LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION – **PHYSICS**

FIRST SEMESTER – NOVEMBER 2007

PH 1810 - STATISTICAL MECHANICS

Date : 02/11/2007 Dept. No. Max. : 100 Marks
Time : 1:00 - 4:00

PART A (10 X 2 = 20)

ANSWER ALL QUESTIONS.EACH QUESTION CARRIES 2 MARKS

01. Distinguish between microstates and macrostates.

02. State any two postulates of statistical mechanics.

03. What is meant by classical limit ?

04. State the theorem of equi-partition of energy.

05. What is the reason for Bose-Einstein condensation ?

06. Why is the transition from He I to He II known as the lambda transition ?

07. Sketch the Fermi-Dirac distribution for an ideal gas in 3-d at absolute zero and at a temperature slightly greater than zero.

08. What are white dwarfs ?

09. What is a stationary Markoff process?

10. Define (i) correlation function and (ii) spectral density for a randomly fluctuating quantity.

PART B (4 X 7.5 = 30)

ANSWER ANY FOUR QUESTIONS. EACH QUESTION CARRIES 7.5 MARKS

11. Explain Gibb's paradox. How is it resolved?

12. Obtain the distribution for an ideal Fermi gas.

13. Discuss the thermodynamic properties of an ideal Bose-Einstein gas.

14. Find the temperature dependence of the chemical potential of an ideal Fermi-Dirac gas.

15. Prove that the fractional fluctuation in concentration is smaller than the MB case for FD statistics and larger for BE statistics.

PART C (4 X 12.5 = 50)

ANSWER ANY FOUR QUESTIONS. EACH QUESTION CARRIES 12.5 MARKS.

16. (a) State and prove Liouville theorem. Use it to arrive at the principle of conservation of density in phase space.
    (b) Express Liouville theorem in Poisson bracket notation.

17. (a) Derive the grand canonical distribution.
    (b) Consider the ideal gas in the grand canonical ensemble and show that the fugacity is directly proportional to concentration.

18. Explain the super-fluidity of Helium using the energy spectrum of phonons and rotons.

19. Show that the specific heat of an ideal Fermi gas is directly proportional to temperature for temperatures very small compared to the Fermi temperature.

20. Discuss Brownian motion in 1-d and obtain an expression for the particle concentration as a function of (x,t). Explain how Einstein estimated the particle diffusion constant.

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