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B.Sc./5th Sem (H)/CHEM/22(CBCS)

2022

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 :

2×5=10

1. What is meant by order of reflection?
2. State and explain second law of crystallography.
3. What is the basic difference between Einstein and Debye theory of heat capacity of solids.
4. Calculate the molar residual entropy of NO.
5. Is partition function dimensionless? What is its maximum and minimum value?
6. Define phase space and microstate.

P.T.O.

(2)

7. Calculate the f_{av} of a polymerizing reaction mixture consisting of 0.8 mole of ethylene glycol, 0.15 mole of glycerol and 0.05 mole of pentaerythritol.
8. What is glass transition temperature?

Group - B

Answer any **four** from the following questions : $5 \times 4 = 20$

9. (a) Write down the limitation(s) of Einstein theory of specific heat of solid.
- (b) An organic compound crystallizes in an orthorhombic system with two molecules per unit cell. The unit cell dimensions are $12.05\text{\AA}$, $15.05\text{\AA}$ and $2.69\text{\AA}$. If the density of the crystal is 1.419g cm^{-3} , calculate the molar mass of the organic compound. 3+2
10. (a) Show that separation of the (hkl) planes d_{hkl} in an orthorhombic crystal with sides a, b and c is given by
$$\frac{1}{d_{hkl}^2} = \frac{h^2}{a^2} + \frac{k^2}{b^2} + \frac{l^2}{c^2}.$$
- (b) Distinguish between Weiss indices and Miller indices. 3+2
11. (a) Four distinguishable molecules are distributed in energy levels E_1 and E_2 with degeneracy 2 and 3 respectively. Calculate the number of microstates with 3 molecules in energy level E_1 and one in energy level E_2 .

- (b) Explain how 3rd law of thermodynamics determines the absolute value of entropy (S_p) of a substance at a temperature (T) above its melting point. 2+3

12. (a) The single particle partition function (f) for a certain system has the form $f = AVe^{BT}$. Calculate the average energy per particle. A and B are constants.
- (b) The relative population in two energy states with energies E_1 and E_2 satisfying Boltzmann distribution is given by —

$$\frac{n_1}{n_2} = \frac{g_1}{g_2} \exp \left[-\frac{(E_1 - E_2)}{k_B T} \right]$$

Calculate relative degeneracy $\frac{g_2}{g_1}$.

- (c) Write the trade name of the following polymers —

(i) polyacrylonitrile (ii) polytetrafluoroethylene.

2+2+1

13. (a) Calculate the Miller indices of crystal planes which cut through the crystal axes at $(2a, -3b, -3c)$.
- (b) Distinguish between addition polymerization and condensation polymerization.
- (c) Give two examples of biodegradable polymer.

2+2+1

P.T.O.

14. (a) Write short note on Molecular forces and chemical bonding in polymers.
- (b) Establish the relation among functionality, extent of reaction and degree of polymerization. 2.5+2.5

Group - C

Answer any *one* from the following question : $10 \times 1 = 10$

15. (a) Define thermodynamic probability. Derive 3rd law of thermodynamics from thermodynamic probability.
- (b) A certain molecule has a doubly degenerate excited state lying at 360 cm^{-1} above the non degenerate ground state. At what temperature will 15 per cent of the molecules be in the upper level?
- (c) Silver is known to be crystallized in cubic form. The Bragg angles, using copper K_{α} X-ray with $\lambda = 154.1 \text{ pm}$, for the first diffraction lines are as follows :
- θ 19.08° 22.17 32.26° 38.78 40.82° 49°
- What is the type of the cubic crystal formed by silver?
- (d) What is graft copolymer? 3+3+3+1

16. Define molecular partition function and hence derive the expression to calculate the molar energy of a perfect monoatomic gas. 2+8
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