2019

B.Sc.

3rd Semester Examination

PHYSICS (Honours)

Paper - C 6-T

Full Marks : 40 Time : 2 Hours

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

1. Answer any *five* questions of the following : 5×2=10

   (a) What is meant by 'thermodynamic equilibrium'. State 'Zeroth Law' of Thermodynamics. 1+1

   (b) Distinguish between adiabatic cooling and Joule Thomson colling. 2

   (c) Certain mass of gas at NTP is expanded to three times of its volume abiabatically. Calculate the resulting temperature $(\gamma = 1.40)$. 2

   (d) The equation of state of an ideal gas is $PV = nRT$. Show that (i) the volume

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expansivity β is equal to $\frac{1}{T}$. and (ii) isothermal compressibility k is equal to $\frac{1}{P}$. 1+1

(e) How is the atomicity of a gas molecules related with the ratio of two speitic heats ? 2

(f) $dn_c = 4\pi n a^3 e^{-bc^2} c^2 dc$ is the number of molecules having lying between c and $c+dc$, where $a = \sqrt{m/2\pi kT}$ and $b = m/2kT$. Plot dn_c vs c for two different temperatures T_1 and $T_2 (T_2 > T_1)$. What is the significance of the total area under curve and the c-axis ? 2

(g) Distinguish between first order and second order phase transition. 2

(h) State the law of corresponding states for real gases. 2

2. Answer any *four* questions : 4×5

(a) Using Kinetic theory of gases, find an expression for the coefficient of self-diffusion for an ideal gas where concentration gradient exists only along one direction.

(b) Show how would you determine

(i) Enthalpy H from a knowledge of Gibb's tree energy G and

(ii) Gibb's free energy G from a knowledge of Helmholtz free energy F. 2½+2½

(c) (i) Derive an expression for change in entropy when ice changes into steam. 3

(ii) Find the change of entropy when 10 gm of ice melt at 0°C to 100°C. 2

(d) Derive clausius clapeyron's Laten heat equation

$$\frac{dP}{dT} = \frac{L}{T(V_2 - V_1)}$$

from Maxwell's thermodynamic relations. 5

(e) Show that the porbability of a gas molecule traversing a distance x without suffering a collision is $\exp(-x/\lambda)$, where λ is the mean free path of the gas.

Calculate the fraction of molecules which will be travelling undeflected after traversing 0.693 times the mean free path. 3+2

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(f) State both the Kelvin-Planck and the Clausius statements of second law of thermodynamics. Show that they are equivalent. 2+3

3. Answer any *one* question : 1×10

(a) Prove that

$$C_p - C_v = T\left(\frac{\partial P}{\partial T}\right)_V \left(\frac{\partial V}{\partial T}\right)_P$$

Hence find the value of $\left(C_p - C_v\right)$ for an

(i) Ideal gas and

(ii) Van der Waal's gas. The symbols have usual meaning. 2+2+4

(iii) Prove that for any substance

$$Tds = C_p dT - T\left(\frac{\partial V}{\partial T}\right)_P dp \qquad 2$$

(b) What do you mean by 'degrees of freedom' of a dynamical system ? State and establish the equipartition theorem. What specific heats are predicted for diatomic and triatomic molecules by the theory ? What is significance of Boyle temperature ? What is the concept of work in Thermodynamics ? 1+(1+2)+2+2+1+1