# 2023

## 5th Semester Examination

## CHEMISTRY (Honours)

### Paper : DSE 1-T

### [Advanced Physical Chemistry]

#### [CBCS]

Full Marks : 40                Time : Two Hours

*The figures in the margin indicate full marks.*
*Candidates are required to give their answers*
*in their own words as far as practicable.*

### Group - A

Answer any *five* from the following questions :

$$2 \times 5 = 10$$

1. What is Bravais lattice?

2. Distinguish between Weiss indices and Miller indices.

3. Calculate the percentage of vacant space in a fcc lattice.

4. Which law of thermodynamics always helps us to calculate absolute value of entropy? Give the statement of that law.

P.T.O.

5. Write differences between mathematical probability and thermodynamic probability.

6. Find the molar residual entropy of a crystal in which molecules can adopt six orientations of equal energy at absolute zero.

7. What are conducting polymers?

8. What is the significance of 6,6 in nylon –6,6.

## Group - B

Answer any *four* from the following questions :

$$5 \times 4 = 20$$

9. (a) Show that the total energy of the system consisting $N$ identical and distinguishable particle is given —

$$E = -\frac{N}{Q}\frac{dQ}{d\beta} \quad (Q \text{ is molecular partition function})$$

(b) What is weight of configuration?                3+2

10. (a) A powder diffraction pattern for a given substance was obtained using X-rays from a *Cu* target $\lambda = 154$ pm. The distance from the capillary to the film was 5.0 cm. Diffracted lines were obtained, one of which was at distance 1.2 cm and another at 3.4 cm from the undeflected beam. Calculate the spacing for the plane that give rise to this line.

(b) Define unit cell.                3+2

11. (a) The molecular partition function of an ideal mono atomic gas is given by $Q = \left(\dfrac{AT}{B}\right)^{\frac{3}{2}} V$, where $A$ and $B$ are constants and other terms have usual significance. Find the expression of molar internal energy and pressure of the gas.

(b) Consider a system of non-interacting particles at constant temperature which are distributed in three non-degenerate energy level's in such a way that $\varepsilon_1$, $\varepsilon_2$, $\varepsilon_3$ levels consist of $4 \times 10^{23}$, $2 \times 10^{23}$ and $1 \times 10^{23}$ particles respectively. Show that energy levels are equispaced.                3+2

12. (a) Atoms of element $B$ form hcp lattice and those of the element $A$ occupy 2/3rd of tetrahedral voids. What is the formula of the compound formed by the elements $A$ and $B$?

(b) An element occurs in two crystalline form $\alpha$ and $\beta$ having a transition temperature $t$, the $\alpha$ form which is stable at a low temperature and has a face-entered cubic structure with the cell dimension of 3.68 Å and the $\beta$ form at the same temperature has a body-centered cubic structure with a cell dimension of 2.92 Å. What is the % of shrinkage or expansion for $\alpha \rightarrow \beta$ transformation?        2+3

P.T.O.

13. (a) Explain the mechanism and kinetics of step growth polymerization.

(b) What are block copolymer? 4+1

14. (a) Calculate the relative number of distinguishable states in ice and in water at 273 K : $\Delta H_{fus}$ = 6.0 kJ mol$^{-1}$ at 273 K, $k_B$ = 1.38 × 10$^{-23}$ JK$^{-1}$.

(b) Write the major criteria for formation of synthetic polymers. 3+2

## Group - C

Answer any *one* from the following questions : 10×1=10

15. (a) Derive Bragg's equation, $n\lambda = 2d_{h,k,l} \sin\theta$.

(b) State and explain Nernst Heat Theorem.

(c) Derive the Einstein equation for heat capacity of solid. 4+3+3

16. (a) On what factors does the intensity of reflected X-ray beams depend?

(b) Write differences between linear polymer and branch chain polymer.

(c) Establish the relation, $n_i = \dfrac{n}{Q} g_i e^{-\beta\varepsilon_i}$ (all terms have their usual significance). 2+2+6

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