K17P 0612

Reg. No.: B6PSPH1609

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Second Semester M.Sc. Degree (Regular/Supplementary/Improvement) Examination, March 2017
PHYSICS
(2014 Admission Onwards)
PHY2C08 – Statistical Mechanics

Time : 3 Hours Max. Marks : 60

SECTION – A

Answer both questions (Either **a** or **b**).

1. a) Define the four thermodynamic potentials. Derive the four Maxwell's thermodynamical relations.

OR

b) Prove Liouvilles theorem and discuss its physical significance.

2. a) Distinguish between paramagnetism and diamagnetism. Apply FD distribution formula to obtain the theory of Pauli's paramagnetism.

OR

b) Discuss the effect of one dimensional Ising model. Show that it is not suitable for ferromagnetism. **(2×12=24 Marks)**

SECTION – B

Answer **any four**. (**One** mark for Part **a**, **3** marks for Part **b**, **5** marks for Part **c**)

3. a) Distinguish between micro and macro states.

b) Explain with example that a macrostate can have number of microstates.

c) A lattice contains N normal lattice sites and N intersticial lattices. N identical atoms are positioned on the lattice. M on the intersticial sites and N-M on the normal sites ($N >> M >> 1$). If an atom occupies a normal site, its energy $E = 0$. If an atom occupies an intersticial site, its energy is $E = \epsilon$. Calculate the internal energy and heat capacity as a function of temperature for this lattice.

P.T.O.

4. a) State equipartition theorem.

   b) What is Gibb's paradox ?

   c) Derive the expressions for energy and energy fluctuations in a canonical ensemble.

5. a) What is BE statistics ?

   b) Show that for B-E condensation, the number of particles in the ground state is given by $n_0 = n\left[1-\left(\frac{T}{T_0}\right)^{\frac{3}{2}}\right]$.

   c) Find the degeneracy for Hydrogen molecule at boiling point T = 20.38 K at atmospheric pressure. When its molar volume is 1400 cc.

6. a) What is Fermi Temperature ?

   b) Consider a free electron at the Fermi level in metal at 0K and show that the de Boglie wavelength associated with an electron is given by $2\left(\frac{\pi}{3n}\right)^{1/3}$, where n is the number of electrons per unit volume.

   c) Show that the ideal Fermi-Dirac gas deviates from ideal perfect gas by some factor. Determine this factor.

7. a) Define an ensemble.

   b) Derive the relation between canonical and microcanonical ensemble.

   c) Consider a solid surface to a two dimensional lattice with N_s sites. N_α atoms are absorbed on the surface, so that each site has either 0 or 1 absorbed atom. At absorbed atom has energy $E = -\epsilon$, where $\epsilon < 0$. Calculate chemical potential of the absorbed atoms as a function of temperature T, ϵ and N_a/N_s using the canonical ensemble, considering $N_a << N_s$.

8. a) What is phase transition ?

   b) Explain how Ising Model can be applied to lattice gas.

   c) Find the nature of the locus of a particle executing a simple harmonic motion (in Cartesian space) in the phase space. **(4×9=36 Marks)**
