

**Bachelor of Science (B.Sc.) Semester—IV (C.B.S.) Examination**

**CH-402 : CHEMISTRY (Physical Chemistry)**

**Paper—II**

Time : Three Hours]

[Maximum Marks : 50

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

(2) Draw diagrams wherever necessary.

1. (A) Derive Van't Hoff reaction isotherm. The equilibrium constant for a reaction at 25° C is  $1.22 \times 10^3$ . Calculate  $\Delta G^\circ$  for the reaction. 5
- (B) Derive an expression for the entropy change when an ideal gas expands reversibly in an isobaric process. 5

**OR**

- (C) How much work can be obtained from an engine working between 0° C and 50°C, when 52 KJ of heat supplied to it ? 2½
- (D) State and explain partial molar quantities. 2½
- (E) Calculate entropy of fusion and vapourization of 27g of water.  
(Enthalpy of fusion = 6.01 KJmol<sup>-1</sup>  
Enthalpy of Vapourization = 40.79 KJmol<sup>-1</sup>). 2½
- (F) Derive Gibbs-Helmholtz equation. 2½
2. (A) How pH of the solution can be determined using hydrogen electrode ?  
Consider the cell,  
Pt, H<sub>2</sub>(g) (1 atm) H<sup>+</sup>(x-moles) || KCl(0.1 M) | Hg<sub>2</sub>Cl<sub>2</sub>|Hg  
If emf of the cell is 0.50 V at 25° C, what would be the pH of x-molar acidic solution ?  
(Given : E°<sub>cal</sub> = 0.281 V). 5
- (B) Derive the relationship between equilibrium constant and emf of the cell.  
for the cell,  
Zn | Zn<sup>2+</sup>(1M) || Cd<sup>2+</sup>(1M) | Cd  
Write the cell reaction and calculate its equilibrium constant at 25° C.  
(Given : E°<sub>cell</sub> = 0.36 V). 5

**OR**

- (C) Derive Nernst equation for EMF of a cell at 25° C. 2½
- (D) Discuss the potentiometric acid-base titration. 2½
- (E) Calculate emf of the following cell at 25° C Pt, H<sub>2</sub>(1 atm) | HCl (a = 0.001) | HCl (a = 0.1) | H<sub>2</sub>(1 atm), Pt. Given : Transference number of H<sup>+</sup> ions = 0.84. 2½
- (F) What do you understand by EMF of a cell ? How can it be measured Experimentally ? 2½
3. (A) What are radioisotopes ? Give important applications of radioisotopes in the field of :
- (i) Medical Science and
- (ii) The study of reaction mechanism. 5
- (B) What are polar and non-polar molecules ? The bond length of HCl molecule is  $2.36 \times 10^{-20}$  m and its dipole moment is found to be  $28.5294 \times 10^{-30}$  Cm. Calculate the percentage ionic character of HCl bond. 5

**OR**

- (C) How does liquid drop model explain nuclear fission reaction 2½
- (D) Calculate binding energy per nucleon of  ${}_1\text{H}^2$  nucleus.  
(Given : Mass of  ${}_1\text{H}^2 = 2.014102$  amu  
 $m_n = 1.008665$  amu  
 $m_p = 1.007825$  amu ). 2½
- (E) Give the application of dipole moment measurements in distinguishing geometrical isomers. 2½
- (F) Discuss briefly bond moment and group moment. 2½
4. (A) Rotational spectrum of HI consists of a series of equally spaced lines separated by  $12.8 \text{ cm}^{-1}$ . Calculate the moment of inertia and internuclear distance.  
(Given : Atomic mass of Hydrogen =  $1.67 \times 10^{-27}$  kg  
Atomic mass of Iodine =  $2.10 \times 10^{-25}$ kg). 5
- (B) Discuss vibrational spectra of diatomic molecule as an anharmonic oscillator. What is fundamental and overtone band ? 5

**OR**

- (C) Discuss rotational spectra of diatomic molecule. 2½
- (D) Explain why do molecules behave as a non-rigid rotors. 2½
- (E) What are simple harmonic oscillators ? What is zero point energy of harmonic oscillator ? 2½
- (F) Discuss normal modes of vibration in linear and non-linear molecules. 2½

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

- (i) Give any two limitations of second law of thermodynamics.
- (ii) What would be the values of entropy for :
  - (a) Condensation of a gas and
  - (b) Melting of a solid ?
- (iii) Define partial molar free energy.
- (iv) What are Voltaic cells ?
- (v) Give the relationship between emf of the cell and free energy change.
- (vi) What are reference electrodes ?
- (vii) What is nuclear fission ?
- (viii) Define polarizability of a molecule.
- (ix) What will be the dipole moment of p-dihydroxy benzene ?
- (x) What is force constant ?
- (xi) Which of the following molecules will show rotational spectra ?  
HCl, CO<sub>2</sub>, N<sub>2</sub>O and NH<sub>3</sub>.
- (xii) What is the selection rule for the transition between rotational energy levels ? 1×10=10