Class XI Session 2023-24
Subject - Chemistry
Sample Question Paper - 9

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. In a homogeneous mixture, **[1]**

   a) the components do not mix with each other and its composition is uniform throughout.

   b) the components completely mix with each other and its composition is uniform throughout.

   c) the components completely mix with each other and its composition is not uniform throughout.

   d) the components do not mix with each other and its composition is not uniform throughout.

2. de-Broglie equation is **[1]**

   a) $\lambda = \frac{hv}{m}$

   b) $\lambda = \frac{mv}{h}$

   c) λ = hmv

   d) $\lambda = \frac{h}{mv}$

3. The bond dissociation energies of H_2, Cl_2 and HCl are 104, 58 and 103 kcal mol^{-1} respectively. The enthalpy of formation of HCl would be **[1]**

   a) +22 kcal mol^{-1}

   b) -44 kcal mol^{-1}

   c) +44 kcal mol^{-1}

   d) -22 kcal mol^{-1}

4. In an atom, an electron is moving with a speed of 600m/s with an accuracy of 0.005%. Certainty with which the position of the electron can be located is (h = 6.6 $\times 10^{-34}$ Js)? **[1]**

   a) 3.84 $\times$ 10^{-3}m

   b) 5.10 $\times 10^{-3}$m

   c) 1.52 $\times$ 10^{-4}m

   d) 1.92 $\times 10^{-3}$m

5. Select the incorrect expression from the following. **[1]**

a) ΔS_{total} < 0 (spontaneous process)

b) $\Delta G = \Delta H - T\Delta S$

c) $\Delta S_{total} = \Delta S_{system} + \Delta S_{surr}$

d) $\Delta S_{surr} = \frac{\Delta H_{surr}}{T} = -\frac{\Delta H_{sys}}{T}$

6. Values of $\frac{e}{m}\left[\frac{\text{charge}}{\text{mass}}\right]$ in the categories alpha particle(α), electron (e) and protons (p) increase in the order: **[1]**

a) p $<$ e $<$ α

b) $\alpha <$ p $<$ e

c) e $< \alpha <$ p

d) $\alpha <$ e $<$ p

7. On the basis of standard electrode potential values, suggest which of the following reactions would take place? (Consult the book for $E^{\ominus}$ value). **[1]**

a) $Mg + Fe^{2+} \rightarrow Mg^{2+} + Fe$

b) $Fe + Cd^{2+} \rightarrow Cd + Fe^{2+}$

c) $Cu + Zn^{2+} \rightarrow Cu^{2+} + Zn$

d) $Br_2 + 2Cl^- \rightarrow Cl_2 + 2Br^-$

8. For estimation of which element Kjeldahl method is used? **[1]**

a) Nitrogen

b) Halogen

c) Sulphur

d) Oxygen

9. A dibromo derivative of an alkane reacts with sodium metal to form an alicyclic hydrocarbon. The derivative is _____. **[1]**

a) 1, 4-dibromobutane

b) 1, 1-dibromopropane

c) 2, 2-dibromobutane

d) dibromoethane

10. According to the recommendation of the International Union of Pure and Applied Chemistry (IUPAC), the groups in the modern periodic table are numbered from: **[1]**

a) 1 to 18

b) 1 to 10

c) 1 to 12

d) 1 to 8

11. The molar specific heat capacity of a substance is the quantity of heat needed to raise the temperature of one **[1]**

a) kilogram by one degree Fahrenheit.

b) mole by one degree celsius or one kelvin.

c) mole by one degree Fahrenheit.

d) gram by one degree celsius.

12. When two hydrogen atoms in benzene are replaced by two similar or different monovalent atoms or groups, how many different position isomers are possible? **[1]**

a) 6

b) 5

c) 2

d) 3

13. **Assertion (A):** Sulphur present in an organic compound can be estimated quantitatively by Carius method. **[1]**
Reason (R): Sulphur can be separated easily from other atoms in the molecule, by lassiagn's test, but the yellow precipitate cannot be obtained.

a) A is correct and R is not correct.

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

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

d) A is not correct but R is correct.

14. **Assertion (A):** Trans-2-butene on reaction with Br_2 gives a meso-2,3-dibromobutane. **[1]**

Reason (R): The reaction involves the syn-addition of bromine.

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):** Splitting of the spectral lines in the presence of a magnetic field is known as the Stark effect. **[1]**

Reason (R): The line spectrum is simplest for the hydrogen atoms.

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.

16. **Assertion (A):** 22-carat gold is a compound. **[1]**

Reason (R): A compound has fixed composition of the elements present in it.

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. For the equilibrium, **[2]**

$2NOCl(g) \rightleftharpoons 2NO(g) + Cl_2(g)$

the value of the equilibrium constant, K_c is 3.75×10^{-6} at 1069 K. Calculate the K_p for the reaction at this temperature?

18. Why are elements at the extreme left and extreme right the most reactive? **[2]**

19. What does the following prefixes stand for – **[2]**

a. pico

b. nano

c. centi

d. deci

20. What do you understated by Resonance energy? **[2]**

OR

How would you convert cyclohexane to benzene?

21. Write the electronic configuration of $_9F^{19}$, $_{16}S^{32}$ and $_{18}Ar^{38}$ and then point out the element with **[2]**

i. maximum nuclear charge.

ii. minimum number of neutrons.

iii. maximum number of unpaired electrons.

Section C

22. Discuss the concept of hybridisation. What are the different types of hybridization that carbon can exhibit? **[3]**

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

(i) The fact that the enthalpy is a state function forms the basis of a very useful law. Name the law. **[1]**

(ii) If the combustion of 1 g of graphite produces 20.7 kJ of heat, what will be molar enthalpy change? Give the significance of the sign also. **[1]**

(iii) Consider the same expansion, but this time against a constant external pressure of 1 atm. **[1]**

24. Give the relationship between ΔU and ΔH for gases. **[3]**

25. Justify giving reactions that among halogens, fluorine is the best oxidant and among hydrohalic compounds, hydroiodic acid is the best reductant. **[3]**

26. According to de Broglie, matter should exhibit dual behaviour, that is both particle and wave like properties. However, a cricket ball of mass 100 g does not move like a wave when it is thrown by a bowler at a speed of 100 km/h. Calculate the wavelength of the ball and explain why it does not show wave nature. **[3]**

27. Give the electronic configuration of the transition elements. Write their four important characteristics. **[3]**

28. Commercially available concentrated hydrochloric acid(HCl) contains 38% HCI by mass. **[3]**

i. What is the molarity (M) of the solution (density of solution = 1.19 g mL^{-1})

ii. What volume required of concentrated HCI is required to make 1.0 L of an 0.10M HCI?

Section D

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

Once an organic compound is extracted from a natural source or synthesised in the laboratory, it is essential to purify it. Various methods used for the purification of organic compounds are based on the nature of the compound and the impurity present in it. Finally, the purity of a compound is ascertained by determining its melting or boiling point. This is one of the most commonly used techniques for the purification of solid organic compounds. In crystallisation Impurities, which impart colour to the solution are removed by adsorbing over activated charcoal. In distillation Liquids having different boiling points vaporise at different temperatures. The vapours are cooled and the liquids so formed are collected separately. Steam Distillation is applied to separate substances which are steam volatile and are immiscible with water. Distillation under reduced pressure: This method is used to purify liquids having very high boiling points.

(i) Which method can be used to separate two compounds with different solubilities in a solvent?

OR

Why chloroform and aniline are easily separated by the technique of distillation?

(ii) Distillation method is used to separate which type of substance?

(iii) Which technique is used to separate aniline from aniline water mixture?

30. **Read the text carefully and answer the questions:** **[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?

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

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

OR

Non-Polar halides are immiscible in water. Why?

Section E

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

(i) Why are Alkenes called olefins? **[1]**

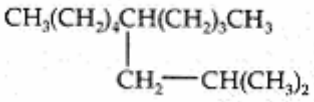
(ii) Convert 1-bromopropane to 2-bromopropane. **[1]**

(iii) If Qc < Kc, when we continuously remove the product, what would be the direction of the reaction? **[1]**

(iv) Convert methane into ethane. **[1]**

(v) What are cycloalkanes? **[1]**

(vi) Write IUPAC name of following: **[1]**



(vii) How will you convert ethanoic acid into ethene? **[1]**

32. At 1127 K and 1 atmosphere pressure, a gaseous mixture of CO and CO_2 in equilibrium with solid carbon has 90.55% CO by mass. **[5]**

$C(s) + CO_2(g) \rightleftharpoons 2CO(g)$

Calculate K_c for the reaction at the above temperature.

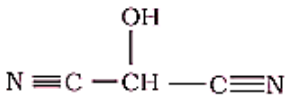
OR

A sparingly soluble salt gets precipitated only when the product of the concentration of its ions in the solution (Q_{sp}) becomes greater than its solubility product. If the solubility of $BaSO_4$ in water is 8×10^{-4} mol dm^{-3}, calculate its solubility in 0.01 mol dm^{-3} of H_2SO_4.

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

(i) i. For each of the following compounds, write a condensed formula and also their bond-line formula. **[2.5]**

a. $HOCH_2CH_2CH_2CH(CH_3)CH(CH_3)CH_3$

b. 

ii. How does **[2.5]**

i. an electron withdrawing group (EWG) and

ii. an electron donating group (EDG) influence the acid strength of carboxylic end?

OR

i. Give condensed and bond line structural formulas and identify the functional groups present, if any, for: **[2.5]**

a. 2, 2, 4-Trimethylpentane

b. 2-Hydroxy-1, 2, 3-propanetricarboxylic acid

c. Hexanedial?

ii. Give three points of differences between inductive effect and resonance effect. **[2.5]**

Solution

Section A

1.

(b) the components completely mix with each other and its composition is uniform throughout.

Explanation: Its a basic criteria of a homogeneous mixture.

i. The components get mixed up uniformly throughout the mixture.

ii. Its individual parts are not easily identifiable.

iii. It has same proportions of its components through out the sample.

2.

(d) $\lambda = \frac{h}{mv}$

Explanation: Louis de-Broglie proposed that matter, like light , has a dual character.It exhibits wave as well as particle nature. The wavelength of the wave associated with a particle of mass m moving with velocity v is given by

$\lambda = \frac{h}{mv}$

3.

(d) -22 kcal mol^{-1}

Explanation: -22 kcal mol^{-1}

4.

(d) 1.92 $\times 10^{-3}$m

Explanation: Velocity = 600m/s

Accuracy = 0.005%

so,uncertainty in the velocity = $\frac{600 \times 5}{1000} = \frac{3000}{1000}$ = 3 m/s

Δx = ?

Using the Heisenberg uncertainty equation, we have

$\Delta x \times \Delta p = \frac{h}{h\pi}$

$\Rightarrow \Delta x = \frac{h}{4\pi m \Delta v}$ = $\frac{6.634 \times 10^{-34}}{4 \times 3.14 \times 9.1 \times 10^{-31} \times 3}$ = 1.92 $\times 10^{-3}$m

5. **(a)** ΔS_{total} < 0 (spontaneous process)

Explanation: For spontaneous process, ΔS_{total} > 0

$T\Delta S_{system}$ - ΔH_{system} > 0 - (ΔH_{system} - $T\Delta S_{system}$) > 0

6.

(b) $\alpha <$ p $<$ e

Explanation: α-particle (He^{2+}) has a very high mass compared to proton and electron, therefore a very small $\frac{e}{m}$ ratio. Proton and electron have the same charge (magnitude) but former is heavier, hence has a smaller value of $\frac{e}{m}$.

7. **(a)** Mg + $Fe^{2+} \rightarrow Mg^{2+}$ + Fe

Explanation: On the basis of standard reduction potential suggested in the reactivity, this series reaction can take place as Mg has a more negative value of the cell. Thus, Mg will be oxidized by losing an electron, and iron will be reduced by gaining an electron.

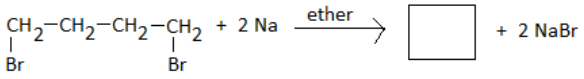
8. **(a)** Nitrogen

Explanation: Nitrogen

9. **(a)** 1, 4-dibromobutane

Explanation: 1,4 - dibromobutane (ie. a dibromo derivative of an alkane, butane) when reacted within$(Na - metal)$

ethereal solution produces alicyclic hydrocarbon, Cyclobutane as per the following reaction.



1,4 dibromobutane Cyclobutane

Therefore, the dibromo-derivative of an alkane is identified as 1, 4-dibromobutane.

10. **(a)** 1 to 18

Explanation: The groups are numbered from 1 to 18; where group 1 is alkali metal group and group 18 is for the noble gases.

11. **(b)** mole by one degree celsius or one kelvin.

Explanation: Molar specific heat capacity can be defined as the amount of heat energy required to raise the temperature of 1 mole of a substance by 1^{o} C.

12. **(d)** 3

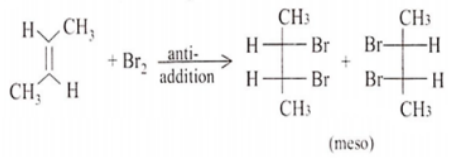
Explanation: The three isomers will be ortho(i.e.1,2- or 1,4-disubstituted), meta(i.e.1,3- or 1,5-disubstituted) and para (1,4-disubstituted).

13. **(d)** A is not correct but R is correct.

Explanation: We know that the Carius method is used to estimate the halogen quantity, hence assertion is found to be wrong. Now reason, Sulphur can be separated easily from other atoms in the molecule, by lassiagn's test, but the yellow precipitate cannot be obtained.

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

Explanation: With trans-2-butene, the product of Br_2 addition is optically inactive due to the formation of symmetric meso compounds.



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

Explanation: Splitting of the spectral lines in the presence of a magnetic field is known as the Zeeman effect and in an electric field is known as the Stark effect. The splitting of spectral lines is due to different orientations which the orbitals can have in the presence of the magnetic field.

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

Explanation: A is false but R is true.

Section B

17. We know that,

$K_p = K_c (RT)^{\Delta n}$

For the above reaction,

$\Delta n = (2 + 1) - 2 = 1$

$K_p = 3.75 \times 10^{-6} (0.0831 \times 1069)$

$K_p = 0.033$

18. Elements at the extreme left and extreme right of periodic table are most reactive. It is due to following reasons:
    1. Alkali metals are present at extreme left end of periodic table. Due to greatest atomic size of alkali metals, their ionisation enthalpy is low. These metals can easily lose electrons to form cations. Hence, these metals are very reactive in nature.

2. On the other hand, Halogens (group 17^{th}) are present on extreme right side of periodic table (Noble gases, group 18^{th}, are stable). Due to smallest atomic size of halogens, their electron gain enthalpy is very high. Therefore, these elements can form anions easily by gaining the electrons. So, These elements are also reactive.

19.

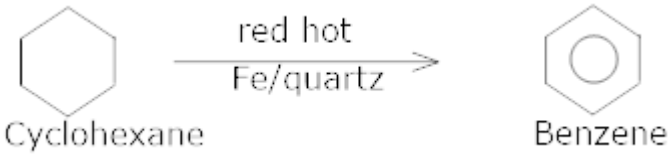
S.No.	Prefix	Value
1.	Pico	10^{-12}
2.	nano	10^{-9}
3.	centi	10^{-2}
4.	deci	10^{-1}

20. **Resonance energy:** The difference between the energy of the most stable contributing structure and the energy of the resonance hybrid is known as resonance energy.

Example: The resonance energy of benzene is 147KJ/mole.

OR

Cyclohexane when treated with iron or quartz in a red hot tube undergoes oxidation to formBenzene:



21. $_9F^{19} = 1s^2 2s^2 2p_x^2 2p_y^2 2p_z^1$,

$_{16}S^{32} = 1s^2 2s^2 2p^6 3s^2 3p_x^2 3p_y^1 3p_z^1$,

$_{18}Ar^{38} = 1s^2 2s^2\ 2p^6\ 3s^2\ 3p^6$

i. Maximum nuclear charge = 18 in $_{18}Ar^{38}$.

ii. Minimum number of neutrons = 10 in $_9F^{19}$.

iii. Maximum number of unpaired electrons = 2 in $_{16}S^{32}$.

Section C

22. **Hybridization**: This concept was put forward by Pauling. He suggested that the atomic orbitals mix together to generate a new set of equivalent orbitals, called as hybrid orbitals or hybridized orbitals.

Types of hybridization in the carbon atom

a. Diagonal **or** sp-hybridization- Carbons involved in forming $C \equiv C$ (triple bond) like in ethyne (C_2H_2) exhibit sp-hybridization.

b. Trigonal **or** sp^2-hybridization- Carbons involved in forming C = C (double bond) like in ethene (C_2H_4) exhibit sp^2 hybridization.

c. Tetrahedral **or** sp^3 -hybridization- Carbons involved in forming single bonds only like in ethane (C_2H_6) exhibit sp^3 hybridization.

23. Answer:

(i) The name of the law is Hess's law of heat summation.

(ii) According to the question, the combustion of 1 g of graphite produces 20.7 kJ of heat.

The molar enthalpy change for the combustion of graphite, ΔH = enthalpy of combustion of 1 g graphite $\times$ molar mass

$\Delta H = -20.7\ kJ\ g^{-1} \times 12\ g\ mol^{-1}$

$= -2.48 \times 10^2\ kJ\ mol^{-1}$

Here, a negative sign indicates that the reaction is exothermic.

(iii)We have $q = -w = p_{ex}\ (8) = 8$ litre-atm

24. Let V_A be the total volume of gaseous reactants,

V_B be the total volume of gaseous product.

Let n_A be the number of moles of the reactant,

n_B be the number of moles of the product,

At constant pressure and temperature,

$pV_A = n_A RT$,

$pV_B = n_B RT$

$\Rightarrow pV_B - pV_A = (n_B - n_A)\ RT$

$\Rightarrow p\ \Delta V = (\Delta n)_g RT$

Here, $(\Delta n)_g = n_B - n_A$ is equal to the difference between the number of moles of gaseous products and gaseous reactants.

We know that,

$\Delta H = \Delta U + (\Delta n)_g RT$

Now, $\Delta H = q_p$(heat change under constant pressure),

$\Delta U = q_v$(heat change under constant volume).

Therefore, $q_p = q_v + (\Delta n)_g RT$

25. i. Halogens have a strong tendency to accept electrons. Therefore, they are strong oxidizing agents. Their relative oxidizing power is however, measured in terms of their electrode potentials.

Since the electrode potentials of halogens decrease in the order :

$F_2 < (2.87V) > Cl_2(+1.36V) > Br_2(+1.09V) > I_2(+0.54V)$,

Therefore, their oxidizing power decreases in the same order.

This is evident from the observation that

a. F_2 oxidizes Cl^- to Cl_2, Br^- to Br_2, I^- to I_2

b. Cl_2 oxidizes Br^- to Br_2 and I^- to I_2 but not F^- to F_2.

c. Br_2, however oxidizes I^- to I_2. But Br_2 fails to oxidise F^- to F_2 and Cl^- to Cl_2

The related above reactions are,

$F_2(g) + 2Cl^-(aq) \rightarrow 2F^-(aq) + Cl_2(g)$; $F_2(g) + 2Br^-(aq) \rightarrow 2F^-(aq) + Br_2(l)$

$F_2(g) + 2I^-(aq) \rightarrow 2F^-(aq) + I_2(s)$; $Cl_2(g) + 2Br^-(aq) \rightarrow 2Cl^-(aq) + Br_2(l)$

$Cl_2(g) + 2I^-(aq) \rightarrow 2Cl^-(aq) + I_2(s)$ and $Br_2(l) + 2I^- \rightarrow 2Br^-(aq) + I_2(s)$

Thus, **F_2 is the best oxidant.**

ii. Conversely, halide ions have a tendency to lose electrons and hence can act as reducing agents. Since the electrode potentials of halide ions decrease in the following order,

$I^-(-0.54\ V) > Br^-(-1.09V) > CI^-(-1.36V) > F^-(-2.87\ V)$,

Therefore, the reducing power of the halide ions or their corresponding hydrohalic acids decreases in the same order: HI > HBr > HCl > HF.

Thus, hydroiodic acid is the best reductant. This is supported by the following reactions.

For example,

HI and HBr reduces H_2SO_4 to SO_2 while HCI and HF do not.

$2HBr + H_2SO_4 \rightarrow Br_2 + SO_2 + 2H_2O$; $2HI + H_2SO_4 \rightarrow I_2 + SO_2 + 2H_2O$

Further I^- reduces Cu^{2+} to Cu^+ but Br^- does not.

$2Cu^{2+}(aq) + 4I^-(aq) \rightarrow Cu_2I_2(s) + I_2(aq)$;

$Cu^{2+}(aq) + 2Br^- \rightarrow$ No reaction

So, HI is a stronger reductant than HBr.

Further, among HCl and HF, HCl is a stronger reducing agent than HF because HCl reduces MnO_2 to Mn^{2+} but HF does not.

$MnO_2(s) + 4HCl(aq) \rightarrow MnCl_2(aq) + Cl_2(g) + 2H_2O$

$MnO_2(s) + 4HF(l) \not\rightarrow$ No reaction

Thus, **t**he reducing character of hydrohalic acids decreases in the order: **HI > HBr > HCl > HF.**

26. Given, m = 100 g = 0.1 kg.

Velocity, v = 100 km/hr $= \frac{100\times1000}{60\times60} = \frac{10000}{36}\ ms^{-1}$.

According to be Broglie, Wavelength $\lambda = \frac{h}{mv}$; Where h = 6.626×10^{-34} Js.

Now, Put the values in above equation, we get

$\lambda = \frac{6.626 \times 10^{-34} Js}{0.1kg \times \frac{1000}{36} ms^{-1}} = 6.626 \times 10^{-36} \times 36\, m$

$\lambda = 238.5 \times 10^{-36}\, m$

Since the wavelength is too small to be detected, so, it does not show wave nature.

27. **General electronic configuration of Transition elements:**

The d-block elements are known as transition elements with general outer electronic configuration as (n-1)d^{1-10} ns^{0-2}.

Characteristics of d-block elements:

(i) They show variable oxidation states.

(ii) Their compounds are generally paramagnetic in nature.

(iii) Most of the transition elements form coloured compounds

(iv) They are all metals with high melting and boiling points.

28. i. Let assume the total mass of the solution is 100g.

38 % HCI by mass means 38 g of HCI is present in 100 g of solution.

The volume of solution (V) = $\frac{\text{mass}}{\text{density}} = \frac{100}{1.19} = 84.03\text{mL}$ (Density of solution = 1.19 g/mL)

Number of moles of HCl (n_B) = $\frac{38}{36.5}$ = 1.04

Molarity = $\frac{n_B \times 1000}{V(\,in\,mL)}$= $\frac{1.04 \times 1000}{84.03\,mL}$= 12.38 M

ii. From the molarity equation, $\underset{\text{acid }_1}{M_1V_1} = \underset{\text{acid }_2}{M_2V_2}$

$12.38\text{M} \times V_1 = 0.10\text{M} \times 1.0\text{L}$

$\therefore V_1 = \frac{0.1 \times 1.0}{12.38} = 0.00808\text{L} = 8.08\text{cm}^3$

Section D

29. **Read the text carefully and answer the questions:**

Once an organic compound is extracted from a natural source or synthesised in the laboratory, it is essential to purify it. Various methods used for the purification of organic compounds are based on the nature of the compound and the impurity present in it. Finally, the purity of a compound is ascertained by determining its melting or boiling point. This is one of the most commonly used techniques for the purification of solid organic compounds. In crystallisation Impurities, which impart colour to the solution are removed by adsorbing over activated charcoal. In distillation Liquids having different boiling points vaporise at different temperatures. The vapours are cooled and the liquids so formed are collected separately. Steam Distillation is applied to separate substances which are steam volatile and are immiscible with water. Distillation under reduced pressure: This method is used to purify liquids having very high boiling points.

(i) Fractional crystallizationis used to separate two compounds with different solubilities in a solvent.

OR

Chloroform and aniline are easily separated by the technique of distillation because chloroform and aniline have sufficient difference in their boiling points.

(ii)
- volatile liquids from nonvolatile impurities.
- the liquids having sufficient difference in their boiling points.

(iii) Aniline is separated from aniline water mixture by steam distillation as one of the substances in the mixture is water and the other, a water insoluble substance.

30. **Read the text carefully and answer the questions:**

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) $PCl_3 + 3H_2O \rightarrow H_3PO_3 + 3HCl$

(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

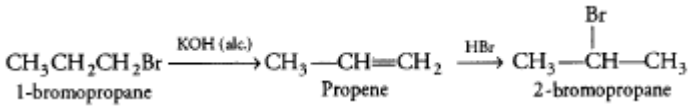
The non-polar halides are immiscible in water because it doesn't show hydrolysis but halides of some element with empty d-orbital undergo hydrolysis.

Section E

31. Attempt any five of the following:

(i) Alkenes are commonly known as olefins because the lower members form oily products on treatment with chlorine or bromine.

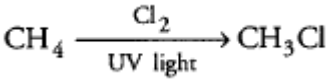
(ii) We can convert 1-Bromopropne into 2-Bromopropane in two steps. In the first step, the dehydrohalogenation of 1-bromo propane with alcoholic KOH gives propene which on reacting with HBr gives 2-bromo propane due to Markovnikov's rule for addition.



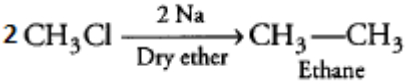
(iii) Continuous removal of a product maintains Qc at a value less than Kc and reaction continues to move in the forward direction.

(iv) Conversion of methane into ethane:

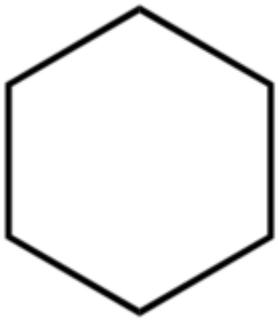
Step 1:



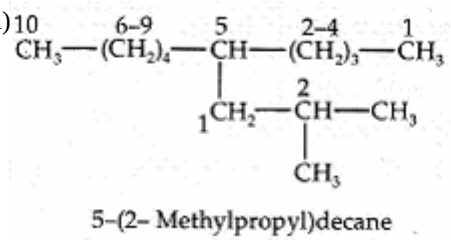
Step 2:



(v) **Cycloalkanes:** When carbon atoms form a closed chain or ring structures, they are known as cycloalkanes.
Example: Cyclohexane

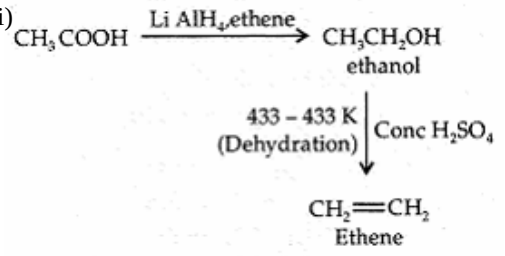


(vi)



5–(2– Methylpropyl)decane

(vii)



32. **Calculation of K_p for the reaction**

Let the total mass of the gaseous mixture = (100 - 90.55) = 9.45 g

No. of moles of CO $= \frac{90.55g}{(28gmol^{-1})} = 3.24mol$

No. of moles of $CO_2 = \frac{90.55g}{(44g\ mol^{-1})} = 0.215\ mol$

pCO in the mixture $= \frac{(3.234mol)}{(3.234+0.215)} \times 1\ atm = \frac{(3.234\ mol)}{(3.449\ mol)} \times 1\ atm = 0.938\ atm$

pCO_2 in the mixture $= \frac{(0.215\ mol)}{(3.449\ mol)} \times 1\ atm = 0.062\ atm$

$C(s) + CO_2(g) \rightleftharpoons 2CO(g)$

Equi. Pressure 0.062 atm 0.938 atm

$K_p = \frac{p^2CO}{pCO_2} = \frac{(0.938\ atm)^2}{(0.062\ atm)} = 14.19\ atm$

Step II. Calculation of K_c for the reaction.

$K_c = \frac{K_p}{(RT)^{\Delta ng}}$

K_p = 1.419 atm, R = 0.0821 L atm K^{-1} mol^{-1}, T = 1127 K, $\triangle n_g$ = 2 - 1 = 1

$K_c = \frac{(14.19\ atm)}{(0.0821L\ atm\ K^{-1}mol^{-1}) \times (1127K)^1} = 0.153mol\ L^{-1}$

OR

	$BaSO_4(s) \rightleftharpoons$	$Ba^{2+}(aq)$ +	$SO_4^{2-}(aq)$
At $t = 0$	1	0	0
At equilibrium in water	1-S	0	0
At equilibrium in the presence of sulphuric acid	1-S	S	(S + 0.01)

Given solubility of $BaSO_4$ is 8×10^{-4} mol dm^{-3}.

Therefore, for $BaSO_4$ in water, $K_{sp} = \left[Ba^{2+}\right]\left[SO_4^{2-}\right] = (S)(S) = S^2$

$\therefore K_{sp} = \left(8 \times 10^{-4}\right)^2 = 64 \times 10^{-8}$ ...(1)

The expression for solubility product (K'_{sp}) in the presence of sulphuric acid will be as follows:

K'_{sp}= (S) (S + 0.01) .....(2)

Since the value of K_{sp} will not change in the presence of sulphuric acid.

Therefore, from (1) and (2), we have,

(S) (S + 0.01) = 64×10^{-8}

$S^2 + 0.01\ S = 64 \times 10^{-8}$

$S^2 + 0.01\ S - 64 \times 10^{-8} = 0$

$\Rightarrow S = \frac{-0.01 \pm \sqrt{(0.01)^2 + (4 \times 64 \times 10^{-8})}}{2}$

$\Rightarrow \frac{-0.01 \pm \sqrt{10^{-4} + (256 \times 10^{-8})}}{2}$

$\Rightarrow \frac{-0.01 \pm \sqrt{1.0256 \times 10^{-4}}}{2}$

$\Rightarrow \frac{-0.01 \pm 1.0127 \times 10^{-2}}{2}$

$\Rightarrow \frac{-0.01 - 1.0127 \times 10^{-2}}{2}, \frac{-0.01 + 1.0127 \times 10^{-2}}{2}$

$\Rightarrow$ -1.006×10^{-2}, 6.35×10^{-5}

Concentration can never be negative. Hence required concentration is 6.35×10^{-5} mol dm^{-3}

33. Answer:

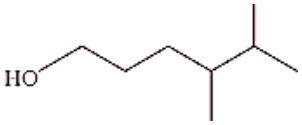
(i) i. Condensed formula of the compound:

a. $HO(CH_2)_3CH(CH_3)CH(CH_3)_2$

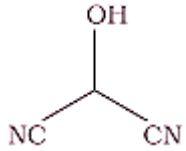
b. HOCH(CN),

Bond-line formula of the compound:

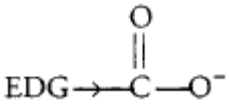
a.



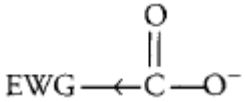
b.



ii. The influence of the inductive effect on acidity is best understood in terms of the conjugate base, $RCOO^-$ and can be summarised as follows

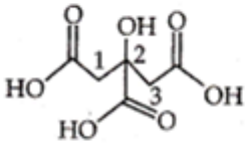
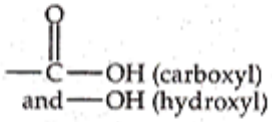
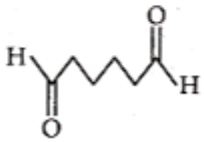
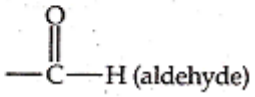
i. 

Electron withdrawing group destabilises $RCOO^-$ because there exists a repulsion between electrons from EDG and negative charge of O. Hence, EDG weakens the acid.

ii. 

Electron withdrawing group stabilities $RCOO^-$ by taking negative charge from O. Hence, EWG strengthens the acid.

OR

Condensed formula	Bond line formula	Functional group/s
(*a*) $(CH_3)_3CCH_2CH(CH_3)_2$		—
i. (*b*) $HOOCCH_2C(OH)(COOH)CH_2COOH$		
(*c*) $OHC(CH_2)_4CHO$		

ii.

S.No.	Inductive effect	Resonance effect
1.	It involves displacement of σ electrons in saturated compounds.	It involves displacement of π electrons or lone pair of electrons in unsaturated and conjugated compounds.
2.	Inductive effect can move only upto 3 to 4 carbons.	In this case, movement of electrons all along the length of conjugated system takes place.
3.	In inductive effect, there is slight displacement of σ electrons and partial +ve or-ve charge develops.	In this effect, there is complete transfer of π electrons and as a result, complete +ve or -ve charge develops.