(c) Prove the thermodynamical equations below, using Maxwell relations

(i) $dU = (C_p - pV\alpha_p)dT + V(\beta_T p - \alpha_p T)dp$

(ii) $dH = C_p dT + V(1 - \alpha_p T)dp$

Here α and β denotes coefficient of volume expansion and compressibility, respectively. (7,3,5)

6. (a) What are transport phenomena? Derive an expression for coefficient of viscosity of a gas in terms of mean free path of its molecules.

(b) Discuss the effect of pressure and temperature on coefficient of viscosity.

(c) The mean free path of the molecules of a gas is 2×10^{-7} meters at pressure p and temperature 200 K. Calculate its value at (i) p, 400 K (ii) 2p, 200 K (iii) ½ p, 400K. (7,3,5)

7. (a) Derive and discuss the Van der Waals gas equation of state of a gas. Mention its defects.

(b) Show that for a gas obeying Van der Waals' equation

$$RT_c/P_cV_c = 8/3$$

(c) Calculate Van der Waals' constants for dry air using the following data: T_c = 132 K, P_c = 37.2 atm., and R = 82.07 cm^3 atm K^{-1}. (7,3,5)

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[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper: 4406 **G**

Unique Paper Code : 32221302

Name of the Paper : Thermal Physics

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

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
3. Question No. **1** is compulsory.
4. Answer any **four** of the remaining **six**.

1. (a) Prove that efficiency of a reversible engine is always higher than efficiency of an irreversible engine working between same limits of temperatures of source and sink.

(b) A cyclic heat engine does 50 KJ of work per cycle. If efficiency of engine is 75%, what will be the heat rejected per cycle?

(c) Using Maxwells thermodynamic relation, calculate

$\left(\frac{\partial Cv}{\partial V}\right)_T$ for a van der Waals gas.

(d) On the basis of third law of thermodynamics prove the unattainability of absolute zero.

(e) Calculate relative magnitude of average speed, root mean square speed and most probable speed. How do these speeds vary with temperature?

(3×5=15)

2. (a) Using first law show that for a gaseous system, the ratio of adiabatic elasticity to isothermal elasticity is equal to the ratio of two heat capacities.

(b) Calculate work done during adiabatic process.

(c) Apply Zeroth's law of thermodynamics to thermal systems to arrive at the conclusion that at equilibrium the systems are at the same temperature. (7,3,5)

3. (a) What do you understand by thermodynamic scale of temperature? Define absolute zero temperature.

(b) Prove that thermodynamic scale of temperature is equivalent to perfect gas scale.

(c) Prove that if Clausius statement is not true, the same holds for Kelvin-Planck statement.

(7,3,5)

4. (a) Obtain the Clausius inequality and discuss its significance.

(b) Using the TS diagram derive the expression for efficiency of a Carnot cycle.

(c) Calculate the total entropy change when 20 g water at 0°C is mixed with an equal amount of water at. 80°C. (Given : Specific heat of water = 1 cal g^{-1} K^{-1}) (7,3,5)

5. (a) Describe how the process of adiabatic demagnetisation leads to cooling in paramagnetic salt.

(b) From the TdS equations calculate the amount of heat transferred when one mole of van der Waals gas undergoes a reversible isothermal expansion from volume v_i to v_f.

P.T.O.