Tutorial-4, Statistical Mechanics & Others (Paper-203), January 2,2016

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Maximum Marks: 50

Q-1. What is ΔS for transition of an isolated particle in 2-D square box from ground to first excited state.

Q-2. What difficulty arises to thermodynamic probability $'W'$ if *Principle of equal a priori probability* is not valid. (Hint: using binomial distribution $(x+y)^N$)

Q-3. Find the maximum distribution of $'N'$ electrons among 5-lowest states ($'s'$-groups,s=5) of an oscillator with energy varying from zero to $4N$ quanta for very high N.

Q-4. Obtain Internal Energy ($\overline{E}$), Helmholtz's free energy ($\overline{A}$), Entropy (S) from translational motion of monoatomic gas. (Indistinuishable)

Q-5. What is Thermal De Broglie wavelength (Λ). Obtain the condition of Boltzmann Statistics in terms of Λ and V.

Q-6. Find the relation between specific heat (C_v) and fluctuation (σ_E) and relative fluctuation in internal energy.

Q-7. Obtain $\overline{E}_{trans}$, $\overline{A}_{trans}$ and S_{trans} of diatomic and polyatomic gases.

Q-8. Obtain $\overline{E}_{rot}$, $\overline{A}_{rot}$ and S_{rot} of hetero-nuclear diatomic gases.

Q-9. Modify q_{rot} of homo-nuclear diatomic and polyatomic gases with symmetry number $'\sigma'$.

Q-10. Find $'\sigma'$ of HCl, H_2, C_2H_2, NH_3, CH_4, CCl_4, C_6H_6, C_2H_4 and $CHCl_3$ (diagrams).

Q-11. Obtain $\overline{E}_{vib}$, $\overline{A}_{vib}$ and S_{vib} of diatomic and polyatomic gases. What happens to $\overline{E}_{vib}$ when $T \to \infty$?

Q-12. Find specific heat (C_v) for translational, rotational, vibrational and electronic degrees of freedom.

Q-13. Obtain C_v of vibration for $T \to \infty$ and $T \to 0$?

Q-14. Using density of states between ε and $\varepsilon + \Delta\varepsilon$ obtain q_{trans}.

Q-15. What is fluctuation at $0K$? What is the fluctuation of a microcanonical ensemble?

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