Fourth Semester Bachelor of Science (B. Sc.) Examination

PHYSICAL CHEMISTRY

Paper–II (CH–402)

Time : Three Hours]　　　　　　　　　　[Max. Marks : 50

N. B. : (1) All **Five** questions are compulsory and carry equal marks.

(2) Draw diagrams wherever necessary.

1. (A) Derive an expression of work–done in Carnot Cycle.　　5

   (B) Derive Gibb's – Helmholtz equation. The Gibb's free energy change of a reaction at 300 K and 310 K are –121 kJ and – 123.5 kJ respectively. Determine the change in enthalpy for the reaction in this temperature range.　　5

   OR

   (C) Give any five statements of 2nd Law of thermodynamics.　　$2\frac{1}{2}$

   (D) Starting from the equation $\triangle G^{0} = -RT\,lnk_{p}$ derive the integrated form of Van't Hoff's equation.　　$2\frac{1}{2}$

   (E) Calculate the entropy change when 2 moles of an ideal gas is allowed to expand at 300 K, from pressure of 10 atm to 2 atm.　　$2\frac{1}{2}$

   (F) (i) Define partial molar free energy.

   (ii) Write the relationship between $\triangle G$ and $\triangle A$.　　$2\frac{1}{2}$

(A) Derive Nernst equation for emf of a cell at 25^0C. How can the equilibrium constant of a cell reaction be calculated from emf ? 5

(B) Derive the relations :

   (i) Between emf and change in free energy of a cell reaction.

   (ii) Between emf and heat of reaction. 5

OR

(C) Discuss briefly reversible and irreversible cells. $2\frac{1}{2}$

(D) Derive an expression for the emf of a concentration cell without transference. $2\frac{1}{2}$

(E) The emf of the cell using quinhydrone electrode was found to be 0.264 V at 25^0C. Calculate the P^H of solution.

   (Given : E^0_{SCE} (reduction) = 0.2415 V and E^0_Q (oxidation) = $-$ 0.6994 V). $2\frac{1}{2}$

(F) What is salt bridge ? What are its functions ? $2\frac{1}{2}$

3. (A) Define :

   (i) Mass defect.

   (ii) Binding Energy and

   (iii) Binding Energy per nucleon.

   Calculate the binding energy per nucleon of $^{16}_8O$, whose mass defect is 0.1370148 amu. 5

(B) What is dipole moment ? How is it used to

calculate percentage ionic character of a [?] covalent bond ?

Calculate the percentage ionic.

Character of Li – H bond. If its observed dipole moment is 1.963×10^{-28} Cm. and the bond length is 1.595 A^0.

(Given : $q = 1.6 \times 10^{-19}$ C)   5

OR

(C) Give the applications of radioisotopes in medical science and agriculture. $2\frac{1}{2}$

(D) How ortho, meta and para substituted isomers of Benzene can be distinguished from dipole moment measurements ? $2\frac{1}{2}$

(E) Compare nuclear shell model with liquid drop model. $2\frac{1}{2}$

(F) Explain polarisation of molecules in the electric field. $2\frac{1}{2}$

4. (A) What is the relationship between dipole moment and Rotational Spectra ?

Derive an expression of rotational energy of diatomic molecule by considering it as rigid rotor.   5

(B) What are harmonic and anharmonic oscillators ? Draw their potential energy diagram. What is fundamental band and overtones ?   5

OR

(C) The rotational constant of NO molecule is 166 m^{-1}. Calculate bond length if its reduced mass is 1.24×10^{-26} kg. $2\frac{1}{2}$

(D) Calculate number of modes of Vibrations in CO_2 molecule. How can they be represented

diagrammatically with vibrational frequency?

$2\frac{1}{2}$

(E) Amongst $H_2(g)$, $CO(g)$, $HCl(g)$, NH_4Cl (s) and H_2O (g), which molecules will give pure rotational Spectra.

$2\frac{1}{2}$

(F) (i) What do you know about non–rigid rotor?

(ii) What is force constant?

$2\frac{1}{2}$

5. Solve any **ten** of the following :—

(i) What are the limitations of 1st Law of thermodynamics?

(ii) Give the criteria of thermodynamic equilibrium in terms of free energy.

(iii) Give an expression of Van't Hoffs reaction isotherm.

(iv) What is emf of the cell?

(v) Give the reduction half cell reaction of calomel electrode.

(vi) What is liquid junction potential?

(vii) What is bond moment and group moment?

(viii) Explain nuclear fission with one example.

(ix) When the dipole moment of a molecule is zero, what will be its Shape?

(x) Draw rotational energy level diagram.

(xi) Write Morse equation and explain the terms involved in it.

(xii) What is the selection rule for the transition between rotational energy levels? $1 \times 12 = 12$