[This question paper contains 2 printed pages.]

Sr. No. of Question Paper : 2071 **GC-3** **Your Roll No.....**

Unique Paper Code : 32221302

Name of the Paper : Thermal Physics

Name of the Course : **B.Sc. (Hons.) Physics CBCS**

Semester : III

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **Five** questions in all including Question No. **1** which is compulsory.
3. All questions carry equal marks.

1. Answer any **five** of the following :
   (a) Using first law of thermodynamics, derive the relation C_P-C_V = R.
   (b) Show that enthalpy remains constant during Joule-Thomson experiment.
   (c) Calculate the average kinetic energy of thermal neutrons at temperature 27°C
   (d) Formulate second law of thermodynamics in terms of entropy.
   (e) Give the kinetic interpretation of Temperature.
   (f) Define "Triple Point" and draw the phase diagram of water.
   (g) Derive the energy equation

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

(5×3=15)

2. (a) What is Carnot's engine? Describe its operation with the help of a PV diagram and derive expression for its efficiency.
   (b) Establish the Clausius inequality theorem.
   (c) One gram mole of a perfect gas expands isothermally to four times its initial volume.

P.T.O.

Assuming complete conversion of heat into work, calculate the change in entropy. Given R = 8.314 J/mol-K. (7,5,3)

3. (a) What are transport phenomena? Deduce expression for thermal conductivity of a gas on the basis of kinetic theory.

   (b) What is meant by Lapse Rate? Obtain an expression for adiabatic lapse rate of earth's atmosphere.

   (c) Find the mean free path of a gas molecule whose diameter is 2 A^0 and number of molecules per cc is 3×10^{19}. (7,5,3)

4. (a) State and prove Carnot 's Theorem.

   (b) With the help of necessary diagram distinguish between first and second order phase transitions. Derive Clausius- Clapeyron equation of latent heat. (6,9)

5. (a) Define four thermodynamic potentials. Using these potentials derive the four Maxwell's thermodynamic relations.

   (b) Prove that

$$G = H + T\left(\frac{\partial G}{\partial T}\right)_P \quad \text{and} \quad F = U + T\left(\frac{\partial F}{\partial T}\right)_V \qquad (9,6)$$

6. (a) Write Maxwell-Boltzmann law of distribution of velocities for molecules of a gas. Hence obtain the relation between most probable velocity C_{mp}, average velocity C_{av} and root mean square velocity C_{rms} for molecules of the gas. Show that $C_{rms} > C_{av} > C_{mp}$.

   (b) Give Einstein's theory of translational Brownian motion in gases. (9,6)

7. (a) Discuss the results obtained by Andrews in his experiment on CO_2. Explain the term "Critical temperature" of a gas.

   (b) Calculate the critical constants of van der Waal's gas in terms of constants "a" and "b". Hence derive the reduced equation of state. (6,9)

8. (a) Discuss the cases when "μ" is negative, positive and zero. Obtain the expression for temperature of inversion of the gas. Explain why hydrogen and helium show heating effect at ordinary temperatures while other gases show cooling effect.

   (b) Derive the Ehrenfest's equations for second order phase transitions. (6,9)

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