

OCTOBER 2011

P/ID 40006/PPHF

Time : Three hours

Maximum : 100 marks

PART A — (10 × 2 = 20 marks)

Answer ALL the questions.

All questions carry equal marks.

1. Give Nernst-Heat theorem.
2. What is first order phase transition? Give an example.
3. What is meant by correct Boltzmann counting?
4. Give the justification to treat the conduction electron in metal as a quantum particle.
5. If 'z' is the partition function of a single particle, what is the total partition function of a system of N-indistinguishable particles?
6. What is an ensemble average?
7. Under what situation F.D. and B.E. statistics approach M.B. statistics.
8. What is meant by spectral density?

9. What will be the fluctuation in energy of a closed system in thermodynamical equilibrium containing 10^{22} particle?
10. What is meant by random motion? Give two examples.

PART B — ($5 \times 6 = 30$ marks)

Answer ALL questions.

All questions carry equal marks.

11. (a) Show that for an isochoric process $dF \leq 0$.
- Or
- (b) How is phase transition of n^{th} order defined by Ehrenfest?
12. (a) Find the entropy of an ideal Boltzman gas.
- Or
- (b) What is stirling approximation? Prove the same.
13. (a) Show that the canonical distribution is $P_i = \frac{e^{-\beta E_i}}{\sum_i e^{-\beta E_i}}$ with symbols having usual meaning.
- Or
- (b) The partition function of a system is $\prod_{i=0}^{\infty} \frac{1}{1 - e^{-\beta E_i}}$. Calculate the Helmholtz free energy of the system.

14. (a) Calculate the total number of distribution of N bosons in the system among the k-possible groups of Eigen state.

Or

- (b) Find the heat capacity of electron in metal.

15. (a) Explain 'Wiener-Khintchine theorem'.

Or

- (b) Show that the energy fluctuation is $\frac{(kT^2C_v)^{\frac{1}{2}}}{E}$ with symbols having usual meaning.

PART C — (5 × 10 = 50 marks)

Answer ALL questions.

All questions carry equal marks.

16. (a) Explain how in the mean field approximation, ferromagnets satisfy Landau theory.

Or

- (b) What are the various critical exponents? Explain each of them.

17. (a) Obtain the condition for (i) Mechanical equilibrium (ii) Particle equilibrium.

Or

- (b) What is Gibb's paradox? Explain the same. How is it resolved?

18. (a) Show that the fractional concentration fluctuation varies as $N^{-1/2}$.

Or

- (b) Explain grand canonical ensemble. Derive an expression for the grand canonical distribution.

19. (a) Derive B.E. distribution formula.

Or

- (b) Obtain an expression for M.B. statistics.

20. (a) Find Fokker-Planck equation.

Or

- (b) Explain a two dimensional Ising model of N-lattice points.