

KAMARAJ COLLEGE (Autonomous)

Accredited with A+ Grade by NAAC

(Affiliated to Manonmaniam Sundaranar University, Tirunelveli)

(3 Pages)

Reg. No:.....

Question Code: 26E03302

Course Code: 24PMPH21

PG Degree - End Semester Examinations, April 2026

Second Semester

M.Sc., PHYSICS

Statistical Mechanics

(For those who joined in July 2024 onwards)

Time : 3Hours

Maximum : 75 Marks

PART - A (10 × 1 = 10 Marks)

Answer ALL Questions

Choose the correct answer :

- CO:1
K:1
1. What kind of energy is possessed by the molecules of gas moving through space with some velocity?
- (a) Translational Energy (b) Spin Energy
(c) Kinetic Energy (d) Potential Energy
- CO:1
K:1
2. Name the number of microstates (Ω) corresponding to a macrostate.
- (a) Entropy (b) Free energy
(c) Thermodynamic probability (d) Partition function.
- CO:2
K:1
3. Which parameters are constant in a micro canonical ensemble?
- (a) N, V, T (b) μ, V, T
(c) N, V, E (d) N, P, T
- CO:2
K:3
4. Choose the correct expression for relation between the Helmholtz free energy (F) and the partition function (Z).
- (a) $F = kBT \ln Z$ (b) $F = -kBT \ln Z$
(c) $F = -kBT \ln Z^2$ (d) $F = -kBT Z$
- CO:3
K:1
5. Which of the following principles is NOT obeyed by bosons?
- (a) Heisenberg's uncertainty principle (b) Pauli's exclusion principle
(c) Aufbau principle (d) Hund's rule

- CO:3 6. The partition function Z for a system is used to derive
K:4
(a) Only kinetic energy (b) Only potential energy
(c) Thermodynamic properties (d) None of the above
- CO:4 7. Identify the lowest temperature range achievable using
K:1
electronic adiabatic demagnetization.
(a) 0.1-1 K (b) 10-100 K
(c) 0.1-10 K (d) 10 – 77 K
- CO:4 8. What happens when Brownian motion becomes more
K:3
pronounced (faster)?
(a) Particle size increases (b) Viscosity of the medium increases
(c) Temperature decreases (d) Particle size decreases
- CO:5 9. What does Gibb's phase rule state?
K:1
(a) $P+F=C-1$ (b) $P+F=C+1$
(c) $P+F=C-2$ (d) $P+F=C+2$
- CO:5 10. Infer the right parameter used in the Landau theory to describe
K:2
a phase transition.
(a) Partition function (b) Order parameter
(c) Correlation length (d) Fugacity

PART - B (5 X 5 = 25 Marks)

Answer ALL Questions choosing either (a) or (b).

Answer should not exceed 250 words.

- CO:1 11. (a) Identify the Postulate of equal Priori Probability.
K:3

(OR)

- (b) Build the Law of Equipartition of Energy.

- CO:2 12. (a) Distinguish between Canonical Ensemble and Grand
K:4
Canonical Ensemble.

(OR)

- (b) Simplify the Phase Space Volume for a Harmonic Oscillator.

- CO:3 13. (a) Compare the Density matrix in Micro Canonical, Canonical
K:3
and Grand Canonical Ensembles.

(OR)

(b) Analyze the Bose-Einstein's Condensation.

CO:4 14. (a) Construct the methods of Production of Low Temperature.

K:3 **(OR)**

(b) Apply the relation between Magnetic Temperature and Kelvin Temperature to explain their conversion.

CO:5 15. (a) Simplify and explain the Thermodynamic Potentials.

K:4 **(OR)**

(b) Analyze the Third Law of Thermodynamics.

PART - C (5 X 8 = 40 Marks)

Answer ALL Questions choosing either (a) or (b).

Answer should not exceed 600 words.

CO:1 16. (a) Identify the concepts of Phase Space in Statistical Mechanics.

K:3 **(OR)**

(b) Identify the Probability Distribution and Entropy of a Two Level System.

CO:2 17. (a) Explain how Gibbs Paradox is resolved?

K:5 **(OR)**

(b) Explain the Partition Function and Thermodynamic Functions for Grand Canonical Ensemble.

CO:3 18. (a) Compare Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein statistics.

K:4 **(OR)**

(b) Simplify the Equation of Dulong and Pettit's Law of Specific Heat of Solids.

CO:4 19. (a) Discuss the Principle, method and Theory of Adiabatic Demagnetization.

K:6 **(OR)**

(b) Discuss about Brownian Movement in detail.

CO:5 20. (a) Determine the Landau's Theory of Phase Transition.

K:5 **(OR)**

(b) Deduce the Exact Solution for the One Dimensional Ising Model.