

B.Sc. 5th Semester (Honours) Examination, 2024 (CBCS)**Subject : Chemistry****Course : DSE-1****Time: 2 Hours****Full Marks: 40***The figures in the margin indicate full marks.**Candidates are required to give their answers in their own words
as far as practicable.*

1. Answer any five questions: $2 \times 5 = 10$
- Show that the heat capacity would remain unchanged in any transformation in the vicinity of zero Kelvin. 2
 - Comment: "Dipole moment is an intensive property and a scalar quantity." 1+1
 - What are the differences between addition polymers and condensation polymers? 2
 - Define degree of polymerisation. What is its significance? 1+1
 - What are the dimensional characteristics of a triclinic Bravais lattice? 2
 - Show that the interplanar distance for a cubic crystal can never be $\frac{a}{\sqrt{7}}$, where 'a' is the length of an edge of the cube. 2
 - Two systems A & B have thermodynamic probabilities W_A & W_B . Find the thermodynamic probability of the system obtained by combining the two with proper reasoning. 2
 - Define Grand Canonical Ensemble. What type of thermodynamic system is described by it? 1+1
2. Answer any two questions: $5 \times 2 = 10$
- (i) Justify or, Criticize — "Miller indices of a crystal face actually refer to a class of faces".
(ii) Find the intercepts made on the three axes by the first (most near to the origin) two planes among the class represented by the Miller indices $(2\bar{1}0)$. Depict the two planes. $2 + (1+1+\frac{1}{2}+\frac{1}{2})$
 - (i) Define residual entropy. Why does carbon monoxide exhibit high value of residual entropy?
(ii) Find the C-Cl bond moment if the total molar polarisation of (1, 1) – dichloro-ethylene be $89.8 \text{ cm}^3 \text{ mole}^{-1}$ at 320 K and $75.05 \text{ cm}^3 \text{ mole}^{-1}$ at 400 K, respectively, neglecting the 'C = CH₂' bond moment. $(1+1)+3$
 - (i) Explain how is the stability of a macro-state determined by its thermodynamic probability.
(ii) Derive a relation between translational partition function of an ideal gas with its de Broglie wavelength. $2+3$

- (d) (i) Why was the concept of average molar mass introduced for polymers?
 (ii) If equal masses of two polymeric forms with molar mass 20 kg mole^{-1} and 30 kg mole^{-1} be present in a suspension, find $\overline{M_n}$ & $\overline{M_w}$. 2+(2+1)

3. Answer *any two* questions: $10 \times 2 = 20$

- (a) (i) Explain why a crystal acts as a three-dimensional diffraction grating for X-rays.
 (ii) What do you mean by order of reflection? What is its significance?
 (iii) Find the minimum interplanar distance for a crystal to produce a diffraction spectra for a given radiation.
 (iv) Find an expression for enthalpy in terms of molecular partition function. 2+(1+1)+2+4
- (b) (i) Explaining all the steps involved in a chain polymerisation, show that both the rate of propagation and the rate of termination can easily be determined from the initial concentration of the monomer and the initiator used for a chain polymerisation.
 (ii) A metal forms a cubic lattice with edge length 6.18 \AA . Find the radius of an atom of the metal (taking an atom to be spherical) if the density of the metal be 1.87 g cm^{-3} & the mass of one atom of it be 132.9 a.m.u. (3+3)+4
- (c) (i) If the energy of an oscillator vibrating with a frequency ν in one direction be given by, $\bar{E} = \frac{h\nu}{h\nu/KT_1}$, arrive at Einstein's equation for heat capacity of solids. How far was the equation successful to explain the heat capacity values of solids?
 (ii) Explain whether a non-polar molecule can be polarised.
 (iii) An ideal gas contains 4 number of particles having "A" category and 5 number of particles having "B" category. Calculate the total partition function of the ideal gas.
 (iv) Comment — While energy is additive, partition function is multiplicative. (3+1)+2+2+2
- (d) (i) Derive the Barometric Distribution formula. From it explain why mountaineers need to carry oxygen cylinders with them.
 (ii) If a polymer solution contains two polymeric forms A and B in equal number of moles, then show that molar mass of B can be represented either as $M_B = \overline{M_n} + (\overline{M_n} \overline{M_m} - \overline{M_n}^2)^{1/2}$.
 or as $M_B = \overline{M_n} - (\overline{M_n} \overline{M_m} - \overline{M_n}^2)^{1/2}$.
 (iii) Examine the validity of Stirling's approximation formula for a system having 50 particles. (3+1)+4+2