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UG/5th Sem/CHEM(H)/T/19

2019

B.Sc. (Honours)

5th Semester Examination

CHEMISTRY

Paper - DSE-1T

Advanced Physical Chemistry

Full Marks : 40

Time : 2 Hours

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

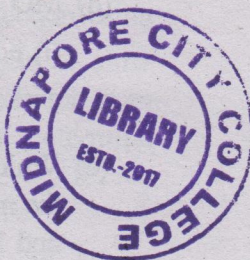
Group - A

1. Answer any five questions :

2×5=10

- (a) State Steno's law of crystallography.
- (b) K^+ and Cl^- ions have same scattering power — Justify.
- (c) Determine the Miller indices of the planes that intersect the crystallographic axes (i) a, 2b, 2c and (ii) a, b, -c.

[Turn Over]



(2)

- (d) MO is B.C.C, $\rho = 10.3 \text{ gm/cc}$. Calculate
(i) edge length (ii) d_{110} and d_{111} ($M = 95.94 \text{ gm/mol}$)
- (e) Which state function of the system is related to the maximum value of thermodynamic probability and how ?
- (f) What is the no. of Microstates for 4 identical distinguishable particles in two states.
- (g) State Planck's law (3rd law of thermodynamics).
- (h) Describe the mechanism of electrical conductivity in conducting polymers.

Group - B

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

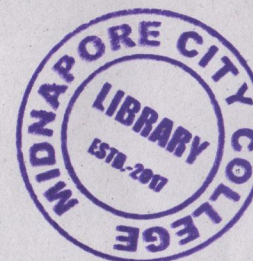
2. (a) KCl has a fcc lattice. But from X-ray diffraction experiment it appears to be simple cubic — Explain. 3
- (b) The density of NaCl is $2.17 \times 10^3 \text{ kg/m}^3$ and (100) plane reflection using X-ray of wave length λ occurs at $\theta = 6^\circ$. Calculate λ . 2
3. (a) Calculate the closest distance between the atoms placed in a fcc lattice. 1

(3)

- (b) The element Po (at wt = 210) crystallizes in the cubic system. Bragg first order reflection using X-ray of wave length 0.154 nm occur at $\sin \theta$ values 0.225 , 0.316 and 0.388 for reflection from (100), (110) and (111) planes (i) Determine whether the unit cell is S.C., B.C.C., F.C.C. (ii) Calculate 'a' (iii) Calculate density. 4
4. (a) The molecules of a gas have two energy states, zero and E and degeneracies g_1 and g_2 respectively. Write down the expression for molecular partition function. 2
- (b) Consider 20 molecules divided equally between four non-degenerate energy levels (i) what is the thermodynamic probability (w) for this distribution? (ii) How does the value of w change if one molecule is removed from one level and added to another ? 3
5. (a) Consider a system of six distinguishable particles. One of the macrostates has the following distribution of particles :

Energy :	0	1	2	3	4
No. of Particles :	0	0	2	2	2

Calculate its thermodynamic probability. 2



[Turn Over]

(4)

- (b) Calculate the difference in entropy between two macrostates I and II where six distinguishable particles are distributed in 3 different energy levels ($0, \epsilon$ and 2ϵ) in the following manner

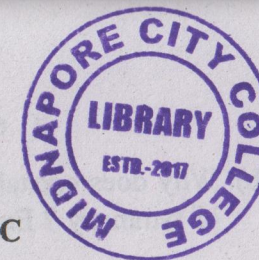
Energy	0	ϵ	2ϵ	
Macrostate - I	3	3	0	3
Macrostate - II	2	2	2	

6. (a) State Dulong & Petit's law. 1
- (b) What is the limitation of Einsteins model of Specific heat of solid ? 2
- (c) The Debye's law has been found to be quite satisfactory in the case of many metallic systems specially for cubical monoatomic ones — Explain. 2
7. (a) What is the criteria for synthetic polymer formations ? 3
- (b) Write short note on — Copolymerization. 2



(5)

Group - C



Answer any *one* question : 10×1=10

8. (a) Derive Barometric distribution formula from Boltzmann energy distribution. 4
- (b) Calculate the total number of Microstates of the distribution of three distinguishable particles in two boxes. 2
- (c) Calculate the rotational partition function for N_2 molecule at 27°C temperature. The internuclear distance of N_2 is 109.76 pm. 2
- (d) Suppose a molecule has two energy levels $\epsilon_1=0$ and $\epsilon_2=kT$. Calculate — (i) the partition function and (ii) ration of the number of molecules in the two levels [K = Boltzmann constant and T is the temperature in Kelvin] 2
9. (a) An element occurs in two forms α and β . α has FCC and β has BCC with 'a' values 3.68\AA and 2.92\AA respectively. (i) Calculate the percentage of shrinkage of volume when α is converted to β and (ii) Calculate the ratio of densities. 3

[Turn Over]

(6)

- (b) Why does crystal not show 5 fold, 7 fold axis of symmetry ? Explain. 3
- (c) What is meant by Tetrahedral and Octahedral voids ? 2
- (d) For which (111) planes do you expect the intensities to be less, those containing Na or those containing Cl^- atoms only in NaCl ? 2
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