Q.1.   Give to the point answer / short description of each question.   (6x5=30)

a) Give physical interpretation of Liouville's theorem.

b) State the Stephen Boltzmann law and show that total energy of photons gas per unit volume is directly proportional to fourth power of absolute temperature.

c) Show that rotational degree of freedom is active on 10K.

d) What is meant by the term ENSEMBLE? Differentiate between canonical and grand canonical ensemble.

e) Define fermions and bosons. Differentiate between Fermi Dirac statistics and Bose Einstein statistics.

f) The entropy of the microcanonical ensemble is given by the relation

$$\sigma = N \log [V (4/3\, \pi\, M)^{3/2}\, (U/N)^{3/2}] + 3N/2.$$

By using this relation, explain what is Gibb's paradox? How can we resolve it?

Q.2.   Answer the following questions.

i. What is Bose-Einstein condensation? Under what condition it is formed? Give examples of this state of matter.   (4+3+3)

ii. a) What is grand canonical ensemble? Derive an expression for the probability of the phase points in the grand canonical ensemble.

b) Draw the graph of Fermi-Dirac distribution function and explain its behavior at low temperature and at high temperature.   (6+4)

iii. Derive an expression of Maxwell velocity distribution function. Also derive the expressions for

(a) Average Velocity   (b) Most Probable Velocity.   (6+2+2)