Name of the Department: Physics

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

Name of the Paper: Thermal Physics

Semester: III

Unique Paper Code: 32221302

Question paper Set number: A

Duration: 3 Hours **Maximum Marks: 75**

Instructions for Candidates

1. Answer any **four** questions.
2. All Questions carry equal marks.

Q. 1 List the characteristics of first order phase transitions.

Derive Clausius Clapeyron latent heat equation. Discuss the effect of change in pressure on boiling and melting points.

Calculate the boiling point of a sample gas at a pressure of 80cm of Hg. The normal boiling point is 80ºC, latent heat of vapourization is 380 joules/g, density of vapour at the boiling point is 4 g/litre and that of the liquid is 0.9 gcm^{-3}.

Which curve has a greater slope, representing an isothermal or adiabatic process. Jusity mathematically

Q. 2 Explain four thermodynamic potentials.

Obtain Maxwell's four thermodynamic relations using the exact differential nature of the thermodynamic potentials.

Show that for an ideal gas,

$$\left(\frac{\partial U}{\partial V}\right)_T = 0$$

and for a dilute real gas,

$$\mathbf{C_p - C_v} = R(1 + 2a/RTV^2)$$

Q3 Define intensive and extensive variables. Give their examples.

Explain the significance of Second Law of Thermodynamics.

Establish the equivalence between Kelvin-Planck and Clausius statements of Second Law of Thermodynamics.

Can a Carnot heat engine attain 100% efficiency? Justify your answer.

Calculate the increase in entropy of 1g of a gas when its temperature is raised from $0^{\circ}C$ to $100^{\circ}C$ at constant volume. C_v for the given gas is 5.035 cal/deg.mole.

Q4 Obtain the general expression for Joule-Thomson(Kelvin) Coefficient. Hence find out its value for an ideal gas.

Obtain the reduced van der Waals equation of state for a gas.

Write down the salient features of results of Andrew's experiment on CO_2 gas.

Q.5 Using Maxwell's distribution function, obtain an expression for average speed (v_{av}), root means square speed (v_{rms}) and most probable speed (v_{mps}).

Calculate the relative magnitude of these speeds. How do these speeds vary with temperature?

Calculate the average energy of nitrogen molecules at $27^{\circ}C$.
Given, $k = 1.38 \times 10^{-23}$ J/K.

Show that,

$$\frac{T_i}{T_c} = \frac{27}{4}$$

Q6 Derive an expression for thermal conductivity (K) of a gas on the basis of kinetic theory of gases. Show that it is maximum for a hydrogen molecule and hydrogen atom.

Calculate mean free path and collision frequency for an ideal gas. Given, molecular diameter is 2 A^o at 20^oC, 1 atm pressure equals 1.01×10^5 N/m^2, velocity of molecules is 511 m/s .

How does mean free path vary with temperature and pressure?