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UG/3rd Sem/PHS(H)/T/19

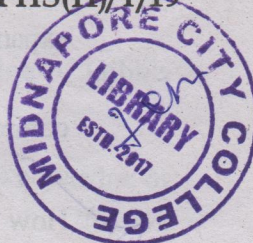
2019

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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(2)

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 specific heats ? 2

(f) $dn_c = 4\pi na^3 e^{-bc^2} c^2 dc$ 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.

(3)

(b) Show how would you determine

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

(ii) Gibb's free energy G from a knowledge of Helmholtz free energy F . $2\frac{1}{2}+2\frac{1}{2}$

(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

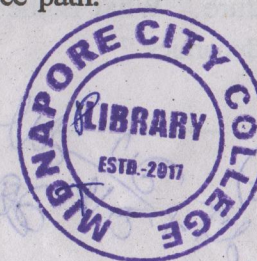
(d) Derive clausius clapeyron's Latent heat equation

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

from Maxwell's thermodynamic relations. 5

(e) Show that the probability 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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(4)

✓ (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 $(C_p - C_v)$ 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

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

(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

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

S, P, T

$u = u(T, V)$
 $du = \left(\frac{\partial u}{\partial T} \right)_V dT + \left(\frac{\partial u}{\partial V} \right)_T dV$