

**Q: 1 Write correct answer for each of the following MCQs.**

- 1 In which of the following process entropy of the system remains constant.
 - a) Reversible adiabatic
 - b) Reversible isothermal
 - c) Reversible isochoric
 - d) Reversible isobaric
- 2 In which of the following process Volume remains constant.
 - a) An isochoric
 - b) An adiabatic
 - c) An isobaric
 - d) An isothermal
- 3 Define Gibbs function $G =$ _____.
 - a) $H - Ts$
 - b) $H + TS$
 - c) $U - PV$
 - d) $VP + TS$
- 4 Which of the following physical parameters remains constant in a system of micro canonical ensemble?
 - a) $[E, N, V]$
 - b) $[E, V, \mu]$
 - c) $[T, V, N]$
 - d) $[T, V, \mu]$
- 5 In Carnot, reversible cycle has following processes.
 - a) 4 isothermal
 - b) 2 isothermal and 2 adiabatic
 - c) 4 adiabatic
 - d) 4 isobaric
- 6 Gibbs paradox in statistical mechanics related to _____.
 - a) Additive property of entropy
 - b) Additive property of momentum
 - c) Additive property of energy
 - d) Additive property of temperature
- 7 Which of the following three physical parameters remains constant in a system of interest in a Grand Canonical ensemble?
 - a) (N, V, E)
 - b) (N, T, V)
 - c) (E, T, N)
 - d) (T, V, μ)
- 8 The Stirling formula is $\ln N! =$ _____.
 - a) $N \ln n$
 - b) $N \ln N - N$
 - c) $N \ln N$
 - d) $N \ln n - N$
- 9 In Fermi-Dirac system, the mean separation between the particles is ____ than the de-Broglie wavelength.
 - a) equal
 - b) larger
 - c) smaller
 - d) None of above
- 10 The spin quantum number (S) for the alpha particle is _____.
 - a) 1
 - b) 0
 - c) 0.5
 - d) 4

Q-2 Write answers of any ten questions in brief.

[20]

- 1 Define heat Engine and a Refrigerator with proper diagram.
- 2 Define adiabatic and isothermal process.

[P. T. O.]

- 3 Write second law of thermodynamics.
 - 4 Obtain First TdS equation.
 - 5 Write important applications of the Joule-Kelvin effect.
 - 6 What is Enthalpy.
 - 7 Define and explain Phase space.
 - 8 Derive Sackur-Tetrode formula.
 - 9 Define and explain in brief about Micro canonical Ensemble.
 - 10 Define Grand Canonical Ensemble.
 - 11 Define M-B system with proper example.
 - 12 Define: 1. Chemical potential (μ) and 2. Ideal M-B gas.
- Q-3 a Using work diagram, obtain Clausius's theorem and derive the equation for second law of thermodynamics. [05]
- b Discuss T- S diagram. [05]
- OR
- Q-3 a With the help of the Carnot cycle of an ideal gas, prove that ideal gas temperature and Kelvin temperatures are equal. [05]
- b Define second order phase transition and obtain Ehrenfest's equation. [05]
- Q-4 a Calculate isothermal compressibility of a gas. With the help of Bridgeman piezometer, obtain $K = 3\delta$. [06]
- b Derive energy equation. [04]
- OR
- Q-4 a Derive Maxwell's four equations. [06]
- b Write short notes on: [04]
- (a) Difference in heat capacities (b) Ratio of heat capacities.
- Q-5 a Explain about the entropy of a perfect gas in a Micro-Canonical ensemble. [05]
- b State and prove Liouville's theorem. [05]
- OR
- Q-5 a Define Canonical ensemble. Obtain the Canonical distribution equation for a close system in terms of classical and quantum statics. [05]
- b What is the postulate of equal a prior probability? Why is it acceptable? [05]
- Q-6 a Define Fermi-Dirac system. Obtain an expression for the F-D distribution of the particles among various states. [05]
- b Derive expression for grand canonical distribution function of a system in quantum as well as classical statics. [05]
- OR
- Q-6 a Write Maxwell-Boltzmann velocity distribution law. Using this law, show that for an ideal gas $V_p < V_{av} < V_{rms}$. [06]
- b Give the difference between Bose -Einstein and fermi- Dirac system. [04]

X

