Tutorial-1, Statistical Mechanics & Others (Paper-203)

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Maximum Marks: 50

Q-1. Distribute of $'N'$ distinguishable systems into two states H and T using binomial expansion of $(H+T)^N$.

Q-2. What is Stirling's approximation? Obtain it.

Q-3. Obtain the condition of maximum binomial distribution among two states H and T for large number of systems $(N \to \infty)$. Discuss its shape around maximum distribution. (Hint: Stirling's Approximation $\ln(N!) = N\ln(N) - N$)

Q-4. Distribute N=10 and N=5 distinguishable systems in two and three ways. Find maximum distributions in each and compare with others.

Q-5. Obtain multinomial distribution of N distinguishable systems into groups of N_1, N_2 and ... N_r. Compare it with multinomial expansion of $(x_1+x_2+..+x_r)^N$.

Q-6. In above multinomial expansion, x_1=x, x_2=y, x_3=y, ... and x_r=y, find the coefficient of distribution of y with degeneracy g=$r-1$ using binomial expansion.

Q-7. Define an ensemble. How many types of well known ensembles are there?

Q-8. What is *Principle of equal a priori probability*? How individual probability of any spin-microstate $(P(\alpha^{N-N_1}, \beta^{N-N_1}))$ can be evaluated by thermodynamic probability $(W(N_1) = \frac{N!}{N_1!(N-N_1)!})$?

Q-9. Uncertainty Principle of quantum mechanics is ignored in ensemble concept- illustrate.

Q-10. Define overall probability P_j that a system of canonical ensemble is in jth quantum state (E_j) according to *Principle of equal a priori probability.* How it relates to maximum values of $W(a)$ for $'A' \to \infty$ number of systems.

Q-11. Define canonical ensemble average of any mechanical property $\overline{M}$ in terms of probability distribution (P_j) and (M_j) of jth quantum state.

Books: McQuarrie (Statistical Mechanics), Callen (Thermodynamics and Thermostatistics), Nash (Elements of Statistical Thermodynamics), Atkins (Physical Chemistry), Landau & Lifshitz (Statistical Physics).