K16P 0428

Reg. No. : ....

Name : ....

**Second Semester M.Sc. Degree (Regular/Supplementary/Improvement)
Examination, March 2016
PHYSICS
(2014 Admn. Onwards)
PHY 2C08 : Statistical Mechanics**

Time : 3 Hours

Max. Marks : 60

SECTION – A

Answer both questions (either **a** or **b**). **Each** question carries **12** marks.   (2×12=24)

1. a) Distinguish between microstates and macrostates. Derive an expression for entropy of a classical ideal gas.

   b) Explain the quantum mechanical ensemble theory. Explain density matrix.

2. a) Explain the thermodynamic behavior of an ideal Bose System. What is the condition for the onset of Bose condensation ?

   b) Define Fermi temperature and Fermi energy. Explain Pauli's theory of paramagnetism.

SECTION – B

Answer **any four**. **1** mark for Section **a**, **3** marks for Section **b**, and **5** marks for Section **c**.

3. a) Explain degenerate state and statistical weight factor.   (4×9=36)

   b) Derive the Gibbs-Duhem relation.

   c) The free energy F of a system depends on a thermodynamic variable

   ϕ as $F = -a\phi^2 + b\phi^6$ where a, b > 0. Find the value of ϕ when the system is in thermodynamic equilibrium.

P.T.O.

4. a) What are the parameters which describe a microstate ?

   b) Show that in a steady state probability density is independent of the coordinates of phase space.

   c) Two states with energy difference 4.83×10^{-17} J occurs with relative probability of e^2. Calculate the temperature of the system ($k = 1.38 \times 10^{-23}$ J/K).

5. a) What is meant by canonical ensemble ?

   b) Explain the term phase space of a classical system.

   c) Energy difference between the ground state $^1s_0$ and the first excited stae $^3s_1$ of He atom is 159843 cm^{-1}. Calculate the fraction of excited atoms in He at 6000 K.

6. a) What is meant by an ideal gas ?

   b) A Bose gas consists of 5 particles and 4 available energy states. How many macrostates are possible ?

   c) Show that for an ideal Bose gas $PV = \dfrac{2E}{3}$.

7. a) Define Fermi gas.

   b) Explain the main features of Pauli theory of paramagnetism.

   c) Derive the equation of state of an ideal Fermi gas.

8. a) What is meant by lattice gas ?

   b) What is the difference between simple and uni-axial ferromagnets?

   c) Give an exact treatment of one dimensional Ising model.

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