

(8 pages)

Reg. No. :

Code No. : 7789

Sub. Code : WPHM 21

M.Sc. (CBCS) DEGREE EXAMINATION,
NOVEMBER 2024.

Second Semester

Physics — Core

STATISTICAL MECHANICS

(For those who joined in July 2023 onwards)

Time : Three hours

Maximum : 75 marks

PART A — (15 × 1 = 15 marks)

Answer ALL questions.

Choose the correct answer :

1. Which of the following is the formula of entropy?

(a) $F = U - TS$ (b) $H = U + PV$

(c) $G = U + PV - TS$ (d) $H = U/PV$

2. When the temperature of a system approaches absolute zero, the entropy of the system approaches a constant value is

- (a) Gibb's phase rule
- (b) Phase transition
- (c) Thermodynamic potential
- (d) Third law of thermodynamics

3. In the process of phase transition

- (a) Gibb's potential function remains constant
- (b) Only entropy remains constant
- (c) Only volume remains constant
- (d) Only temperature remains constant

4. In micro canonical ensemble, the individual systems cannot exchange

- (a) particles (b) energy and particles
- (c) energy (d) none

5. Two ends of a rod are kept at 127°C and 227°C. When 2000 cal of heat flows in this rod, then the change in entropy is

- (a) 1.0 cal/K (b) 20 cal/K
- (c) 6.9 cal/K (d) 0.7 cal/K

6. In a phase space, the state of an assembly of N particles is represented by a point in the _____ dimensional space.
- (a) $5N$ (b) $3N$
(c) $6N$ (d) N
7. The classical partition function Z gives the
- (a) sum of energy of the system
(b) sum of momentum of the system
(c) sum of states of the system
(d) none
8. The particle fluctuation will vary with
- (a) $1/\sqrt{N}$ times (b) $\sqrt{N}$ times
(c) $2\sqrt{N}$ times (d) $1/2\sqrt{N}$ times
9. In a grand canonical ensemble, the comprising system are capable of exchanging
- (a) only energy
(b) only constituent particles
(c) both energy and constituent particles
(d) none of the above

10. The number of particles are limited in
- (a) Bose Einstein statistics
(b) Fermi Dirac statistics
(c) Maxwell Boltzman statistics
(d) Both (b) and (c)
11. Particles are indistinguishable in
- (a) BE (b) FD and MB
(c) MB (d) FD and BE
12. Deduction of Planck's law is possible on the basis of
- (a) Fermi Dirac statistics
(b) Classical statistics
(c) Maxwell Boltzman statistics
(d) Bose Einstein Statistics
13. Second order phase transitions are called as
- (a) continuous phase transitions
(b) discontinuous phase transitions
(c) first order phase transitions
(d) infinite order phase transition

14. One dimensional Ising model cannot be ferromagnetic because

- (a) N Ising spin arranged in a ring
- (b) Transition temperature
- (c) Discontinuous phase transition
- (d) No transition temperature

15. Which one of the following statement related to Brownian motion is correct?

- (a) It is a result of the combined effect of chemical, Electrical and gravitational forces
- (b) Brownian speed increases if the vessels containing gas is shaken violently
- (c) Brownian motion is faster if the viscosity is low
- (d) Brownian speed increases if the pressure difference between end points of a container is increased

PART B — ($5 \times 4 = 20$ marks)

Answer ALL questions, choosing either (a) or (b).
Each answer should not exceed 250 words.

16. (a) Discuss the Gibb's phase rule.

Or

(b) What are order parameters? Explain.

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17. (a) Define ensemble. List the three most commonly used ensembles. What is micro canonical ensemble?

Or

(b) Write a note on phase space.

18. (a) Explain (i) canonical ensemble and (ii) grand canonical ensemble.

Or

(b) What is partition function? Explain the effect of shifting the zero level of energy on the (i) mean energy (ii) entropy.

19. (a) Explain the statistics of indistinguishable particles.

Or

(b) Write a note on Bose Einstein statistics.

20. (a) Write a note on fluctuations and transport phenomena.

Or

(b) Derive Fokker – Planck equation.

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PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b)
Each answer should not exceed 600 words.

21. (a) What is phase transition? Explain Ehrenfest's classifications based on first order and second order transitions.

Or

- (b) Explain Landau's theory of phase transition.

22. (a) What is Gibb's paradox? How this paradox is resolved?

Or

- (b) Derive the expression for entropy of an ideal gas using the micro canonical ensemble.

23. (a) State Liouville's theorem. Derive the expression for the principle of conservation of density in the phase space.

Or

- (b) Derive the equations for energy and density fluctuations in canonical ensemble.

24. (a) Derive the equation for ideal fermi gas.

Or

- (b) Derive the expression for Bose Einstein condensation.

25. (a) What is Ising model? Derive the equation for magnetization M using one dimensional Ising model.

Or

- (b) Derive the equation for Langevin's theory.
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