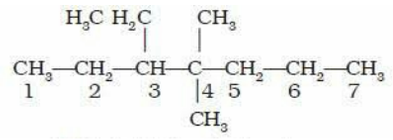
c) 16 and 8 d) 16 and 15

7. In Ostwald's process for the manufacture of nitric acid, the first step involves the oxidation of ammonia gas by oxygen gas to give nitric oxide gas and steam. What is the maximum weight of nitric oxide that can be obtained starting only with 10.00 g of ammonia and 20.00 g of oxygen? **[1]**

a) 15g of NO b) 20g of NO

c) 16g of NO d) 25g of NO

8. Which of the following is the correct IUPAC name of the given compound? **[1]**



a) 4, 4-Dimethyl-3-ethylheptane b) 4, 4-Bis(methyl)-3-ethylheptane

c) 3-Ethyl-4, 4-dimethylheptane d) 5-Ethyl-4, 4-dimethylheptane

9. Acetylene is prepared by the action of water on: **[1]**

a) all of these b) CaC_2

c) Silicon carbide d) Al_4C_3

10. The effective distance between the centre of the nucleus of an ion and the point up to which the nucleus has an influence on its electron cloud is called_____. **[1]**

a) ionic radius b) cationic radius

c) covalent radius d) anionic radius

11. Enthalpies of formation of CO(g), CO_2(g), N_2O(g), and N_2O_4(g) are -110, –393, 81, and 9.7 kJ mol^{-1} respectively. Find the value of $\Delta_r H$ for the reaction:$N_2O_4\,(g) + 3CO\,(g) \rightarrow N_2O\,(g) + 3CO_2\,(g)$ **[1]**

a) - 850 kJ b) -600 kJ

c) -778 kJ d) -802 kJ

12. Which of these is not a characteristic of Aromatic Hydrocarbons? **[1]**

a) Carbon atoms form a closed chain or ring. b) Carbon atoms form a an open chain.

c) They may contain double bonds. d) They are special type of cyclic compounds.

13. **Assertion (A):** Moving phase is liquid and stationary phase is solid in paper chromatography. **[1]**
Reason (R): Paper chromatography is used for analysis of polar organic compounds.

a) Both A and R are true and R is the correct explanation of A. b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false. d) A is false but R is true.

14. **Assertion (A):** Fluoride has the lowest and iodide has the highest boiling point. **[1]**
Reason (R): Boiling points of haloalkanes increases with increasing atomic mass.

a) Both A and R are true and R is the correct explanation of A. b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false. d) A is false but R is true.

15. **Assertion (A):** In case of isoelectronic ions the ionic size increases with the increase in atomic number. **[1]**

Reason (R): The greater the attraction of nucleus, greater is the ionic radius.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) Both A and R are false.

16. **Assertion (A):** The standard unit for expressing the mass of atoms is a.m.u. **[1]**

Reason (R): a.m.u. stands for mass of 1 atom of carbon.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

Section B

17. Mention the general characteristics of equilibria involving physical processes. **[2]**

18. What would be IUPAC names and symbols for elements with atomic numbers 122, 127, 135, 149 and 150? **[2]**

19. Determine the molecular formula of an oxide of iron in which the mass per cent of iron and oxygen are 69.9 and 30.1 respectively. **[2]**

20. Explain why the system are not aromatic. **[2]**

OR

Suggest a route to prepare ethyl hydrogensulphate (CH_3 - H_2 - OSO_2 - OH) starting from ethanol (C_2H_5OH).

21. Wavelengths of different radiations are given below: **[2]**

λ = (A) 300 nm

λ (B)= 300 μ m

λ (C)= 3 nm

λ (D) =30$\overset{o}{A}$

Arrange these radiations in the increasing order of their energies.

Section C

22. Predict the dipole moment of **[3]**

i. a molecule of the type AX_2 having a linear geometry.

ii. a molecule of the type AX_4 having tetrahedral geometry.

iii. a molecule of the type AX_2 having angular geometry.

iv. a molecule of the type AX_4 having square planar geometry.

23. **Answer:** **[3]**

(a) Define intensive properties. **[1]**

(b) One mole of acetone requires less heat to vaporise than 1 mole of water. Which of the two liquids has the higher enthalpy of vaporisation? **[1]**

(c) Define standard enthalpy. **[1]**

24. 221.4J is needed to heat 30g of ethanol from 15^0C to 18^0C. Calculate (a) specific heat capacity, and (b) molar heat capacity of ethanol. **[3]**

[3]

25. Depict the galvanic cell in which the reaction Zn (s) + $2Ag^+(aq) \longrightarrow Zn^{2+}(aq) + 2Ag(s)$ takes place, Further show:

i. which of the electrode is negatively charged,

ii. the carriers of the current in the cell, and

iii. individual reaction at each electrode.

26. The Balmer series in the hydrogen spectrum corresponds to the transition from $n_1 = 2$ to $n_2 = 3,4, ...$ This series lies in the visible region. Calculate the wave number of line associated with the transition in Balmer series when the electron moves to n= 4 orbit. ($R_H = 109677\ cm^{-1}$) **[3]**

27. Write characteristics of all seven periods of the periodic table. **[3]**

28. Calculate the amount of $KClO_3$ needed to supply sufficient oxygen for burning 112 L of CO gas at NTP. **[3]**

Section D

29. **Read the following text carefully and answer the questions that follow:** **[4]**

IUPAC (International Union of Pure and Applied Chemistry) system of nomenclature. Common names are useful and in many cases indispensable, particularly when the alternative systematic names are lengthy and complicated. A systematic name of an organic compound is generally derived by identifying the parent hydrocarbon and the functional group(s) attached to it. By using prefixes and suffixes, the parent name can be modified to obtain the actual name. In a branched-chain compound, small chains of carbon atoms are attached at one or more carbon atoms of the parent chain. The small carbon chains (branches) are called alkyl groups. An alkyl group is derived from a saturated hydrocarbon by removing a hydrogen atom from carbon. Abbreviations are used for some alkyl groups. For example, methyl is abbreviated as Me, ethyl as Et, propyl as Pr and butyl as Bu.

i. Draw the structure of 3-Ethyl-4,4-dimethylheptane. (1)

ii. How is the numbering in branched chain hydrocarbon done? (1)

iii. Derive the structure of 2-Chlorohexane. (2)

OR

Why CH_4 after becoming-CH_3 called a methyl group? (2)

30. **Read the following text carefully and answer the questions that follow:** **[4]**

The ionic character of metallic halides tends toward covalent nature as per Fajan's rule. Such covalent halides behave as non-metal in their higher oxidation states. The property to hydrolyse to give oxy-acids of the element and corresponding hydro halogen acid for most non-metallic elements proceeds exceptionally in the way, keeping oxidation number of element and halide sam in oxo-acids.

Non-polar halides are immiscible in water, as they do not show hydrolysis, but halides of some elements with empty d-orbital undergo hydrolysis. Stability of halides of the higher state is governed by the inert-pair effect.

i. How does halide undergo hydrolysis to give oxy-acids of underlined element PCl_3? (1)

ii. Out of NCl_3 and BCl_3 undergoes hydrolysis to form oxy-acids? Write the chemical reaction for the correct answer. (1)

iii. Out of $PbCl_4$, PbF_4, PbI_4 and $PbBr_4$ which one doesn't exist? (2)

OR

Non-Polar halides are immiscible in water. Why? (2)

Section E

31. **Attempt any five of the following:** **[5]**

(a) What happens when benzene is treated with acetyl chloride in presence of $AlCl_3$? **[1]**

(b) Write IUPAC name: $CH_3 - CH = CH - CH_2 - CH = CH - \underset{\underset{C_2H_5}{|}}{C}H - CH_2 - CH = CH_2$ **[1]**

(c) Classify the hydrocarbons according to the carbon-carbon bond. **[1]**

(d) Arrange the following: HCl, HBr, Hl, HF in order of decreasing reactivity towards alkenes. **[1]**

(e) Why is CH_2 = CH - CH_2 - Cl more easily hydrolysed than CH_3 - CH_2 - CH_2 - Cl? **[1]**

(f) Which of the two trans-but-2-ene or trans-pent-2-ene is non-polar? **[1]**

(g) What are benzenoids? **[1]**

32. K_1 and K_2 for dissociation of H_2S are 4×10^{-3} and 1×10^{-5}. Calculate sulphide ion concentration in 0.1 M H_2S solution. **[5]**

OR

Calculate the degree of ionization of 0.05 M acetic acid if its pK_a value is 4.74. How is the degree of dissociation affected when its solution also contains

a. 0.01 M

b. 0.1 M HCl?

33. **Answer:** **[5]**

(a) i. Which bond is more polar in the following pairs of molecules: **[2.5]**

a. H_3C-H, H_3C-Br

b. H_3C-NH_2, H_3C-OH

c. H_3C-OH, H_3C-SH

ii. Explain the principle of paper chromatography. **[2.5]**

OR

i. Write the IUPAC names of the compounds (i)-(iv) from their structures **[2.5]**

i. $CH_3 - CH_2 - \underset{\underset{OH}{|}}{CH} - CH_2 - CH_2 - \underset{\underset{CH_3}{|}}{CH} - CH_2 - CH_3$

ii. $CH_3 - CH_2 - \overset{\overset{O}{||}}{C} - CH_2 - \overset{\overset{O}{||}}{C} - CH_3$

iii. $CH_3 - \overset{\overset{O}{||}}{C} - CH_2 - CH_2 - CH_2 - COOH$

iv. CH ≡ C - CH = CH - CH ≡ CH_2

ii. Draw the resonance structures of the following compounds: **[2.5]**

i. $CH_2 = CH - \ddot{\underset{\cdot\cdot}{\underset{\cdot\cdot}{Cl}}}:$

ii. CH_2 = CH — CH = CH_2

iii. $CH_2 = CH - \underset{\underset{H}{|}}{C} = O$

Solution

Section A

1. **(a)** Both Normality and Molarity
   Explanation: Since Molarity and Normality both the modes of expression to represent the strength of a solution are volume-dependent, a variation in temperature of the solution results in a change in concentration or strength of the solution. It is due to the thermal expansion of liquids.

2. **(b)** probability density of finding an electron
   Explanation: The probability density of finding an electron at a point within an atom, predicts the region around the nucleus where the electron can most probably be found.

3. **(d)** Heat of combustion
   Explanation: Combustion is an exothermic process. Hence heat of combustion has a negative value.

4. **(c)** Photoelectric effect
   Explanation: Electrons are ejected from the metal when the light of a certain frequency strikes the surface of a metal, This phenomenon is known as the photoelectric effect and the ejected electrons are called photoelectrons.

5. **(d)** whose value is independent of path.
   Explanation: A state function value depends only on the state of the system and is independent of path.

6. **(d)** 16 and 15
   Explanation: There are 8 protons in a single atom of oxygen and 8 neutrons. Thus, a molecule of oxygen (O_2) would contain 16 of each. To gain + charge it must have to loose one electron. So number of electrons in O_2^+ = 16-1=15.

7. **(a)** 15g of NO
   Explanation: The reaction that takes place in ammonia and oxygen is given below:
   $\underset{68g}{4NH_3} + \underset{160g}{5O_2} \rightarrow \underset{120g}{4NO} + 6H_2O$
   Limiting reagent
   160g of oxygen reacts with 68g of ammonia
   20g of oxygen reacts with $\frac{68\times20}{160}$ = 8.5g of ammonia
   Therefore for 20g of oxygen 8.5g of ammonia is used. Therefore 1.5g ammonia is in excess and therefore oxygen is the limiting reagent.
   160 g of O_2 produces = 120g of NO
   Therefore, 20 g of O_2 produces= $\frac{120\times20}{60}$ = 15 g of NO.

8. **(c)** 3-Ethyl-4, 4-dimethylheptane
   Explanation: In IUPAC name, functional groups are written in alphabetical order. Locant 3 is assigned to ethyl group and the two methyl groups are present on C-4. The longest C chain has 7 C atoms so the IUPAC name is 3-ethyl-4,4-dimethylheptane.

9. **(b)** CaC_2
   Explanation: The reaction of CaC_2 (Calcium carbide) with water produces acetylene (C_2H_2).
   The chemical equation for the reaction of calcium\ carbide (CaC_2) with water to yield acetylene ($HC \equiv CH$) is
   $CaC_2 + H_2O \rightarrow CaO + C_2H_2$
   The calcium oxide (CaO) is formed as a byproduct, which simultaneously reacts with water to give $Ca(OH)_2$
   $CaO + H_2O \rightarrow Ca(OH)_2$

Thus, the overall reaction is,

$CaC_2 + 2H_2O \rightarrow C_2H_2 + Ca(OH)_2$

10. **(a)** ionic radius

Explanation: Since 'Ionic radius' is defined as the effective distance from the centre of the nucleus of an ion up to which it has an influence on its electron cloud. The correct answer is " ionic radius ".

The term Ionic radius is a general term used for both the cations as well as anions.

11. **(c)** -778 kJ

Explanation: Heat of reaction, Δ_rH = $\sum \triangle_r H_{products} - \sum \triangle_r H_{reactants}$

$\Rightarrow \Delta_r H$ = [$\Delta_f H$(N_2O) + 3$\Delta_f H$(CO_2)] - [$\Delta_f H$(N_2O_4) + 3$\Delta_f H$(CO)]

$\Rightarrow \Delta_r H$ = [81 + {3 $\times$ (-393)}] - 99.7 + {3 $\times$ (-110)}] kJ

$\Rightarrow \Delta_r H$ = -777.7 kJ $\approx$ -778 kJ

12. **(b)** Carbon atoms form a an open chain.

Explanation: Aromatic hydrocarbon is not an open chain. They are ring structures. they contain one or more benzene rings either fused or isolated in their molecules.

13. **(d)** A is false but R is true.

Explanation: Paper chromatography is a liquid-liquid partition chromatography in which the water adsorbed or chemically bond to cellulose of paper acts as the stationary phase while the mobile phase is another liquid which is usually a mixture of two or three solvents in which water is one of the components.

14. **(a)** Both A and R are true and R is the correct explanation of A.

Explanation: For a given halogen the boiling point rises with increasing atomic mass of the halogen, so that fluoride has the lowest boiling point and iodide has the highest boiling point.

15. **(d)** Both A and R are false.

Explanation: In case of isoelectronic ions, i.e., ions, having the same number of electrons and different nuclear charge, the size decreases with increase in atomic number.

Ion	**At. No.**	**No. of electrons**	**Ionic radii**
Na^+	11	10	0.95 $\overset{o}{A}$
Mg^{2+}	12	10	0.65 $\overset{o}{A}$
Al^{3+}	13	10	0.50 $\overset{o}{A}$

16. **(c)** A is true but R is false.

Explanation: A is true but R is false.

Section B

17. The general characteristics involving physical equilibria are

a. Equilibrium is possible only in a closed system at a given temperature.
b. Both the opposing processes occur at the same rate and there is a dynamic but stable condition.
c. All measurable properties of the system remain constant.
d. The magnitude of such quantities at any stage indicates the extent to which the physical process has proceeded before reaching equilibrium.

18. The roots 2, 7, 5, 9 and 0 are referred as bi, hept, pent, enn and nil respectively. Therefore, their names and symbol are

Z(Atomic number)	Name	Symbol
122	Unbibium	Ubb
127	Unbiseptium	Ubs

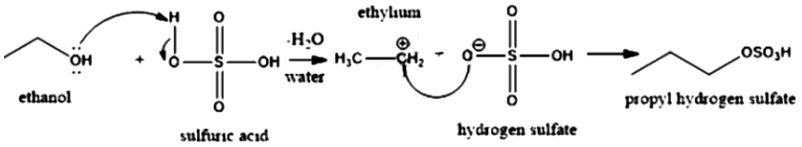
135	Untripentium	Utp
149	Unquadennium	Uqe
150	Unpentnilium	Upn

19. The mass per cent of iron (Fe) = 69.9 % (given)
The mass per cent of oxygen (O) = 30.1%, (given)
Number of moles of iron present in the oxide = [69.9 / 55.85]
Number of moles of oxygen present in the oxide = [30.1 / 16]
The ratio of iron to oxygen in the oxide, = 1.25 : 1.88
or, = (1.25 / 1.25) : (1.88 / 1.25)
= 1 : 1.5
So, a whole number ratio
= 2 : 3
hence, the empirical formula of the oxide is Fe_2O_3
The empirical formula mass of $Fe_2O_3 = 2 \times 55.85 + 3 \times 16.00$
$= 159.7 \text{ g mol}^{-1}$
$n = \frac{\text{Molar mass}}{\text{Empirical formula mass}}$
n = 159.69 g / 159.7g = 0.9999
= 1 (approx.)
The molecular formula of a compound is obtained by multiplying the empirical formula with this positive integer (n)
Thus, as per the empirical formula (Fe_2O_3) of the given oxide,
n = 1.
Hence, the molecular formula is same as empirical formula, Fe_2O_3
The molecular formula of the oxide is Fe_2O_3

20. For the given compound, the number of π-electrons is 8.
By Huckel's rule,
$\Rightarrow 4n + 2 = 8$
$\Rightarrow 4n = 6$
$\Rightarrow n = 3/2$
For a compound to be aromatic, the value of n must be an integer (n = 0, 1, 2…).
This is not true for the given compound as it is a fraction. Hence, it is not aromatic in nature.

OR

Ethanol when treated with sulphuric acid at around 140°C gives hydrogen sulphate. The reaction takes place as follows.



21. λ (A) = 300 nm = 300×10^{-9} m
λ (B)= 300 μ m = 300×10^{-6} m
λ (C)= 3 nm = 3×10^{-9} m
λ (D) =30$\mathring{A}$ = 3×10^{-9} m
We know that, $E \propto \frac{1}{\lambda}$.
Since, increasing order of wavelength is given as, 300 μm < 300 nm < 3 nm < 30$\mathring{A}$
Therefore, $\lambda(B) < (A) < \lambda(C) = \lambda(D)$

Section C

22. i. In AX_2 molecule with a linear geometry, the individual bond moments of A-X bonds will cancel being equal in magnitude and opposite in direction. This will cause the overall dipole moment of the molecule to be 0.
ii. In AX_4 molecule having tetrahedral geometry, the individual dipole moments of A-X bonds will cancel out being equal in magnitude and opposite in direction. This will cause the overall dipole moment of the molecule to be zero.

iii. In AX_2 molecule having angular geometry, the individual bond moments of A-X bonds will add up and thus the molecule will have a net non-zero dipole moment.

iv. In AX_4 molecule having square planar geometry the individual dipole moments of A-X bonds will cancel out being equal in magnitude and opposite in direction. This will cause the overall dipole moment of the molecule to be zero.

23. Answer:

(i) Properties which depend on the nature of the substance and not on the amount of the substance are called intensive properties.

(ii) Lesser the heat required to vaporise 1 mole of a liquid less is its enthalpy of vaporisation. Hence, water has a higher enthalpy of vaporisation.

(iii) **Standard enthalpy:** The standard enthalpy of reaction is the enthalpy change for a reaction when all the participating substances are in their standard states.

Standard conditions are denoted by adding the superscript $\ominus$ to the symbol ΔH, e.g., $\Delta H^{\ominus}$

24. According to the question, 221.4 J is needed to heat 30 g of ethanol from 15^0C to 18^0C.

a. We know that, Specific heat capacity = C = $\frac{\text{Heat absorbed by the substance}}{Mass \text{ of the substance} \times \text{Rise in temp.}}$

$= \frac{221.4J}{30g(18^0C - 15^0C)}$

$= \frac{221.4}{30\times 3} \text{Jg}^{-1} \circ C^{-1}$

= 2.46 Jg^{-1} $^oC^{-1}$

b. Molar heat capacity, C_m = specific heat × molar mass

= 2.46 × 46

= 113.2 $Jmol^{-1}$ $^oC^{-1}$

The molar heat capacity of ethanol is 113.2 J mol^{-1} $^oC^{-1}$.

25. i. The given redox reaction is ,

Zn (s) $2Ag^+$ (aq) $\longrightarrow$ Zn^{2+} (aq) + 2 Ag (s)

Since Zn (s) gets oxidized, to Zn^{2+} (aq) ions, and Ag^+ (aq) ions gets reduced to Ag (s) metal, therefore, oxidation occurs at the zinc electrode *(*acting as anode*)* and reduction occurs at the silver electrode (as cathode*)*. Thus, the galvanic cell corresponding to the above redox reaction is depicted as:

$Zn_{(s)} \mid Zn^{2+}$ (aq) $\parallel Ag^+$ (aq) $\mid Ag_{(s)}$

ii. a. Since oxidation occurs at the zinc electrode, therefore, electrons accumulate on the zinc electrode,/ anode. Hence, zinc electrode is negatively charged.

b. Electrons move from Zn anode to Ag cathode in the external circuit. Since the direction of current in the external circuit is opposite to that of the electrons so,

The carriers of current are silver cathode and Zinc anode through an external circuit in a direction from silver cathode to zinc anode.

c. The reactions occurring at the two electrodes are

At anode:

Zn (s) $\longrightarrow$ zn^{2+} (aq) + $2e^-$

At cathode

Ag^+ (aq) + e^- $\longrightarrow$ Ag (s)

26. From Rydberg formula,

Wave number, $\bar{v} = R_H \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$ cm^{-1} ; Where R_H = 109677 cm^{-1}

Here n_1 =2, n_2=4 (Transition in Balmer series)

$\bar{v} = 109677 \left[\frac{1}{2^2} - \frac{1}{4^2}\right] = 109677 \left[\frac{1}{4} - \frac{1}{16}\right]$ = 20564.44 cm^{-1}

27. First period is the shortest period of the periodic table. It contains 2 elements, $_1$H and $_2$He.

Second and third periods contain 8 elements each called short periods. The second period contain elements $_3$Li to $_{10}$Ne and $_{11}$Na to $_{18}$Ar.

Fourth and fifth period contains 18 elements each namely $_{19}$K to $_{36}$Kr and $_{37}$Rb to $_{54}$Xe and are long periods.

Sixth period contains 32 elements from $_{55}Cs$ to $_{86}Rn$ and is the longest period.

Seventh period is incomplete period. It has all other elements starting with $_{87}Fr$ onwards. Elements from 93 onwards are purely synthetic and are called trans–uranium elements and their properties have not been studied properly yet.

28. Burning of CO takes place in the presence of oxygen as represented by chemical equation:

$\underset{1mol}{CO} + \underset{0.5mol}{\frac{1}{2}O_2} \rightarrow \underset{1mol}{CO_2}$

Now, 1 mol of CO require O_2 = 0.5 mol

22.4 L of CO at NTP require O_2 = 0.5 mol

Therefore, 112 L of CO at NTP will require $O_2 = \frac{0.5}{22.4} \times 112 = 2.5\text{mol}$

This O_2 is to be obtained by heating $KClO_3$.

$\underset{2mol}{2KClO_3} \rightarrow 2KCl + \underset{3mol}{3O_2}$

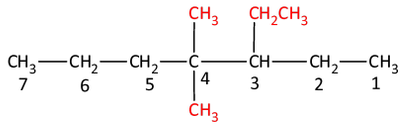
Molecular mass of $KClO_3$ = 1 × K +1 × Cl + 3 × O = 39 + 35.5 + 3 ×16 =39 +35.5 +48 = 122.5.

1 mol of O_2 is produced from = 2 mol of $KClO_3$

1 mol of O_2 is produced from = 2× 122.5 = 245 g of $KClO_3$.

3 moles of O_2 are produced from $KClO_3 = \frac{245 \times 2.5}{3} = 204.167\text{g}$.

Section D

29. i. 

ii. The numbering is done in such a way that the branched carbon atoms get the lowest possible numbers.

iii. 'Hexane' indicates the presence of 6 carbon atoms in the chain. The functional group chloro is present at carbon 2. Hence, the structure of the compound is $CH_2CH_2CH_2CH_2CH(Cl)CH_3$.

OR

CH_4 after becoming-CH_3 called a methyl group because an alkyl group is named by substituting 'yl' for 'ane' in the corresponding alkane.

30. i. $PCl_3 + 3H_2O \rightarrow H_3PO_3 + 3HCl$

ii. BCl_3 undergoes hydrolysis to form oxy-acids. The chemical reaction is as follows:

$BCl_3 + 3H_2O \rightarrow H_3BO_3 + 3HCl$

iii. PBI_4 doesn't exist because Pb^{4+} is strong oxidant, where as I^- is strong reductant.

OR

The non-polar halides are immiscible in water because it doesn't show hydrolysis but halides of some element with empty d-orbital undergo hydrolysis.

Section E

31. Attempt any five of the following:

(i) Acetophenone is formed.

(ii)

$$\overset{10}{CH_3} - \overset{9}{CH} = \overset{8}{CH} - \overset{7}{CH_2} - \overset{6}{CH} = \overset{5}{CH} - \underset{\underset{C_2H_5}{|}}{\overset{4}{C}}H - \overset{3}{CH_2} - \overset{2}{CH} = \overset{1}{CH_2}$$

(iii)Hydrocarbons are categorized into three categories according to the carbon-carbon bond that exists between them:

a. Saturated hydrocarbon (In which carbon-carbon single bond are present)

b. Unsaturated hydrocarbon (In which carbon-carbon double and triple bonds are present)

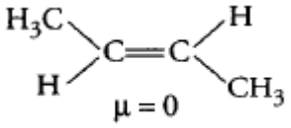
c. Aromatic hydrocarbon (In which alternate single and double bond and (4n+2)π electrons are present)

(iv)HI > HBr > HCl > HF

(v) Carbocation formed gets stabilised due to resonance.

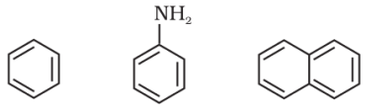
(vi)In trans-but-2-ene, the dipole moments of the two C—CH_3 bonds are equal and opposite and therefore, they cancel out each other.

Hence, trans-2-butene is non-polar.



(vii) **Benzenoids:** Aromatic hydrocarbon compound containing benzene ring are known as benzenoids.

Examples for benzenoids are:



Benzene Aniline Naphthalene

32. The first step of the dissociation of H_2S is

$H_2S \rightleftharpoons H^{\oplus} + HS^{\ominus}$

$K_1 = \frac{[H^{\oplus}][HS^{\ominus}]}{[H_2S]} = 4 \times 10^{-3}$

$[H^*] = C\alpha$, $[HS^{\ominus}]$ = Cα, [H2S] = C (1 - α)

$\therefore 4 \times 10^{-3} = \frac{C\alpha \cdot C\alpha}{C(1-\alpha)} = \frac{C\alpha^2}{(1-\alpha)}$

$4 \times 10^{-3} = \frac{0.1 \times \alpha^2}{(1-\alpha)}$ (1 - α should not be neglected)

or α = 0.18,

$\therefore [H^{\oplus}]$ = Cα = 0.1 0.18 = 0.018 M

$[HS^{\ominus}]$ = Cα = 0.1 $\times$ 0.18 = 0.018 M

[H2S] = C(1 - α) = 0.1(1 -0.18) = 0.082 M

Now, $HS^{\ominus}$ further dissociates to $H^{\oplus}$ and S^{2-};

$C_1 = [HS^{\ominus}]$ = 0.018 M

$HS^{\ominus} \rightleftharpoons H^{\oplus} + S^2$

1	0	0
(1 - α_1)	α_1	α_1

$\therefore K_2 = 1 \times 10^{-5} = 0.018$ and thus, dissociation of $HS^{\ominus}$ further suppresses due to common ion effect and 1 - $\alpha \approx 1$.

$\therefore$ 1 $\times$ 10-5 = $\frac{0.018 \times C_1\alpha_1}{C_1(1-\alpha_1)}$ = 0.018 $\times$ α_1

$\alpha_1 = \frac{1 \times 10^{-5}}{0.018} = 5.55 \times 10^{-4}$

$[S^{2-}] = C_1\alpha_1 = 0.018 \times 5.55 \times 10^{-4}$

$= 0.099 \times 10^{-4}$

OR

pK_a = - log K_a = 4.74

or log K_a = -4.74 = $\bar{5}.26$ $\therefore K_a = 1.82 \times 10^{-5}$

$\alpha = \sqrt{K_a/C} = \sqrt{(1.82 \times 10^{-5})/(5 \times 10^{-2})} = 1.908 \times 10^{-2}$

In presence of HCl, due to high concentration of H^+ ion, dissociation equilibrium will shift backward, i.e. dissociation of acetic acid will decrease.

a. In presence of 0.01 MHCl, if x is the amount dissociated, then

$CH_3COOH \rightleftharpoons CH_3COOH^- + OH^+$

Initial	0.05 M		
After disso.	0.05 – x	x	0.01 + x
	≃ 0.05		≃ 0.01 M

(0.01 M H^+ ions are obtained from 0.01 M HCl)

$\therefore K_a = \frac{x(0.01)}{0.05}$ or $\frac{x}{0.05} = \frac{K_a}{0.01} = \frac{1.82 \times 10^{-5}}{10^{-2}} = 1.82 \times 10^{-3}$

or $\alpha = 1.82 \times 10^{-3}$ $\left(\because \alpha = \frac{Amount\ dissociate\ d}{Amount\ taken}\right)$

The degree of ionization is $\alpha = 1.82 \times 10^{-3}$

b. In the presence of 0.1 M HCl, if y is the amount of acetic acid dissociated, then at equilibrium

$[CH_3COOH] = 0.05 - y \simeq 0.05M$

[CH_3COO^-] = y, $[H^+] = 0.1M + y \simeq 0.1M$

$K_a = \frac{y(0.1)}{0.05}$ or $\frac{y}{0.05} = \frac{K_2}{0.1} = \frac{1.82 \times 10^{-5}}{10^{-1}} = 1.82 \times 10^{-4}$ i.e.

$\alpha = 1.82 \times 10^{-4}$

The degree of ionization is $\alpha = 1.82 \times 10^{-4}$

33. Answer:

(i) i. a. CH_3–Br, since Br is more electronegative than H

b. H_3C–OH, since O is more electronegative than N.

c. H_3C–OH, since O is more electronegative than S.

ii. This is the simplest form of chromatography. Here a strip of paper acts as an adsorbent. It is based on the principle which is partly adsorption. The paper is made of cellulose fibres with molecules of water adsorbed on them. This acts as stationary phase. The mobile phase is the mixture of the components to be identified prepared in a suitable solvent.

OR

i. i. 6-methyl octan-3-ol,

ii. Hexane-2,4-dione,

iii. 5-oxohexanoic acid,

iv. Hexa-1, 3-dien-5-yne

ii. Resonance structure of the given compounds are as follows:

i. $CH_2 = CH - Cl \leftrightarrow {}^+CH_2 - CH = Cl^+$

ii. $CH_2 = CH - CH = CH_2 \leftrightarrow {}^+CH_2 - CH = CH \cdot CH_2^- \leftrightarrow CH_2 - CH = CH \cdot CH_2^+$

iii. $CH_2 = CH \cdot CHO \leftrightarrow {}^+CH_2 \cdot CH = CHO^-$