CHEMISTRY

Paper – 1

(THEORY)

Three hours and a quarter

(The first 15 minutes of the examination are for reading the paper only.

Candidates must NOT start writing during this time).

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*Answer **all** questions in Part I. From Part II, answer any four questions from Section A, any three questions from Section B and any two questions from Section C.*

All working, including rough work, should be done on the same sheet as, and adjacent to the rest of the answer in the answer booklet.

The intended marks for questions are given in brackets [ ].

Balanced equations must be given wherever possible and diagrams where they are helpful.

When solving numerical problems, all essential working must be shown.

In working out problems, use the following data:

Gas Constant R = 1.987 cal deg^{-1} mol^{-1} = 8.314 JK^{-1} mol^{-1} = 0.0821 dm^3 atm K^{-1} mol^{-1}

PART I (40 marks)

*Answer **all** questions.*

Question 1.

(a)   *Correct the following statements.*   **[5]**

   (i)   Osmotic pressure and boiling points are colligative properties.

   (ii)   Both temperature and enthalpy are intensive properties.

   (iii)   Mesomeric effect is exhibited by compounds in presence of an attacking reagent.

   (iv)   Diethyl ether exhibits geometrical isomerism.

   (v)   Compounds having a ketonic group reduces Tollen's reagent.

(b) *Each question is followed by four possible choices of answers. Choose the correct answer and write it in your answer booklet.*

(i) Emission of β-rays leads to the formation of

    A   isotone.

    B   isotope.

    C   isomer.

    D   isobar.

(ii) The chemical formula of potassium hexacyanoferrate (III) is

    A $K[Fe(CN)_6]$.

    B $K_2[Fe(CN)_6]$.

    C $K_3[Fe(CN)_6]$.

    D $K_4[Fe(CN)_6]$.

(iii) The concentration unit independent of temperature is

    A   normality.
    B   molarity.
    C   molality.
    D   strength.

(iv) The bond order of N_2 is

    A   zero.

    B   one.

    C   two.

    D   three.

(v) Flux used in the smelting of copper ore is

    A   coke.

    B   silica.

    C   limestone.

    D   quicklime.

(vi)   Zwitter ion in acidic medium

    A   moves towards the cathode.

    B   moves towards the anode.

    C   remains in solution.

    D   becomes a salt.

(vii)   Crystalline compounds possess all the following properties *except*

    A   isotropy.

    B   cleavage planes.

    C   regular geometry.

    D   sharp melting point.

(viii) I_2 solution on treatment with H_2S produces

    A   HIO.

    B SO_2.

    C   HI.

    D   S.

(ix)   When fats are heated with sodium hydroxide, the products formed are

    A   glycerol and soap.

    B   soaps and detergents.

    C   glycerol and fatty acids.

    D   detergents and fatty acids.

(x)   Colloids are prevented from coagulation by

    A   electrophoresis.

    B   electrosmosis.

    C   Tyndal effect.

    D   dialysis.

(c) **Fill in the blanks choosing appropriate word/s given in the brackets. Write the co***

answers in your answer booklet.

(Law of mass action, heat, geometrical, optical, common ion effect, 12, internal energy, 6, alums, hypo)

(i) The dissociation of HCN will decrease when HCl is added due to …………..

(ii) 48250 coulombs of electricity will deposit …….. grams of magnesium.

(iii) For an adiabatic process the change in …….. is zero.

(iv) ……….. are also used for purification of water.

(v) Dichloroethene exhibits ……. …..isomerism.

(d) **Match the items of column A with the items in column B. Rewrite the correct pairs in your answer booklet.** **[5]**

Column A	Column B
(i) Cannizzaro's	(a) CH_3COCH_3
(ii) Haloform	(b) $C_6H_5CH_3$
(iii) Carbylamine	(c) C_6H_5Cl
(iv) Wurtz-Fittig	(d) C_6H_5OH
(v) Kolbe's reaction	(e) $C_2H_5OC_2H_5$
	(f) HCHO
	(g) CH_3CONH_2
	(h) $C_6H_5NH_2$

(e) **Answer the following questions.**

(i) What is the type of bonding present in sulphuric acid that is not present in water? **[1]**

(ii) Hydrolysis of methylacetate is a first order reaction. Give reason. **[1]**

(iii) Gases ooze out when a carbonated drink is opened. Explain with the help of the law governing it. **[1]**

(iv) Write the expression for Ksp of a salt A_2B, if its solubility is x. **[1]**

(v) What should be the e.m.f for a functional electrochemical cell? **[1]**

(vi)   Give the mathematical expression for the first law of Thermodynamics. Give *one* of its limitations.

(vii) Hydrolysis of tertiary alkylhalide is a SN_1 reaction. Explain the statement with the help of equations.   **[2]**

(viii) Sucrose reduces Tollen's reagent only when preheated with dilute hydrochloric acid. Give reasons to support your answer.   **[2]**

(ix)   Give the chemical equation for the preparation of Teflon. Name the monomers.   **[2]**

(x)   Give the structural formula for ethane nitrile and methyl carbylamine.   **[2]**

PART II (28 marks)
SECTION A
Answer any **four** *questions.*

Question 2.

(a) The vapour pressure of pure benzene at a certain temperature is 200 mm Hg. At the same temperature the vapour pressure of a solution containing 2 gm of non-volatile non-electrolyte solute in 78 gm of benzene is 195 mm Hg. Find the molecular mass of the solute.   **[3]**

(b) Aqueous sodium chloride and copper wire both conduct electricity. Explain the difference in their conduction on the basis of their crystal structure.   **[2]**

(c) Give a suitable reason for the following: **[2]**

   (i)   When light passes through a colloidal solution, its path becomes visible.

   (ii) Heterogeneous catalysis is also called surface catalysis.

Question 3.

(a) Write and balance the following nuclear equations.   **[3]**

   (i) $_3Li^7$ (P, n)

   (ii) $_{13}Al^{27}$ (α, n)

   (iii) $_7N^{14}$ (α, P)

(b)   Give details for the preparation of the following:

    (i)   an emulsion

    (ii)   colloidal sulphur

(c)   20% of sugar was hydrolyzed in half-an-hour. Find the half-life of the reaction
        assuming it to be of first order.   **[2]**

Question 4.

(a)   Taking ethane as an example, write about the following bonding features: **[3]**

    (i)   hybridization

    (ii)   shape and bond angles

    (iii)   the number of σ and π bonds

(b)   The following data are for the reaction, $A + B \rightarrow$ products   **[2]**

| Sl. No.	Conc. of A (mole)	Conc. of B(mole)	Rate (Mole/lit. sec
1.	0.01	0.02	3.2×10^{-4}
2.	0.01	0.04	6.4×10^{-4}
3.	0.02	0.02	3.2×10^{-4}

Derive the rate equation.

(c)   An old furniture in a museum was found to have C^{14}/C^{12} ratio 0.6 times that in a living
        tree. Find the age of the furniture. (Half life of C^{14} = 5760 years)   **[2]**

Question 5.

(a)   The solubility product of barium sulphate is 1.0×10^{-10} at 25°C. If 50 ml each of
        1.2×10^{-6} M $BaCl_2$ and 1.1×10^{-5}M sodium sulphate is mixed, will there be
        precipitation? Give reasons to support your answer.   **[3]**

(b) NH_3 has a dipole, while CCl_4 does not. Explain the statement.   **[2]**

(c)   State the law governing the following observations: **[2]**

    (i)   Iodine dissolves to different extents when added to a mixture of CS_2 and water.

    (ii)   Dilute acetic acid contains more hydrogen ions than concentrated acetic acid
        per unit volume.

Question 6.

(a)   Calculate the e.m.f of the following cell at 25°C:

       Zn / Zn^{2+} (0.0004M) $\| Cd^{2+}$ (0.2M) / Cd
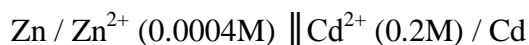
       if the standard reduction potential for zinc and cadmium electrodes are -0.76 V and

       + 0.40 volts respectively.   **[3]**

(b)   Give a suitable reason for the following: **[2]**

       (i)   Zinc sulphide is not precipitated on passing H_2S through aq. $ZnCl_2$ in acidic

              medium.

       (ii)   Aqueous solution of ferric chloride is acidic.

(c)   The molecular weights of sodium chloride and glucose are determined by depression in

       freezing point method. What will be their experimental molecular weights as compared

       to their theoretical molecular weight. Support your answer.   **[2]**

Question 7.

(a)   The solubility of aniline in water and benzene is 2 gm/lit and 20 gm/lit respectively.

       If 5 gm of aniline is shaken with a mixture of 100 ml of water and 50 ml of benzene,

       in what ratio will aniline be distributed in the two layers?   **[3]**

(b)   Calculate the cell constant of a conductivity cell containing 0.001 M KCl solution at

       298K if its resistance is 1500Ω and the specific conductivity is 0.146×10^{-3} S cm^{-1}.   **[2]**

(c)   Write a short note on imperfections in solids.   **[2]**

SECTION B (18 marks)

Answer any **three** *questions.*

Question 8.

(a) (i)   Name *one c*hief ore of copper and give its formula. **[1]**

(ii) How is this ore concentrated? **[1]**

(iii) In the extraction of copper, how is matte converted to blister copper. **[2]**

(b) What do you observe when NH_4OH is added gradually, then in excess to a solution of copper sulphate? Write the relevant balanced equations. **[2]**

Question 9.

(a) (i)   Classify the following reactions as substitution, addition or elimination. **[3]**

1.   Propylene with HBr in presence of oxygen

2.   Benzene with Cl_2 in presence of $FeCl_3$

3.   2-bromo propane with alcoholic alkali

(b) (i)   Why are free radicals very active? **[2]**

(ii) How are free radicals formed?

(iii) How many valence electrons are present in

1.   methyl carbanion?

2.   methyl carbocation?

(c) What property is exhibited by H_2O_2 on reacting with: **[1]**

1.   ozone?

2.   PbS?

Question 10.

(a) (i)   Explain the manufacture of fluorine from KHF_2 and HF by electrolytic method. **[3]**

(ii) F_2 cannot be liberated from fluorides by chemical reagents. Why? **[1]**

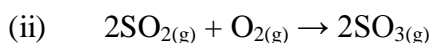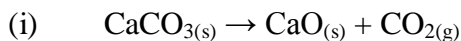---

(b)   Mention the organometallic catalyst used in:

    1.   homogeneous catalysis.

    2.   heterogeneous catalysis.
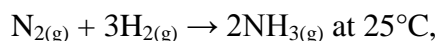
Question 11.

(a)   Indicate whether the entropy increases or decreases in the following changes and give

    reasons to support your answer.   **[3]**

    (i) $CaCO_{3(s)} \rightarrow CaO_{(s)} + CO_{2(g)}$

    (ii) $2SO_{2(g)} + O_{2(g)} \rightarrow 2SO_{3(g)}$

    (iii)   evaporation of water

(b)   Calculate ΔG for the reaction,

    $N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$ at 25°C,
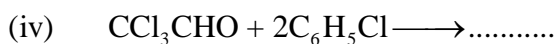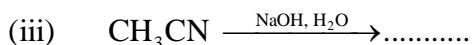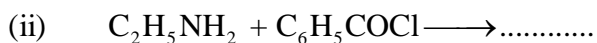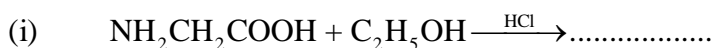
    if $\Delta H = -92.3 KJ$ and $\Delta S = -198 JK^{-1} mol^{-1}$. Is the reaction spontaneous? Why?   **[3]**

SECTION C (14 marks)
Answer any **two** *questions.*

Question 12.

(a)   Complete the reactions and name the product formed in each case.   **[4]**

    (i) $NH_2CH_2COOH + C_2H_5OH \xrightarrow{\text{HCl}}$ ....

    (ii) $C_2H_5NH_2 + C_6H_5COCl \longrightarrow$ ....

    (iii) $CH_3CN \xrightarrow{\text{NaOH, H}_2\text{O}}$ ....

    (iv) $CCl_3CHO + 2C_6H_5Cl \longrightarrow$ ....

(b)   What do you observe when :   **[2]**

    (i)   oxalic acid is treated with $KMnO_4$ solution.

    (ii)   acetaldehyde is warmed with iodine and caustic soda solution.

(c)   Synthetic detergents are preferred to soaps with hard water. Explain.   **[1]**

Question 13.

(a)   Carry out the following conversions with the help of balanced chemical equations.

   (i)   Acetic acid to methyl amine

   (ii)   Methanol to urotropine

   (iii)   Ammonia to urea

   (iv)   Acetic acid to ethyl acetate

(b)   Mesotartaric acid and racemic mixture of tartaric acid are both optically inactive.
       Explain with the help of structures.   **[2]**

(c)   What is the basic difference between starch and cellulose?   **[1]**

Question 14.

(a)   An organic compound A with molecular formula C_7H_6O on treatment with acidified
       potassium dichromate produces a carboxylic acid B. B on treatment with soda lime
       produces a hydrocarbon C. Compound C on reaction with a mixture of conc. HNO_3
       and conc, H_2SO_4 yields a compound D. Identify the compounds A, B, C and D.   **[4]**

(b)   Write the balanced chemical equations for the following reactions.   **[2]**

   (i)   Hexamethylene diamine is heated with adipic acid.

   (ii)   Glucose and phenylhydrazine at room temperature.

(c)   Write the possible structural isomers represented by the molecular formula C_3H_6O.   **[1]**