Total number of printed pages–4

3 (Sem–3 /CBCS) PHY HC 2

2021

(Held in 2022)

PHYSICS

(Honours)

Paper : PHY–HC–3026

(Thermal Physics–II)

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 is an isobaric process ?

     (b) What is the entropy of a perfect
     crystalline solid at absolute zero
     temperature ?

Contd.

(c) Whether Maxwell-Boltzmann velocity distribution is applicable to photons.

(d) Joule-Kelvin coefficient of a perfect gas is infinite. (State True **or** False)

(e) At what temperature, does all molecular motion cease ?

(f) Name the transport phenomenon present in a gas that involves momentum transfer.

(g) How does the diameter of a gas molecule affect mean free path ?

2. Answer the following questions : $2 \times 4 = 8$

(a) Is temperature a microscopic or macroscopic concept ? Explain.

(b) Differentiate between extensive and intensive variables with examples.

(c) Calculate the average thermal energy of a helium atom at 27°c.

[Given $k_B = 1.38 \times 10^{-23} \, m^2 \, kg \, s^{-2} K^{-1}$]

(d) How do viscosity and temperature affect Brownian motion of gas molecules ?

3. Answer **any three** questions : $5 \times 3 = 15$

(a) A reversible engine takes in heat from a reservoir of heat at 527°C and gives out heat to sink at 127°C. How many calories per second must it take from the reservoir to produce useful mechanical work at the rate of 750 watts ?

(b) Derive an expression for work done during an adiabatic process considering n moles of an ideal gas.

(c) Explain an experimental method to verify velocity distribution of gas molecules.

(d) The van der Waals constants of oxygen are $a = 1.382 \, L^2 \, bar/mol$ and $b = 0.03186 \, L/mol$. Calculate its Boyle's temperature and temperature of inversion. $2\frac{1}{2} + 2\frac{1}{2} = 5$

(e) Derive Clausius-Clapeyron equation.

4. Answer the following questions :
$10 \times 3 = 30$

(a) Using Maxwell's thermodynamic relations, derive T_{ds} equations. 10

Or

What is Gibbs free energy ? Using Gibbs free energy G, show that

$$G = -T^2 \left[\frac{\partial}{\partial T} \left(\frac{G}{T} \right) \right]_P$$

where the symbols have their usual meanings. $1+9=10$

(b) Define coefficient of diffusion. Discuss the theory of diffusion in a gas and show that coefficient of diffusion is directly proportional to square root of temperature. $1+2+7=10$

Or

Derive the van der Waals equation of state and calculate the value of critical constants. $5+5=10$

(c) What do you mean by thermodynamic scale of temperature ? Show that the thermodynamic scale of temperature is identical with the perfect gas scale of temperature. $3+7=10$

Or

Write short notes on the following : *(any two)* $5 \times 2 = 10$

(i) Carnot cycle

(ii) Degrees of freedom

(iii) Joule-Thomson cooling

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