

**Bachelor of Science (B.Sc.) Semester—IV Examination
(New & Old)**

CH-402 : CHEMISTRY (Physical Chemistry)

Compulsory Paper—II

(New Course)

Time Three Hours]

[Maximum Marks : 50

N.B. :— (1) All FIVE questions are compulsory.

(2) Write chemical equations and draw diagrams wherever necessary.

- ✓ (A) State and explain laws of crystallography. 5
- (B) Derive Bragg's equation for diffraction of X-rays. The diffraction of X-rays of wavelength 3.0×10^{-10} m gives first order reflection at 27° . Calculate the interplanar distance. 5

OR

- (C) Write the difference between crystalline and amorphous solids. 2½
- (D) A crystal plane cuts the X-axis at unit distance and is parallel to Y and Z axes. Calculate Weiss and Miller indices. 2½
- (E) Explain Powder method of crystallography. What are its advantages over other methods? 2½
- (F) Why is Bragg's method unable to show that KCl has FCC crystal structure like NaCl. 2½
- 2 (A) What is transport number? Explain moving boundary method for determination of transport number. 5
- (B) Give the application of Kohlrausch's law in the determination of solubility of sparingly soluble salt. The specific conductivity of 0.001028 m acetic acid is 4.95×10^{-5} S.cm⁻¹. Calculate dissociation constant, if λ^∞ for acetic acid is 390.7 S cm² mol⁻¹. 5

OR

- (C) Write note on Relaxation effect. 2½
- (D) Explain variation of equivalent conductivity of the weak electrolytes with dilution. 2½
- (E) What are advantages of conductometric titrations over usual titration. 2½
- (F) The resistance of a 0.1 m KCl solution in a conductivity cell is 325 ohm and the specific conductance of the same solution is 1.29 S m⁻¹. If the resistance of a 0.05 m NaCl solution in the same cell is 752.4 ohm. Calculate the equivalent conductance of NaCl solution. 2½

0.011

2½

3. (A) Derive an expression for the frequency of rotational lines in the pure rotational spectrum. What types of molecules exhibit rotational spectra ? 5
- (B) What is simple harmonic oscillator ? How does its potential energy vary with displacement from equilibrium position ? Sketch its vibrational energy levels. What is zero point energy ? 5

OR

- (C) The rotational spectrum of CO shows a series of equidistant lines spaced 384.235 cm^{-1} apart. Calculate moment of inertia and bond length of CO bond. (Atomic mass of C = 12, O = 16 amu and $h = 6.626 \times 10^{-34} \text{ J.S.}$) 2½
- (D) Discuss P, Q and R branches of vibrational-rotational spectra. 2½
- (E) Describe normal modes of vibrations of H₂O molecule. 2½
- (F) Which of the following give pure rotational spectra CO_{2(g)}, HCl_(g), NO_(g) and H_{2(g)}? 2½

- (A) Derive de Broglie relation. How is dual nature of electron verified experimentally ? 5

- (B) Explain the applications of magnetic susceptibility in :
- Deciding molecular structure of substance.
 - The study of co-ordination compounds.

OR

- (C) State the postulates of quantum mechanics. 2½
- (D) Explain the terms :
- Normalised wave function.
 - Orthogonal wave function.
- (E) Calculate magnetic moment of a molecule having four unpaired electrons. 2½
- (F) Explain Gouy's method for the determination of magnetic susceptibility. 2½

5. Attempt any TEN questions of the following : <https://www.rtmnuonline.com>

- Identify the crystal system having unit cell parameters $a \neq b \neq c$; $\alpha \neq \beta \neq \gamma$.
- Define Unit Cell.
- Draw the unit cell of CsCl.
- Give the relation between specific conductance, observed conductance and cell constant.
- State Ostwald's dilution law.
- If the transport number of cation is 0.84. Calculate the transport number of anion.
- Give selection rule for pure vibrational spectra.
- What is rigid rotor ?
- Define fundamental vibrational frequency.
- Define threshold frequency.
- State Heisenberg's Uncertainty principle.
- Write Clausius-Mosotti equation. 1 × 10 = 10