

Full Marks: 60

Time: 3 hours

(Answer any five questions out of eight)

1. a) Write short notes on i) Adiabatic process, ii) Isothermal process 4
- b) State first law of thermodynamics? From first law of thermodynamics derive Mayer's relation. 5
- c) A certain mass of gas at NTP is expanded to three times its volume under adiabatic conditions. Calculate the resulting temperature and pressure. γ for the gas is 1.40. 3
2. a) What do you mean by entropy? Show that entropy remains constant in reversible process but increases in irreversible process. 4
- b) Derive Maxwell's four thermodynamics relations. Use one of these to obtain Clausius-Clapeyron's latent heat equation. 4
- c) Calculate the depression of melting point of ice produced by one atmosphere increase of pressure. Given that latent heat of ice = 80 cal/gm and specific volume of ice and water at 0°C are 1.091 cm³ and 1.0 cm³ respectively. 4
3. a) State the fundamental assumptions of the kinetic theory of gases. 2
- b) Show from the kinetic theory that the mean kinetic energy of translation of one molecule of perfect gas is $\frac{3}{2}kT$, where k is Boltzmann's constant and T is the absolute temperature of the gas. 7.5
- c) The kinetic energy of a molecule of hydrogen at 0 °C is 5.64×10^{-14} ergs and the molecular gas constant R equals to 8.32×10^7 ergs.gm⁻¹.mole⁻¹.K⁻¹. Calculate Avogadro's number N 2.5
4. a) Write short notes on i) Reverberation, ii) group velocity? 3
- b) Derive the equation of wave motion in the form $y = a \sin 2\pi/\lambda (vt-x)$ 4
- c) A simple harmonic motion is represented by the equation $Y = 10 \sin (10t - \pi/6)$ 5
Where y is measured in metres, t in seconds and the phase radians. Calculate: ~~ix~~ the frequency ~~ix~~ the time period ~~ix~~ the maximum displacement ~~ix~~ the maximum velocity ~~ix~~ the maximum acceleration, and vi) displacement, velocity and acceleration at time, t = 0 and t = 1 second.
- ~~5. a) What are the free, damped and forced vibrations? Derive the differential equation of damped harmonic oscillator. 5~~
- ~~b) Write short notes on i) Seebeck effect and ii) Peltier effect 3~~
- ~~c) Calculate the change in entropy when 10 g of water at 60°C is mixed with 30 g of water at 20°C. 4~~
- ~~6. a) What are miller indices? How can miller indices be determined? 1+3~~
- ~~b) What is Bragg's Law? Deduce Bragg's equation. 1+4~~
- ~~c) Explain co-ordination number and packing fraction. 3~~

7. a) Define diffraction of light with example? Distinguish between interference and diffraction. 3.5
- b) Define polarization. What are the methods of obtaining polarized light, explain one of this? State and explain Malus' law of polarization. 6
- 6.0
- c) How will you have to orient the polarizer and analyzer so that a beam of natural light is reduced to 0.25, 0.50 and 0.75 of its initial intensity? 2.5
8. a) What is coherent source? What are the conditions of interference? 1+2
- b) Describe the Young's double slit experiment and discuss the conditions for bright and dark bands. 4
- c) An interference spectra is formed in the screen at a distance of 1.0 m from two slits having separation of 0.4 mm. If the wavelength of light is 5000 Å. Find the distance between two successive bright bands. 3
- d) The path difference between two points in a wave is $\lambda/4$. What is the phase difference between those two points? 2

$$\Delta x = \frac{n\lambda R}{a}$$