LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION - PHYSICS

FIRST SEMESTER – NOVEMBER 2011

PH 1815/1810 - STATISTICAL MECHANICS

Date : 09-11-2011 Dept. No. Max. : 100 Marks

Time : 1:00 - 4:00

PART – A

Answer **ALL** the questions (10 X 2 = 20)

1. What is an ergodic surface?
2. What is meant by correct Boltzmann counting?
3. What is the total energy of a system of 5 non interacting particles at temperature T whose Hamiltonian is $H = \sum_1^5 aP_{x_i}^2 + bx_i^2$?
4. Sketch Maxwell's velocity distribution.
5. What is mechano-caloric effect?
6. What is the significance of the critical temperature for an ideal Bose gas?
7. Why does electronic heat capacity dominate atomic heat capacity at very low temperatures?
8. Does a Fermi gas exert pressure at absolute zero? Substantiate your answer.
9. Why do small particles immersed in a fluid show Brownian motion?
10. Define the correlation function for a randomly fluctuating quantity.

PART – B

Answer any **FOUR** questions (4 X 7.5 =30)

11. i) Prove that Phase trajectory of a harmonic oscillator is an ellipse. Hence draw the phase trajectory of a damped harmonic oscillator.
    ii) Write down the wave function of a two particle system when the particles are: a) Classical b) Bosons and c) Fermions
12. Obtain the grand canonical distribution function.
13. Apply BE statistics to photons and obtain Planck's formula for the energy density of black body radiation.
14. Show that larger the mass, smaller the volume for a white dwarf.
15. Obtain an expression for the concentration fluctuation in a grand canonical ensemble. Show that for an ideal gas it increases as the volume decreases.

PART – C

Answer any **FOUR** questions (4 X 12.5 =50)

16. Obtain the distribution functions for i) classical gas, ii) Bose gas and iii) Fermi gas.
17. i) Discuss the features of the Gibb's canonical ensemble.
    ii) Obtain the rotational partition function of a system of diatomic molecules.
18. Discuss the thermodynamic properties of an ideal Bose-Einstein gas
19. Obtain an expression for the variation of chemical potential of a degenerate Fermi gas and demonstrate the result graphically.
20. Discuss Brownian motion in one dimension and obtain an expression for the particle concentration as a function of (x, t). Explain how Einstein estimated the particle diffusion constant.

****