

Please check whether you have got the right question paper.

- N.B:**
1. All questions are **compulsory**
 2. Use of **non-programmable scientific calculator** is **allowed**.

Useful constants: $c=2.998 \times 10^8 \text{ ms}^{-1}$

$N_A=6.023 \times 10^{23} \text{ mol}^{-1}$ $h=6.625 \times 10^{-34} \text{ Js}$

$1\text{ev}=1.602 \times 10^{-19} \text{ J}$ $1\text{e}=1.602 \times 10^{-19} \text{ C}$

$R=8.314 \text{ Jk}^{-1} \text{ mol}^{-1}$ $k=1.3811 \times 10^{-23} \text{ JK}^{-1} \text{ molecule}^{-1}$

$m_e=9.11 \times 10^{-31} \text{ kg}$ $m_p=1.673 \times 10^{-27} \text{ kg}$

$\mu_B=9.274 \times 10^{-24} \text{ JT}^{-1}$ $\mu_N=5.051 \times 10^{-27} \text{ JT}^{-1}$

- Q.1** Attempt **any five** of the following **15**
- (a) How are solids classified?
 - (b) Show that the critical radius-ratio for a triangular coordination is 0.155.
 - (c) Distinguish between ferromagnetism and Anti-ferromagnetism.
 - (d) Explain optical fibers. Give their importance in telecommunication.
 - (e) Explain the terms
 - i) Statistical weight factor 'g'
 - ii) Occupancy number
 - (f) Calculate number of ways to distribute
 - i) TWO distinguishable objects in two boxes
 - ii) TWO distinguishable objects in three boxes
 - (g) With Jablonski diagram, explain phosphorescence
 - (h) State and explain the principle of microscopic reversibility.
- Q.2** a) What are vapour phase transport methods? How and where are they used? **05**
- OR**
- a) Describe the single crystal method for characterization of solids. **05**
 - b) What are the factors that affect diffusion in solids? What is steady state diffusion? **05**
- OR**
- b) What are the different types of defects in solids? What are their characteristics? How do they affect the properties of solids? **05**
 - c) Calculate the distance between two adjacent ions of KCl crystal having F.C.C structure. **05**
(Given the density of KCl $=1.99 \times 10^3 \text{ kg/m}^3$ and molar mass of KCl =74.6.)
- Q.3** (a) Define the terms **05**
- i) Valence band
 - ii) Conduction band
 - iii) Forbidden gap. Hence classify, The solids into conductors, semiconductors and insulators.
- OR**
- (a) What is Nano technology? Describe in brief Three dimensional nano materials. **05**
 - (b) With the help of Fermi-Dirac statistics. Prove that the Fermi level in Intrinsic semiconductors lies exactly at the middle of the forbidden gap. **05**

OR

[P.T.O]

- (b) What is Piezeoelectricity? Describe in brief Ultrasonic echo sounding. 05
- (c) If the ratio of A^{3+} to A^{2+} in a non-stoichiometric sample of ionic crystal AO were 0.15, what fraction of cation sites would be occupied by vacancies? 05
- Q.4** a) Derive an expression for the translational partition function of gaseous molecule. 05
- OR**
- a) Derive the relation between internal energy and partition function. 05
- b) Derive Fermi-Dirac distribution law for Fermions using statistical considerations. 05
- OR**
- b) Derive the relation between Helmholtz function and partition function. 05
- c) The rotational constant of gaseous HCl determined from microwave spectroscopy is 10.59cm^{-1} . Calculate the rotational partition function of HCl at 100 K. ($\sigma = 1$). 05
- Q.5** a) Give a brief account of 05
- i) Photooxidation
- ii) Flash photolysis.
- OR**
- a) Explain the terms: 05
- i) Driving force
- ii) Flux
- iii) Entropy production in coupled reactions
- b) What is fluorescence? Explain the role of intersystem crossing in fluorescence . 05
- OR**
- b) How are electrokinetic effects explained by Onsager's relations? 05
- c) Explain conservation of mass in open and closed system. 05
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