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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 °C and 27 °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 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

$$\frac{dP}{dT} = \frac{L}{T(V_2 - V_1)}$$ 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 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 °C is mixed with an equal mass of water at 80 °C. Calculate the resultant increase in entropy. 5

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