and $2\varepsilon$ such that total energy is $2\varepsilon$ considering the particles are :

(i) Classical

(ii) Bosons (4)



[This question paper contains 8 printed pages.]

**Your Roll No.....**

**Sr. No. of Question Paper : 6092** **H**

Unique Paper Code : 2224001202

Name of the Paper : Thermal Physics

Name of the Course : **B.Sc. Hons. – GE**

Semester : II

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 **all** the following questions. (3×6=18)

(a) What are intrinsic and extrinsic properties of a thermodynamic system. Give at least two examples of each.

(b) What do you mean by thermodynamic equilibrium? Illustrate its different conditions.

(c) The equilibrium states of a system are given by

$$V - b = \frac{rT}{P} - \frac{a}{T^m},$$

where b, r, a and m are constants, V, P and T are the volume, pressure and temperature of the system, respectively. Calculate the volume expansivity of the system.

(d) What are the advantages of TS diagram over PV diagram of a Carnot cycle.

(e) Using Maxwell's relations derive the two TdS equations.



(c) Two ideal blackbodies A and B at temperature 227°C and 327°C respectively are placed in an evacuated enclosure whose wall are blackened and kept at 27°C. Compare their rates of loss of heat. (4)

6. (a) Obtain an expression for thermodynamic probability and the most probable distribution function for a system obeying Fermi-Dirac statistics. (10)

(b) Distinguish between Classical, Fermi-Dirac and Bose-Einstein statistics. (4)

(c) Calculate the number of ways in which three particles are distributed in the energy levels 0, ε

(b) How does the mean free path depend on temperature and pressure of a gas? (4)

(c) 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 $2.2 \times 10^{-6}$ cm. (4)

5. (a) What are the basic assumptions of Planck's theory of blackbody radiation? Derive Planck's Law of blackbody radiation. (10)

(b) Explain the spectral distribution of blackbody radiation with proper graphical representation. (4)



(f) Define mean free path and write its expression. What are the factors on which the mean free path of molecules of a gas depends?

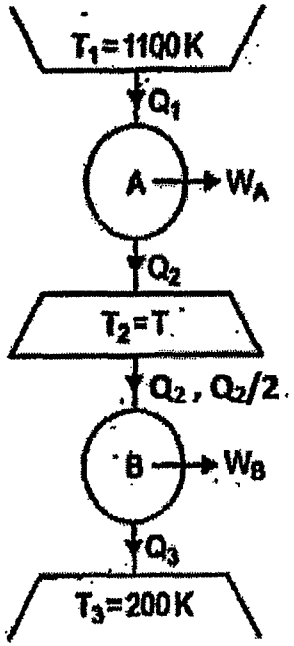
2. (a) Using the first law of thermodynamics, establish :

$$C_P - C_V = R\left[1 + \frac{2a}{RTV} + \cdots\right] \quad (10)$$

(b) Find an expression for the work done in an adiabatic process. (4)

(c) Two Carnot engines A and B are operated in series. First engine A absorbs heat at 1100K and rejects it to the sink at T K. Second engine B absorbs half amount of heat rejected by first engine and rejects heat to the sink at 200K. If the

work performed by both the engines are equal, calculate the temperature T. (4)






3. (a) Establish the Maxwell's four relations of thermodynamics. (10)

(b) Using Maxwell's relation, derive Clausius-Clapeyron equation and interpret the result. (4)

(c) Prove from the laws of thermodynamics

$$\left(\frac{\partial U}{\partial V}\right)_T = T\left(\frac{\partial P}{\partial T}\right)_V - P$$

Hence show that the internal energy of an ideal gas is independent of its volume whereas it is not true for a real gas. (4)

4. (a) What are the transport phenomena in gases? Derive an expression for the coefficient of viscosity on the basis of kinetic theory. (10)