(d) Derive the relation, $\eta = \frac{1}{3}\rho \bar{c} \lambda$, where

$\eta \rightarrow$ coefficient of viscosity

$\rho \rightarrow$ density

$\bar{c} \rightarrow$ average velocity

$\lambda \rightarrow$ mean free path

(e) What is equation of state? Write the ideal gas equation. Explain the two correction introduced in ideal gas equation to derive van der Waals equation of state. On what factors do the van der Waals constant a and b depend? 1+1+6+2=10

(f) Write short notes on ***any two*** of the following: 5+5=10

(i) Reversible and irreversible process

(ii) Refrigerator and coefficient of performance

(iii) Gibbs potential

(iv) Joule-Thomson cooling

3 (Sem-3/CBCS) PHY HC 2

2023

PHYSICS

(Honours Core)

Paper : PHY-HC-3026

(Thermal Physics)

Full Marks : 60

Time : Three hours

The figures in the margin indicate full marks for the questions.

1. Answer the following questions: 1×7=7

(a) What are intensive thermodynamic variables?

(b) Write the differential form of 1st law of thermodynamics.

(c) What is the change in internal energy of a system over one complete cycle?

(d) Why the workdone in isochoric process is zero?

(e) State 3rd law of thermodynamics.

Contd.

(f) Name the transport phenomenon present in gas that involves transfer of mass.

(g) How does mean free path of gas molecule change when temperature and pressure are doubled?

2. Answer the following questions: 2×4=8

(a) 'Work and heat are equivalent to each other' – Explain.

(b) Why efficiency of a Carnot engine cannot be 100%?

(c) Find the change in entropy when 10 *gm* of ice at 0°C is converted into water at the same temperature.

(d) If critical temperature of a gas is 300*K*, find its temperature of inversion.

3. Answer ***any three*** of the following: 5×3=15

(a) Derive an expression of work done in adiabatic process.

(b) Derive the expression of change in entropy of a perfect gas when its state changes from (T_1, P_1) to (T_2, P_2).

(c) Using laws of thermodynamics derive Maxwell's first thermodynamic relation.

(d) State law of equipartion of energy using this law find the expression of ratio between two specific heat of a gas in terms of degree of freedom. 1+4=5

(e) The molecular diameter of a gas molecule is $10^{-8}cm$. Calculate the mean free path at temperature 27°C and at pressure $10^5 dyne/cm^2$. [Boltzmann constant, $k = 1{\cdot}4 \times 10^{-16} erg/K$]

4. Answer ***any three*** of the following: 10×3=30

(a) What is heat engine? Is Carnot engine a heat engine? Describe the four processes involved in a Carnot engine and hence derive the efficiency of the engine. 1+1+8=10

(b) Derive Clausius-Clapeyron equation from Maxwell's thermodynamic relation. Using this law explain the effect of pressure (i) on boiling point of liquid (ii) on melting point of solid. 6+2+2=10

(c) Derive the expression of average speed, r.m.s speed and most probable speed of gas molecules using Maxwell's velocity distribution law and hence find their ratio. 3+3+3+1=10

 Contd.