Model Question Paper

Course Name: Statistical Mechanics Course Code: BSCHPHSC601

Discipline: UG Physics (Hons) Semester- VI Course Type: CC-13

Prepared/Compiled by: *Sri Arindam Changder, Deptt of Physics, Raniganj Girls' College*

Group-A

(Each question carries ONE mark)

1. Statistical mechanics gives meaningful result if the number of particles in the system is – (a) Small (b) infinity (c) Very large (d) None of these.
2. The value of probability of an event cannot be – (a) 1 (b) ½ (c) 0 (d) negative.
3. Two phase trajectories in a phase space can – (a) not intersect (b) intersect (c) intersect in some cases (d) neither of these.
4. To which type of particles of a system does MB-statistics apply?
5. MB-Statistics is applicable for- (a) photon (b) ideal gas (c) electron (d) proton.
6. What is the spin of a photon?
7. What is the value of rest mass of photon?
8. Particles obeying BE-Statistics have- (a) any spin (b) integral spin (c) half integral spin (d) none of these.
9. The number of meaningful ways in which 4 fermions can be arranged in 5 compartments is – (a) 1 (b) 4 (c) 5 (d) 9.
10. What do you understand by Fermi energy?
11. Do electrons have zero energy at 0K?
12. FD-distribution approaches MB-distribution at – (a) low temperature and high pressure (b) high temperature and low pressure (c) low temperature and low pressure (d) high density and low energy range.

Group-B

(Each question carries TWO marks)

1. What are phase space and phase trajectory?
2. Explain macro and micro-states.
3. Define thermodynamic probability.
4. Why two phase trajectories cannot intersect in phase space?
5. Discuss the validity of the law of equipartition of energy.
6. What is partition function?
7. What is the significance of rms velocity of a gas molecule?
8. What do you understand by Bose-Einstein Condensation?
9. What are the basic changes made by Bose in classical statistics?

Group-C

(Each question carries FIVE marks)

1. Explain what is meant by phase space? A linear harmonic oscillator moves with constant energy E along the X-axis. What will be its phase trajectory?
2. Obtain the relation, $= K \ln \Omega$, the different letters have their usual meanings.
3. What do you mean by ensemble? Define micro-canonical, canonical and grand canonical ensemble.
4. What is thermodynamic probability? How does it differ from mathematical probability?
5. Three distinguishable particles, each of which can be in one of the E, 2E, 3E, 4E energy states, have total energy 6E. Find all possible distributions of particles in the energy states. Find the number of micro-states in each case.
6. Six distinguishable particles are distributed over three non-degenerate levels of energies 0, E and 2E. Calculate the total number of micro states of the system. Find the total energy of the distribution for which the probability is a maximum.
7. Five distinguishable particles are distributed in three non-degenerate level with energies 0, E and 2E. Determine the most probable distribution for a total energy 3E.
8. What are the limitations of classical statistics? Discuss the validity of the law of equipartition of energy.
9. What is Gibb's paradox? How is it resolved?
10. Write down Sackur-Tetrode formula for entropy and explain its significance.

Group-D

(Each question carries TEN marks)

1. Define ensemble average and time average. Discuss the relation between ensemble average and time average.
2. Deduce Sackur-Tetrode formula for the entropy of a perfect gas.
3. What is Gibb's Paradox? What is its origin? Point out how this paradox is resolved.
4. Obtain Planck's formula for blackbody-radiation using Bose-Einstein statistics. Show that Wien's formula and Rayleigh-Jeans formula can be deduced as particular cases of Planck's law.
5. Explain the phenomenon of BE-condensation and show graphically how the condensate fraction varies with temperature.
