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16/5/11



[This question paper contains 8 printed pages]

Your Roll No. :

Sl. No. of Q. Paper : **1809** **GC-4**

Unique Paper Code : 32171201

Name of the Course : **B.Sc.(Hons.) Chemistry**

Name of the Paper : Organic Chemistry-1

Semester : II

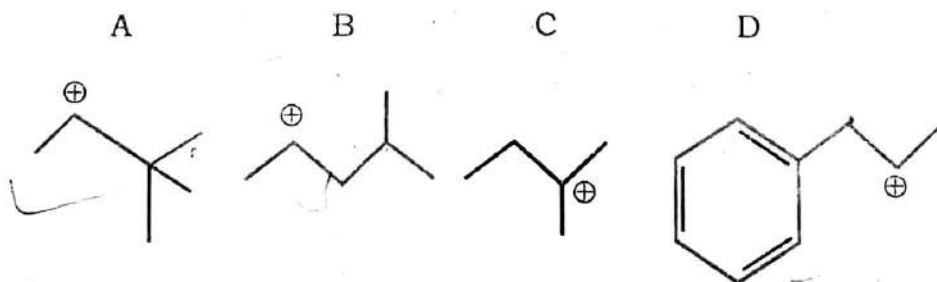
Time : 3 Hours

Maximum Marks : 75

Instructions for Candidates :

- (a) Write your Roll No. on the top immediately on receipt of this question paper.
- (b) Attempt any **six** questions in **all**.
- (c) Question **No.1** carries **15** marks.

1. (a) Differentiate between E1 and E2 reactions.
- (b) Salicylic acid ($pK_a = 2.98$) is more acidic than o-methoxy salicylic acid ($pK_a = 4.09$). Explain why ?
- (c) Identify type of intermediate among the following as 1° , 2° , 3° and which intermediate(s) will rearrange preferably ?



P.T.O.

- (d) Among ethylamine and aniline which one is more basic and why ?
- (e) Explain when 1-chloropropane reacts with benzene under Friedel Craft's alkylation the product obtained is not n-propyl benzene but 2-phenyl propane. $5 \times 3 = 15$

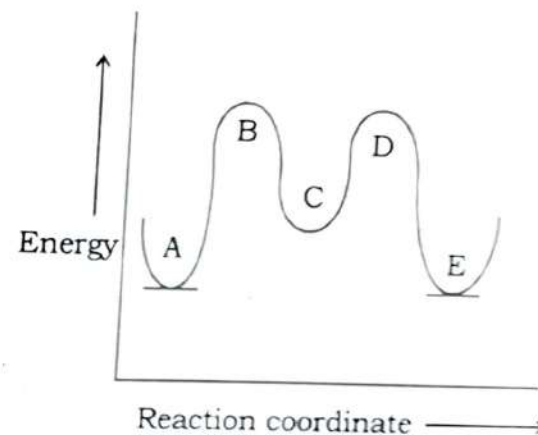
2. Draw structures of the following (Attempt any six) : $6 \times 2 = 12$

- (a) (R) - 2- Bromobutanoic acid
- (b) (S) - 2 - Pentanol
- (c) (E) -2- Bromo-1-chloro-1- iodo-1-propene
- (d) (Z) -3- Flouro-2- methyl-hex-2-enoic acid
- (e) (E) - Ethenedioic acid
- (f) (Z) - 3-Ethyl- 4,4,5- trimethyl-hex-2-ene
- (g) (R) - 2 - chloropropanoic acid
- (h) (S)-1-Dutereo-1- phenyl ethane

3. (a) Write mechanism of reaction caused by reacting 3-methyl butene with HOBr.

(b) Illustrate the meaning of hydration and hydrogenation using propene as your example, giving required reaction conditions respectively.

(c) In the reaction coordinate diagram shown (A-E) indicate :



- (i) What point(s) represent(s) transition state (s) ?
- (ii) What point(s) is (are) reactive intermediate(s) ? $3 \times 4 = 12$

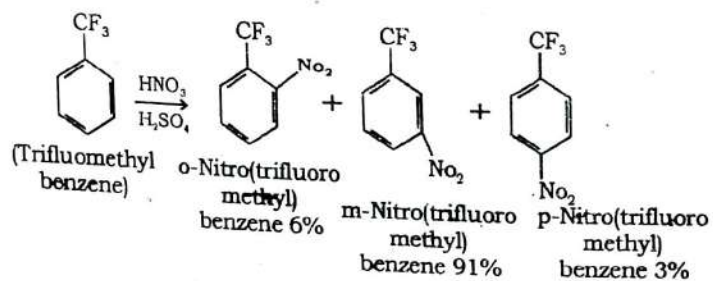
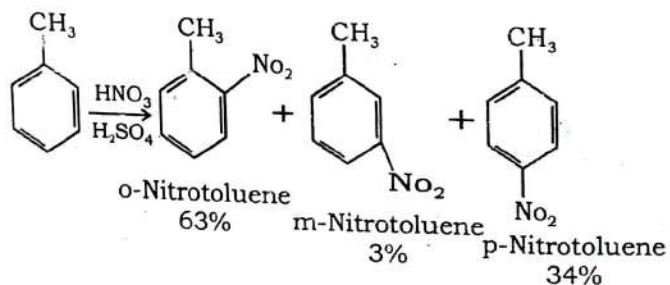
4. (a) Give mechanism for addition of bromine to cis-2-butene.
- (b) In the above reaction write down possible stereoisomers of the product formed, designate respective D and L and the relation between the isomers.
- (c) Butane-2-ol contains an asymmetric carbon atom, but the product of the reaction of but-1-ene with concentrated sulphuric acid followed by water is not optically active. Explain.

- (d) Give reaction conditions for the following reaction and explain with mechanism :

4×3=12



5. (a) Explain why nitration of toluene and trifluoromethyl benzene differ in their respective product ratios :



4

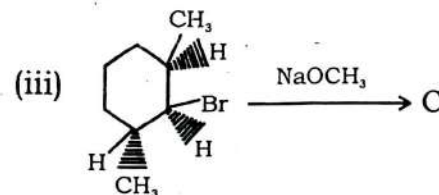
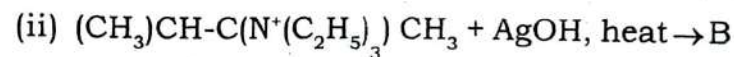
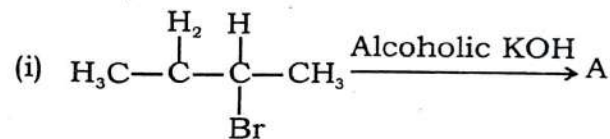
- (b) Calculate the % of isomers formed during the monobromination of 2,3 dimethyl butane. The relative reactivity of primary, secondary and tertiary hydrogen are 1,82,1600 respectively.

- (c) Comment upon order of reactivity in halogenations of alkanes follows :
 $\text{F}_2 > \text{Cl}_2 > \text{Br}_2 > \text{I}_2$

But the selectivity follows: $\text{Br}_2 > \text{Cl}_2 > \text{I}_2 > \text{F}_2$.

3×4=12

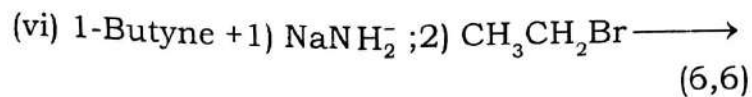
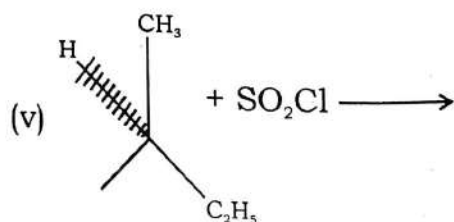
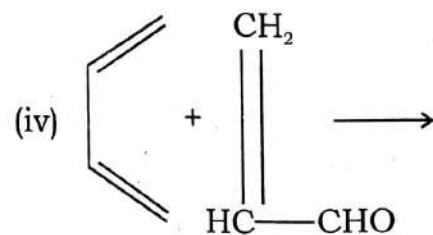
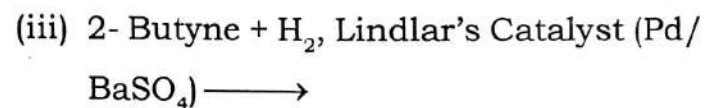
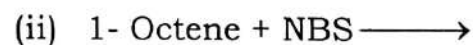
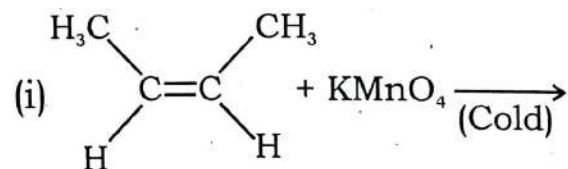
6. (a) Predict the product(s) for the following reactions with plausible explanations :



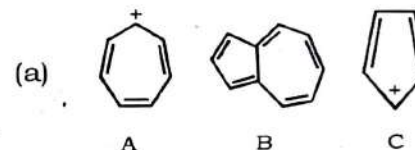
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P.T.O.

(b) Complete the following reaction with complete regioselectivity :

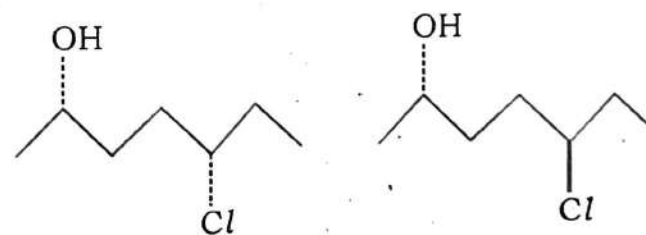


7. Identify among following as aromatic, antiaromatic and nonaromatic and give reason for your answer :



(b) Draw energy diagram of chair, boat and twist cyclohexanes.

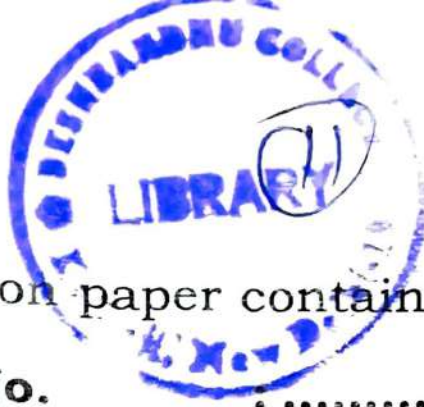
(c) Determine the relationship in between following pairs of compounds : (6,4,2)



8. Write short notes on (Any **four**) :

4×3=12

- (i) Difference in substitution and elimination reactions.
- (ii) Bayer's strain theory.
- (iii) Mechanism of sulfonation (with toluene).
- (iv) Mechanism of Hydroboration of cyclohexene.
- (v) Mechanism of HBr addition on 1, 4-Butadiene.



28/5/17

[This question paper contains 8 printed pages]

Your Roll No.

Sl. No. of Q. Paper : 1810 **GC-4**

Unique Paper Code : 32171202

Name of the Course : **B.Sc.(Hons.) Chemistry**

Name of the Paper : Physical Chemistry-II

Semester : II

Time : 3 Hours

Maximum Marks : 75

Instructions for Candidates :

- Write your Roll No. on the top immediately on receipt of this question paper.
- Answer **six** questions in **all**.
- Question No. **1** is compulsory.
- Use of scientific calculators is allowed. Logarithmic tables can be provided if required.

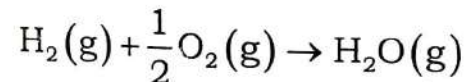
1. Explain giving reasons any **five** of the following :

5×3=15

- What are extensive and intensive variables ? Classify the following as extensive or intensive – energy, molar entropy, heat capacity and chemical potential.

P.T.O.

- (b) Synthesis of ammonia which is an exothermic reaction is preferably carried out at low temperature and high pressure.
- (c) N_2O does not possess zero entropy at 0K.
- (d) Freezing of a substance occurs spontaneously below its freezing point although it leads to a more ordered state.
- (e) Comment on units of the equilibrium constant K_p for the reaction :



- (f) Experimental value of Osmotic pressure of solutions of benzoic acid in water and in benzene (at same concentration) is found to be different.
- (g) For an ideal solution partial molar volume of the components is same as their molar volumes. True or False ? Give reasons.
- (h) Comment on the heat capacity of water in equilibrium with ice at 0°C and 1 atm.

2. (a) Describe the Joule – Thomson experiment. Show that the expansion in this experiment is an isenthalpic process.
- (b) One mole of an ideal gas with $C_v = 3/2 R$ undergoes adiabatic reversible expansion from 22.4L to 44.8L. If the initial temperature is 27°C, calculate the final temperature and the work done in the process.
- (c) Derive the relation :

$$C_p - C_v = \left[P + \left(\frac{\partial U}{\partial V} \right)_T \right] \left(\frac{\partial V}{\partial T} \right)_P$$

3. (a) Show that for a gas that follows the equation $\left(P + \frac{a}{V^2} \right) V = RT$, P is a state function. 4
- (b) Define bond dissociation enthalpy and bond enthalpy. Why are they identical for a diatomic molecule ? 4

- (c) The standard enthalpy of formation of gaseous H_2O at $25^\circ C$ is $-241.82 \text{ kJ mol}^{-1}$. Determine its value at $100^\circ C$. $C_{p,m}(H_2O, g) = 33.58 \text{ JK}^{-1} \text{ mol}^{-1}$, $C_{p,m}(H_2, g) = 28.84 \text{ JK}^{-1} \text{ mol}^{-1}$, $C_{p,m}(O_2, g) = 29.37 \text{ JK}^{-1} \text{ mol}^{-1}$. 4

4. (a) Starting from $H = f(T, P)$ show that

$$\mu_{JT} = \frac{1}{C_p} \left(T \left(\frac{\partial V}{\partial T} \right)_P - V \right) \text{ and } \mu_{JT} = 0 \text{ for an}$$

ideal gas. 5

- (b) Calculate the free energy change and maximum work that can be extracted from the given reaction, carried out in a bomb calorimeter at $25^\circ C$: 4



$$\Delta U = -2810 \text{ kJ mol}^{-1} \text{ and } \Delta S = 182.4 \text{ JK}^{-1}$$

- (c) State zeroth law of thermodynamics and give one of its applications. 3

5. (a) Show that $pV^\gamma = \text{constant}$ for an ideal gas undergoing reversible adiabatic expansion. 4

- (b) Calculate ΔS for the transformation Ice ($0^\circ C$, 1 bar) \rightarrow Steam ($100^\circ C$, 1 bar) if

$$T_m = 0^\circ C, \Delta H_{fus} = 6.100 \text{ kJ mol}^{-1}, T_b = 100^\circ C, C_p(H_2O, l) = 75.24 \text{ JK}^{-1} \text{ mol}^{-1} \text{ and}$$

$$\Delta H_{vap} = 40.65 \text{ kJ mol}^{-1}. \quad 5$$

- (c) Show that the decrease in Gibbs free energy at constant temperature and pressure is equal to network over and above the mechanical work. 3

6. (a) The partial molar volume of ethanol in an ethanol-water solution with 55 mole% ethanol is $58 \text{ cm}^3 \text{ mol}^{-1}$. The density of solution is 0.85 g cm^{-3} . Calculate the partial molar volume of water in the solution. 5

- (b) Using Gibb's - Duhem equation, show that for a two component system, if the chemical potential of one component increases then the chemical potential of other component must decrease. 5

- (c) Which of the following are not partial molar quantity? 2

$$\left(\frac{\partial A}{\partial n_i} \right)_{T,V}, \left(\frac{\partial V}{\partial n_i} \right)_{T,P}, \left(\frac{\partial U}{\partial n_i} \right)_{S,V}, \text{ and } \left(\frac{\partial H}{\partial n_i} \right)_{T,P}$$

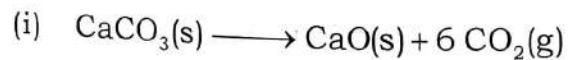
7. (a) Consider the reaction $\text{N}_2\text{O}_4(\text{g}) \rightleftharpoons 2\text{NO}_2(\text{g})$ at 25°C and 1 atm. If 1 mole of N_2O_4 is confined in a vessel at 1 atm pressure, calculate the degree of dissociation if ΔG_f° for N_2O_4 is 95.8 and for NO_2 is 50.3 kJ mol^{-1} .

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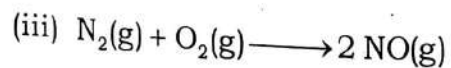
- (b) Derive the van't Hoff equation

$$\frac{d \ln k_p}{d \left(\frac{1}{T} \right)} = \frac{-\Delta H^\circ}{R} \quad 4$$

- (c) Predict the sign of ΔS_{sys} , giving reasons, for any **two** of the following : 3



- (ii) When a normal rubber band is stretched.



8. (a) Derive a relation between Van't Hoff factor and degree of dissociation of a weak electrolyte. 3

- (b) The addition of 100g of a compound to 750g of CCl_4 lowered the freezing point of the solvent by 10.5K. Calculate the molar mass of the compound and the osmotic pressure of the solution at 298 K given $K_f = 31.8 \text{ KKgmol}^{-1}$ and density of CCl_4 is 1.59 gcm^{-3} .

5

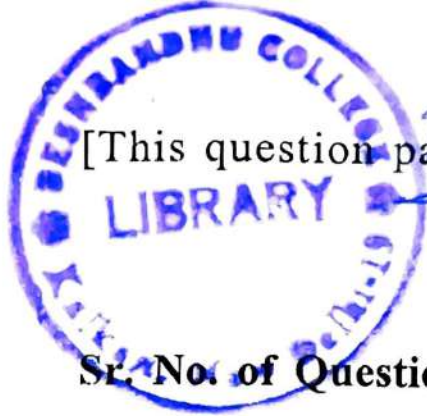
- (c) Define Raoult's law and Henry's law ? 2

- (d) Explain why aerated soda bottles give effervescence on opening. 2

9. (a) State and explain third law of thermodynamics. How is it useful in calculating the absolute entropy of a substance ? 4

(b) Derive the relation $\left(\frac{\partial V}{\partial S}\right)_T = \left(\frac{\partial T}{\partial P}\right)_V$ 4

(c) Calculate the enthalpy change for the reaction $\text{C}_2\text{H}_4(\text{g}) + \text{H}_2(\text{g}) \longrightarrow \text{C}_2\text{H}_6(\text{g})$. Bond energy values of C - C, C = C, C - H, H - H bond are 336.81, 606.68, 410.87, 431.79 kJmol^{-1} respectively. 4



For booting old papers (12)

[This question paper contains 6 printed pages.]

Your Roll No.....
16/5/17

Sr. No. of Question Paper : 751 G
Unique Paper Code : 217201
Name of the Paper : Physical Chemistry – I Chemical Thermodynamics and Systems of Variable Composition
Name of the Course : **B.Sc. (Hons) Chemistry**
Semester : II
Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **six** questions in all.
3. Question No. 1 is compulsory.
4. Use of scientific calculator and log table is allowed.

1. Explain why
 - (a) Heat of neutralization of all acids and bases in dilute solution is constant.
 - (b) Differentiate between isolated and open system.
 - (c) The entropy of a perfectly crystalline substance is Zero at the zero of Kelvin. Explain.

P.T.O.

- (d) Explain with examples spontaneous and non spontaneous processes.
- (e) Give the significance of Chemical Potential.
- (f) What is inversion temperature in Joule-Thomson Effect. (6×2½)
2. (a) Explain the term entropy and give its physical significance. The entropy of the universe is increasing. Explain.
- (b) Given that $dU = TdS - PdV$, show that
- (i) $dH = VdP + TdS$
- (ii) $dG = -SdT + VdP$
- (iii) $dA = -SdT - PdV$
- (c) Calculate the value of Δu and ΔH on heating 64.0 g of O_2 from $0^\circ C$ to $100^\circ C$. The C_v and C_p values on an average are 5.0 and 7.0 cal/mol/deg. (3+5+4)
3. (a) Deduce the free energy function for isothermal conditions. What is the physical significance of G ?
- (b) Define the enthalpy of neutralization and explain why all acids and bases in dilute solutions have constant enthalpy of neutralization.

- (c) At $25^\circ C$ for the combustion of 1 mole of liquid benzene the heat of reaction at constant pressure is given by :
- $$C_6H_6(l) + 7\frac{1}{2}O_2(g) \rightarrow 6CO_2(g) + 3H_2O(l). \Delta H = -780.980 \text{ Cal}$$
- What would be the heat of reaction at constant volume ? (4+4+4)
4. (a) What is the significance of partial molar free energy or the chemical potential ?
- (b) Derive the thermodynamic equation for open system in terms of u , H , A , S and V .
- (c) The heat of combustion of ethyl alcohol is -330 kcal. If the heat of formation of $CO_2(g)$ and $H_2O(l)$ be -94.3 kcal and $-68.$ kcal respectively, calculate the heat of formation of ethyl alcohol.
- Given :
- $$C_2H_5OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l) \quad \Delta H = -330 \text{ kcal}$$
- $$C(\text{graphite}) + O_2(g) \rightarrow CO_2(g) \quad \Delta H = -94.3 \text{ kcal}$$
- $$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l) \quad \Delta H = -68.5 \text{ kcal}$$
- (4+4+4)

5. (a) Deduce Entropy Change for an ideal gas in terms of

(i) T and V as variables

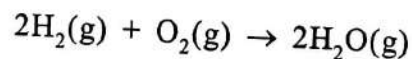
(ii) P and T as variables.

(b) Derive Maxwell's Thermodynamic Relations.

$$(i) (\partial T / \partial V)_S = -(\partial P / \partial S)_V$$

$$(ii) (\partial S / \partial V)_T = (\partial P / \partial T)_V$$

(c) For the reaction



The Gibbs free energy changes at 298 K and 500 K are -474.36 kJ and -408.4 kJ, respectively. Calculate the heat of reaction.

(4+3+5)

6. (a) What are the conditions of equilibrium and criteria for a spontaneous change?

(b) Summarize the criteria for reversible and irreversible reaction at

(i) Constant E and V

(ii) Constant S and V

(iii) Constant S and P

(iv) Constant P and T

(c) What is Joule-Thomson Effect and give its significance? How is the Joule-Thomson Coefficient (μ) related with cooling of the gas? (4+4+4)

7. (a) Derive the Clausius and Clapeyron equation to be applied to various physical equilibria.

(b) How can the third law of thermodynamics be used to determine the absolute entropy of steam at 373 K and 1.0 atm pressure?

(c) (i) State Function and Path Functions.

(ii) Reversible and Irreversible Processes. (4+4+4)

8. (a) What do you understand by the terms C_p and C_v ? Derive:

$$C_p - C_v = VT \alpha^2 / \beta$$

(b) Derive the following relationship for an ideal gas undergoing adiabatic process.

$$PV^\gamma = \text{constant}$$

- (c) The heat of reaction for $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$ at 27°C was found to be -21.976 kcal. What will be heat of reaction at 50°C ?

[The molar heat capacity at constant P and at 27°C for N_2 , H_2 and NH_3 are 6.8, 6.77 and 8.86 cal/mol/deg.]

(4+4+4)



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[This question paper contains 7 printed pages.]

2215117

Your Roll No.....

Sr. No. of Question Paper : 752 G

Unique Paper Code : 217203

Name of the Paper : Analytical Method in Chemical Analysis [CHHT - 204]

Name of the Course : B.Sc. (Hons) Chemistry

Semester : II

Duration : 3 Hours

Maximum Marks : 75

Instructions for Candidates:

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **Six** questions in all including **Q. No. 1**, which is compulsory.
3. Use of scientific calculator is allowed.
4. **Log table** to be provided to the candidates.

1. (a) Fill in the blanks (Any Five) (5x1=5)

(i) The Finger print region in the IR spectrum range from _____ cm^{-1}

P.T.O.

- (ii) The UV absorption peaks are usually _____ than the IR absorption peaks.
- (iii) In the thermogravimetry, when a compound is heated at uniform rate _____ is recorded as function of temperature.
- (iv) The glass electrode has _____ resistance.
- (v) The apparatus used for solvent extraction is _____.
- (vi) The process by which a representative fraction is acquired is called _____.
- (b) Attempt any Five (5×2=10)
- (i) What is the basic difference between the principle of prism and grating as monochromator.
- (ii) Write down the factors that produce deviations from Lambert Beer's law.
- (iii) How many types of transitions are possible in electronic spectroscopy? Arrange these transitions in the increasing order of their energy.

- (iv) Describe the method of extraction of any metal ion using acetylation as chelating agent.
- (v) CO_2 does not have permanent dipole moment but is IR active. Explain why?
- (vi) How do distribution coefficient and distribution ratio differ in solvent extraction?
2. Attempt any **Four** (4×3=12)
- (i) What is coordinate water and lattice water? How are they differentiated by TGA.
- (ii) Distinguish among
- (a) spectroscopy,
- (b) spectrograph, and
- (c) spectrophotometer,
- (iii) Draw conductometric curve for $(\text{HCl} + \text{CH}_3\text{COOH})$ vs NaOH . What are the advantages of these titrations over the ordinary titrations?
- (iv) The percentage transmittance of an aqueous solution of unknown compound is 30% at 25°C at 345nm for 4.0×10^{-5} M in a 2.0 cm cell. Calculate:

- (a) The absorbance (A)
- (b) The molar extinction or absorption coefficient
- (c) The percentage transmittance of 2.0×10^{-5} M solutions in a 2.0 cm cell.
- (v) What are liquid ion exchangers? Compare them with ion exchanger resins.

3. Attempt any **Three** (3x4=12)

- (i) State Beer's Law give its mathematical expression and explain the terms involved in it.
- (ii) The mixture of CaO and CaCO_3 is analyzed thermogravimetrically. The thermogram shows one reaction between 500°C - 900°C where the mass of sample decrease from the 125.3 mg to 95.4 mg. What is the % composition of mixture?
- (iii) Discuss the basic principle and mechanisms of solvent extraction method.
- (iv) Describe any method by which chemical interference in quantitative analysis using AAS can be minimized.

4. Attempt any **Three** (3x4=12)

- (i) Calculate standard deviation and relative standard deviation for five values obtained in typical redox titration of oxalic acid against potassium permanganate?

9.990;9.985;9.973;9.980;9.983 mL.

- (ii) Draw the TGA curve of MgC_2O_4 Give the reaction and explain?
- (iii) Outline the principle by which an internal current amplification of analog signal is achieved in Photomultiplier Tube?
- (iv) Define precision and accuracy. Explain with the help of a diagram.
5. (i) How do furnace heating rate effect the TG curve. Explain with example.
- (ii) Draw labeled diagram of Glass electrode. What happens to the response of glass electrode at $\text{pH} > 9$.
- (iii) What do you understand by resolving power of a Prism? How does it affect the spectral quality?

(3x4=12)

P.T.O.

6. (i) Flame AAS is widely used as a routine method for quantitative estimation of trace metals in solution, however for alkali metals flame photometer is recommended. Explain.
- (ii) Explain the selection of solvent system in the separation by TLC.
- (iii) Differentiate any two
- (a) Atomic Emission and Atomic Absorption Spectroscopy
- (b) Photo Cell and Photomultiplier Tube
- (c) Random Error and Systematic Error (3x4=12)
7. (i) Which of the following molecules show infra-red absorption spectra, justify your answer.
H₂, HCl, CH₄, H₂O
- (ii) Quartz cuvette can be used for both ultra-violet and visible light region while glass cuvettes are used only for visible region. Explain.
- (iii) Enlist the necessary conditions which should be fulfilled by radiation source used in the spectrophotometers.

- Name different radiation sources used in ultra-violet and visible spectrophotometers. (3x4=12)
8. (i) What are the advantages of using FTIR Spectrometer instead of dispersive IR spectrometer.
- (ii) What are the main factors effecting the solvent extraction?
- (iii) What is the function of a monochromator in spectrophotometer? (3x4=12)

S. No. of Question Paper : **754**
 Unique Paper Code : 222251
 Name of the Paper : Physics-I
 Name of the Course : B. Sc. (Hons.) Chemistry
 Semester : II
 Duration : **3 Hours**



Maximum Marks : 75

(Write your Roll No. on the top immediately on receipt of this question paper)

Attempt Five questions in all.

Use of non-programmable scientific calculator is allowed

1. (a) Identify the polar and axial vectors among the following: (5)
- angular momentum
 - linear momentum
 - force
 - torque
 - magnetic force $[\vec{q}(\vec{v} \times \vec{B})]$
- (b) Prove the following identities: (5, 5)
- $(\vec{A} \times \vec{B}) \cdot (\vec{C} \times \vec{D}) = (\vec{A} \cdot \vec{C})(\vec{B} \cdot \vec{D}) - (\vec{A} \cdot \vec{D})(\vec{B} \cdot \vec{C})$
 - $\vec{A} \times (\vec{B} \times \vec{C}) + \vec{B} \times (\vec{C} \times \vec{A}) + \vec{C} \times (\vec{A} \times \vec{B}) = 0$
2. (a) State and prove Stoke's theorem of vector calculus. (10)
- (b) Using the divergence theorem,
 evaluate $\iint_S \vec{A} \cdot \hat{n} \, dS$,
 where $\vec{A} = y^2 \hat{i} - (2xy + z^2) \hat{j} + 2yz \hat{k}$ and S is the unit cube situated at the origin and lies in first octant. (5)
3. (a) Find the centre of mass for a structure of four masses 1 kg, 2 kg, 3 kg and 4 kg placed at the corners of a square of side 1 m and held by massless rods w.r.t. 1 kg mass. Calculate the moment of inertia of this structure about any one side of the square. (4, 4)
- (b) What are elastic collisions? What are the final velocities of the two bodies of masses m_1 and m_2 after a head-on collision given that u_1 and u_2 are the initial velocities of the masses, respectively. (7)

4. (a) Define angular momentum of a particle about a point. Prove that the relation between the torque applied on a rotating body and its angular momentum is given by

$$\vec{\tau} = \frac{d\vec{L}}{dt} .$$

Hence, state the law of conservation of angular momentum. (2, 4, 2)

- (b) State and prove the theorem of parallel axes for Moment of Inertia. (7)
5. (a) Establish the equation of motion of damped harmonic oscillator and obtain the steady state solution in weak damping approximation. What do you understand by Q factor of an oscillator? What is the value of Q factor of an ideal oscillator? (7, 3, 2)
- (b) In an experiment to obtain Lissajous Figures, one tuning fork is of frequency 250 Hz and a circular figure occurs after every 5 seconds. What deductions may be made about the frequency of the other tuning fork? (3)
6. (a) Monochromatic light is incident on a Fresnel Biprism arrangement. Explain the formation of interference fringes. Derive an expression for the fringe width. (3, 7)
- (b) What are coherent sources of light? Explain why two independent sources of light of the same wavelength cannot produce observable interference pattern. (5)
7. (a) Obtain the expressions for the resolving power and dispersive power of a plane transmission grating. Establish the relation between them. (6, 3)
- (b) Give three differences between a zone plate and a convex lens. (6)
8. (a) What are quarter wave plate and half wave plate? How can we produce circularly polarised light from unpolarised light with the help of polariser and quarter wave plate? (2, 2, 3)
- (b) What do you understand by plane polarised, circularly polarised and elliptically polarised light? (6)
- (c) State Brewster's Law of polarization. (2)