Tutorial-3, Statistical Mechanics & Others (Paper-203)

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Maximum Marks: 50

Q-1. Maximize thermodynamic probability $'W(a)' = \frac{A!\prod_j g_j^{a_j}}{\prod_j a_j!}$ of a canonical-ensemble (Diagram). Obtain probability of j-th state (P_j) and partition function $Z(N, V, \beta)$.

Q-2. Obtain the relation between internal energy ($\overline{E}$), $Z(N, V, \beta)$ and β.

Q-3. Obtain the relation between pressure ($\overline{p}$), $Z(N, V, \beta)$ and β.

Q-4. Comparison of Classical Thermodynamics and Equilibrium Statistical Mechanics calls $\beta \propto 1/T$- justify. What is the difficulty in assuming $\beta \propto T$?

Q-5. Maximize thermodynamic probability $'W(a)' = \frac{A!}{\prod_N \prod_j a_{Nj}!}$ of a grand-canonical-ensemble (Diagram). Obtain probability of Nj-th state (P_{Nj}) and partition function $Z(\mu, V, \beta)$.

Q-6. Obtain the relation between internal energy ($\overline{E}$), $Z(\mu, V, \beta)$ and β.

Q-7. Obtain the relation between pressure ($\overline{p}$), $Z(\mu, V, \beta)$ and β.

Q-8. Obtain the relation between average number of particle in a system ($\overline{N}$), $Z(\mu, V, \beta)$ and γ.

Q-9. Obtain the relation between $'\beta'$ and $'T'$ using the Boltzmann Postulate $'S = k_B \ln(W)'$. Is $'S'$ an extensive/intensive property?

Q-10. Obtain the relation between $\overline{E}$ and $Z(N, V, T)$.

Q-11. Obtain the relation between $\overline{p}$ and $Z(N, V, T)$.

Q-12. Obtain the relation between $\overline{E}$ and $Z(\mu, V, T)$.

Q-13. Obtain the relation between $\overline{p}$ and $Z(\mu, V, T)$.

Q-14. Obtain the relation between ($\overline{N}$) and $Z(\mu, V, T)$.

Q-15. Find $Z(N, V, T)$ for particle in a 1-D box with slanted bottom $\left(slope = \frac{V}{a}\right)$. Predict $\overline{E}$, $\overline{S}$ and C_v.

Q-16. Find Helmoltz Free Energy $'A'$ of canonical and grand canonical ensembles.

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