

Total number of printed pages-4

**3 (Sem-3/CBCS) PHY HC 2**

**2024**

**PHYSICS**

(Honours)

Paper : PHY-HC-3026

**(Thermal Physics)**

Full Marks : 60

Time : Three hours

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

Answer the following questions:  $1 \times 7 = 7$

- (a) What is a cyclic process?
- (b) Is coefficient of performance of a refrigerator a constant quantity?
- (c) What is the importance of Clausius inequality in thermodynamics?
- (d) What is the entropy value of a perfect crystalline solid at absolute zero temperature?

Contd.

- (e) Name the phenomenon where transport of momentum takes place in gas.
- (f) What do mean by temperature inversion ?
- (g) Define compressibility factor.

2. Answer the following questions : 2×4=

- (a) Why is  $C_P$  greater than  $C_V$  ? Explain
- (b) What is the basic difference between reversible and irreversible processes ?
- (c) What is the effect of temperature and pressure on mean free path ?
- (d) How does velocity distribution curve depend on temperature ?

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

- (a) Derive an expression for work done during an isothermal process.
- (b) The melting point of solid tin is  $232^\circ\text{C}$ . The specific heat of solid tin is  $0.055 \text{ cal/gm K}$  and molten tin is  $0.064 \text{ cal./gm.K}$ . Calculate the change in entropy when one gm of solid tin is heated from  $147^\circ\text{C}$  to  $310^\circ\text{C}$ . (Given,  $L = 15 \text{ cal./gm}$ ).

- (c) Calculate the average speed and the most probable speed of 1 mole of hydrogen molecule at 300 K. Neglect mass of electron.

$K_B =$  Boltzmann constant =  
 $1.380649 \times 10^{-23}$  joule per kelvin (K).  
 $2\frac{1}{2} + 2\frac{1}{2} = 5$

- (d) For 6.75 mol. of  $N_2$  gas in a volume of 1 litre at 150 K, calculate the pressure exerted by  $N_2$  using (i) ideal gas law (ii) Van der Waals equation and (iii) Compressibility factor.

Given  $a = 1.39 \text{ atm L}^2/\text{mol}^2$

$b = 0.03913 \text{ L/mol}$

$R = 0.0821 \text{ Latm/mol K}$

$1+2+2=5$

- (e) Show that in an isothermal expansion of a Van der Waals' gas, the heat taken

in is  $Q = RT \log \left( \frac{V_f - b}{V_i - b} \right)$  where  $V_f$  and  $V_i$  are the final and initial volume respectively.

Answer **any three** of the following questions :  $10 \times 3 = 30$

- (a) Explain Carnot's cycle. Calculate the work done in the cycle of operation and hence find the efficiency of a Carnot engine.

- (b) Show that the change of entropy of one mole of a perfect gas is given by

$$\Delta S = C_V \log_e \frac{P_2}{P_1} + C_P \log_e \frac{V_2}{V_1}$$

- (c) Deduce Clausius Clapeyron equation from Maxwell's second thermodynamic relation.
- (d) Derive Maxwell's velocity distribution function.
- (e) Derive an expression of coefficient of viscosity using kinetic theory.
- (f) Deduce Van der Waals equation.