


IISER Kolkata
Mid-Semester Examination
Third Year Semester II
PH3201 (Basic Statistical Mechanics) .
Time: 1 hour 30 minutes; Full Marks 20
Answer all questions

1. Write down the Hamiltonian of a particle of mass m thrown vertically up with some initial velocity. Sketch the phase space diagram.
2. Take 10^{-6} J of heat from a system at a temperature of 300 K and add it to a system at 299 K. Find the change of entropy. By what factor does the number of accessible states change?
3. The entropy S of a system is given by the formula $S = \frac{4}{3}\sigma V^{\frac{1}{3}} E^{\frac{2}{3}}$ where σ is a constant and E, V are the energy and volume respectively. Find the temperature of the system. Can you identify the system?
4. A system has non-degenerate energy levels with energy $E_n = (n + \frac{1}{2})\epsilon$ where $\epsilon = 1.4 \times 10^{-23}$ J and n is a positive integer or zero. What is the probability that the system is in the state $n = 1$ if it is in contact with a heat bath at 1K ?
5. For a classical gas containing N molecules, the canonical partition function is given as $Z = \left(\frac{V_N b}{N}\right)^N \left(\frac{2\pi m k_B T}{h^2}\right)^{\frac{3N}{2}} e^{\frac{N^2 a^2}{V k_B T}}$, where V and T are the volume and temperature and a, b, k_B, m, h are all constants. Find out an expression for the pressure of the gas. From the equation of state, can you recognize the gas?
6. A set of N indistinguishable particles is given by the quantum state $\psi = \psi(s_1, s_2, \dots, s_n)$ where s_i is a set of quantum numbers for the i th particle. Show that ψ has to be either symmetric or antisymmetric under exchange of particles.


20/2/19