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**3 SEM TDC PHYH (CBCS) C 6**

**2023**

( December )

PHYSICS

( Core )

Paper : C-6

( **Thermal Physics** )

Full Marks : 53

Pass Marks : 21

Time : 3 hours

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

1. Choose the correct answer from the following : 1×5=5
- (a) Zeroth law of thermodynamics is related to
- (i) internal energy
  - (ii) heat
  - (iii) temperature
  - (iv) work
- (b) In case of a reversible cyclic process, change in entropy is
- (i)  $ds = 0$
  - (ii)  $ds > 0$

- (iii)  $ds < 0$   
 (iv) either  $ds > 0$  or  $ds < 0$  depending on the initial condition
- (c) Gibbs potential is defined as
- (i)  $G = U - PV + TS$   
 (ii)  $G = U + PV + TS$   
 (iii)  $G = U - PV - TS$   
 (iv)  $G = U + PV - TS$
- (d) Mean free path is
- (i) maximum distance between two collisions  
 (ii) minimum distance between two collisions  
 (iii) average distance between two collisions  
 (iv) None of the above
- (e) The van der Waals' equation of states for a real gas is
- (i)  $\left(P + \frac{a}{V^2}\right)(V - b) = RT$   
 (ii)  $PV = RT$   
 (iii)  $\left(P - \frac{a}{V^2}\right)(V - b) = RT$   
 (iv)  $\left(P - \frac{a}{V^2}\right)(V + b) = RT$

2. (a) Calculate the efficiency of a Carnot engine which works between the temperature limits  $227^\circ\text{C}$  and  $27^\circ\text{C}$ . 2  
 (b) State and explain the first law of thermodynamics. 2  
 (c) Write down Maxwell's thermodynamical equations. 2  
 (d) Calculate the r.m.s. velocity of hydrogen at NTP, given that 1 litre of hydrogen weighs  $0.08987\text{ g}$  at NTP. 2
3. (a) Derive the expression of work done during adiabatic expansion. 3  
 (b) Show that entropy remains constant in reversible process but increases in irreversible process. 3  
 (c) Establish the Clausius-Clapeyron equation
- $$\frac{dP}{dT} = \frac{L}{T(V_2 - V_1)} \quad 3$$
- (d) State Maxwell's law of distribution of velocities. Explain the law of equipartition of energy. 1+2=3
4. (a) Describe the porous plug experiment. What correlation has been drawn from it? What is inversion temperature? 4  
 (b) Derive an expression for thermal conductivity of a gas on the basis of kinetic theory of gases. 4

5. (a) Describe Andrew's experiments on carbon dioxide and discuss the results obtained. 5
- (b) What are the critical constant of a gas? State and explain van der Waals' equation. Calculate the van der Waals' constants  $a$  and  $b$  in terms of  $V_c$ ,  $P_c$  and  $T_c$ . 5
- (c) Derive the following Maxwell's thermodynamical relations : 5

$$\left(\frac{\partial T}{\partial V}\right)_S = -\left(\frac{\partial P}{\partial S}\right)_V$$

$$\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$$

- (d) What is Carnot's engine? The efficiency of a Carnot's cycle is  $1/6$ . If on reducing the temperature of the sink by  $65\text{ K}$ , the efficiency becomes  $1/3$ , find the initial and final temperatures between which the circle is working.  $1+4=5$

Or

50 gm of water at  $0^\circ\text{C}$ . is mixed with an equal mass of water at  $80^\circ\text{C}$ . Calculate the resultant increase in entropy. 5

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