(b) Calculate the diameter of a molecule of benzene, if $n = 2.79 \times 10^{19}$ molecules per c.c and mean free path for benzene is 2.2×10^{-6} cm. (3)

5. (a) What are the basic assumptions of Planck's theory of black body radiation? Derive Planck's Law of black body radiation. (15)

(b) Calculate the maximum amount of heat lost per second by the radiation from a sphere of 10 cm diameter at a temperature of 227C that is placed in an enclosure at a temperature of 27C. [$\sigma = 5.7 \times 10^{-12} Wcm^{-2}K^{-4}$]. (3)

6. (a) Obtain an expression for the most probable distribution function for a system obeying Maxwell- Boltzmann statistics. (12)

(b) Find the number of microstates of a system of 2 particles and 3 states if the system obeys.

(i) Maxwell-Boltzmann (M.B) statistics

(ii) Fermi Dirac (F.D) statistics and

(iii) Bose-Einstein (B.E) statistics. (6)

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4813 **J**

Unique Paper Code : 2224001202

Name of the Paper : Thermal Physics

Name of the Course : **B.Sc. Hons. - (Physics)_NEP: UGCF-2022**

Semester : IV / VI (GE Paper)

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt any **five** questions in all. Question no. **1** is compulsory.
3. Use of non-programmable Scientific Calculator is allowed.

1. Attempt any **six** question from the following : (6×3=18)

   (a) What are intensive and extensive variables of a thermodynamic system. Give one example for each of them.

   (b) Calculate the change in entropy when 10 g of ice at 0°C is converted into water at the same temperature. Latent heat of fusion of ice is 80 cal/g.

   (c) State the First law of thermodynamics and explain each of its term.

   (d) Draw the labelled P-V diagram and the T-S diagram for a Carnot Cycle.

   (e) Calculate the temperature of body using following data: λ_m = 4753 Å and Wien's constant b = 2.898 × 10^{-3} m-K.

   (f) What is mean free path? Explain.

   (g) Define microstates and macrostates.

2. (a) Derive the adiabatic equation of state for a perfect gas. (4)

   (b) State and prove Carnot's theorem. (6)

   (c) A Carnot's engine whose low temperature reservoir is at 7°C has an efficiency of 50%. It is desired to increase the efficiency to 70%. By how many degrees should the temperature of the high temperature reservoir be increased. (4)

   (d) Find the thermal efficiency of a reversible engine working between steam and ice point of water. (4)

3. (a) Derive the Maxwell's four relations of thermodynamics. (9)

   (b) Using Maxwell's thermodynamic relation, establish the Clausius-Clapeyron equation

$$\left(\frac{\partial P}{\partial T}\right) = \frac{L}{T\,(V_2 - V_1)}$$

   where all the symbols have their usual meaning. (4)

   (c) Prove that entropy change during a reversible process is zero. (5)

4. (a) What are the transport phenomena in gases? Derive an expression for the coefficient of viscosity on the basis of kinetic theory. (15)