Tutorial-2, Statistical Mechanics & Others (Paper-203)

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Maximum Marks: 50

Q-1. Obtain partition function $Z(N, V, E)$ of a microcanonical ensemble.
(Hint: use multinomial expansion with degeneracy factor)

Q-2. Energy of particle in a cube of side $'a'$, $\epsilon_{n_x,n_y,n_z} = \frac{\pi^2 \hbar^2}{2ma^2} \left(n_x^2 + n_y^2 + n_z^2 \right)$. Find approximate total degeneracies of states with very high energy.

Q-3. Calculate number of states (ω) between ϵ and $\epsilon + \Delta\epsilon$ for particle in a cube with very high energy. Find ω for $T = 300K$, $m = 10^{-22}$g, $a = 10$cm and $\Delta\epsilon = 0.01\epsilon$

Q-4. Given $dE = TdS - PdV$ for a one component reversible system, find relations of T and P with E respectively. Obtain further relation between T and P.

Q-5. Given $dH = TdS + VdP$ for a one component reversible system, find relations of T and V with H respectively. Obtain further relation between T and V.

Q-6. Given $dG = VdP - SdT$ for a one component reversible system, find relations of V and S with G respectively. Obtain further relation between V and S.

Q-7. Given $dA = -PdV - SdT$ for a one component reversible system, find relations of P and S with A respectively. Obtain further relation between P and S.

Q-8. Define E, H, A and G for many-component closed system. Illustrate chemical potential (μ) in terms of above functions.

Q-9. Using method of Lagrangian Multipliers, obtain maximum ground state level of a particle in 3-D box with sides a, b and c having total volume constant.

Q-10. Using method of Lagrangian Multipliers, obtain maximum perimeter of a rectangle having constant area.

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