Quiz: Statistical Thermodynamics: SCI205/405 - Spring 2020: 27 Mar 2020

Time: 30 mins Rool no. 20183011 to 201830120 and 201981101 Max. marks=25

Questions carry equal marks.

- 1. Write an expression for the ionization constant at temperature T of an atom $A \rightleftharpoons A^+ + e$ in terms of the relevant microscopic quantities, assuming perfect gas like behaviour for all species. Note that the electron may be treated like a monatomic system.
- 2. Explain briefly how entropy is related to the degeneracy of a state with a certain energy..
- **3.** The lower the force constant of a molecule, the higher is the population of excited vibrational states. Use a statistical result to explain this.
- 4. Why is the ratio of ortho and para hydrogen in ordinary hydrogen at -100K not the same as predicted for an equilibrium mixture by statistical mechanics?
- 5. Calculate the molar energy, Helmholtz free energy and entropy of HCl gas at 1 atm, 37° C (given : $\frac{\hbar^2}{2Ik_B} = 15.2$ K; $\frac{h\nu}{k_B} = 4140$ K; $D_0 = 102.2$ kcal.mol⁻¹. Assume ideal behaviour.