St.Joseph's college of arts and science (Autonomous)
PG and Research Department of Physics
Subject: Statistical Mechanics
Subject Code: PPH701
Subject Incharge: Ms.S.Sangeetha Margreat

2 Marks

1. Define phase space

2. Write a note on ensemble

3. Give the volume element of phase space and its dimension

4. Define the term density of states

5. Why Cp is greater than Cv

6. State the third law of thermodynamics

7. What is entropy and give its unit

8. If V_1 and V_2 are the volume occupied by two subsystems in gamma space, find the entropy of two composite systems

9. Does the chemical potential of an ideal Fermi gas depend on temperature?

10. What is phase transition?

11. Distinguish between microstates and macrostates.

12. What is the difference between entropy and ensemble.

13. State postulates of statistical mechanics.

14. How does the vibrational contribution to the specific heat depend on temperature at very low temperature.

15. What is the pressure exerted by a Fermion gas at absolute temperature.

16. State correlation function.

17. What is the implications of Einstein's result for the energy fluctuations of black body radiation.

18. Write a note on thermionic emission.

19.   Define the spectral density for a randomly fluctuating quantity.

20. Can you extend one dimensional Ising model fo all kinds of magnetic substances.

21.   State Liouville's theorem

22.   Describe partition function

23.   Write about Helmholtz free energy.

24.   State equipartition law of energy

25.   State the conditions of Fermi Dirac statistics.

26.   Define specific heat capacity of a solid.

27.   What do you mean by electron gas?

28.   What are white dwarfs?

29. Briefly write about Brownian motion.

30. Distinguish between the class ideal gas and classical real gas.

31. Define statistical equilibrium.

32. What is the connection between the relation and the probability.

33. Define degeneracy.

34. Distinguish between the phonon gas and photon gas.

35. Give the fluctuation value of energy and enthalpy.

<center>5 Marks</center>

1 . What are macroscopic and microscopic properties of a system?

2 . State and explain equal a priori probability

3. State and explain the zeroth and first law of thermodynamics.

4. Derive the condition for an ensemble to be in statistical equilibrium.

5. Show that the difference in entropy between a state of volume V_i and a state of volume

V_f (temperature and number of molecules remain constant) is equal to V_f / V_i using the

statistical definition of entropy.

6. Explain enthalpy and Gibb's potential.

7. Calculate the change in entropy of 1 gm of hydrogen gas when the temperature is raised from 0 C to 273 C if the volume is finally four times the original volume. Given that C_v =2.43 cal/(gm-C), R=2.01 cal/(mole-C), molecular weight of hydrogen =2 and $\log_e$ =2.3026

8. Explain Bose-Einstein statistics for a system of particles.

9. Discuss Maxwell Boltzmann statistics.

10. Explain Debye's model for specific heat of solids.

11. Calculate the Fermi energy in electron volt for sodium assuming it has one free electron per atom. Given: density of sodium = 0.97gm/cm^{3}, atomic weight of sodium = 23

12. Briefly write about fluctuations in pressure of a system

13. Discuss fluctuation dissipation theorem

14. Explain the Brownian movement

15. Derive the partition function for a particle.

16. Write a note on the Gibb's free energy of an ensemble.

17. Give the comparisons of three different statistics.

18. State and explain the law of equipartition of energy.

19. Write a note on Bose Einstein condensation.

20. What are white dwarfs? Explain.

21. Discuss the fluctuations in enthalpy H of a system.

22. Write a note on canonical and grand canonical ensembles

23. Derive the partition function for a particle

24. Define the mean speed and most probable speed

25. Outline the importance of Planck's law of radiation

26. Write a note on super fluidity

27. Explain Boltzmann's transport equation.

28. Explain phonon gas.

29. Discuss the Gibb's paradox.

30. Explain the concept of random walk.

10 Marks

1. Differentiate microstate and macro state with an example

2. State and prove Liouville's theorem

3. Discuss briefly i) Density of distribution in phase space

                ii) Helmholtz free energy

4. Give a comparison of MB, BE, FD statistics

5. Write a note on Bose Einstein condensation

6. Discuss the energy fluctuations of a closed system in thermal equilibrium

7. Write a note on white dwarfs.

8. Deduce the expression for the probability of one dimensional random walk.

9. Write a note on micro canonical and grand canonical ensembles with their uses.

10. Discuss the density of distribution in phase space. Comment on the statement "entropy is a measure of disorder".

11. Derive the Maxwellian's distribution of velocities.

12. Explain in detail the Pauli's theory of paramagnetism.

13. Give the Boltzmann entropy relation.