KNT/KW/16/5080

Bachelor of Science (B.Sc.) (C.B.S.) Semester–II Examination

PHYSICS

(Oscillations, Kinetic Theory of Gases and Thermodynamics)

Compulsory Paper–1

Time : Three Hours] [Maximum Marks : 50

N.B. :— (1) All questions are compulsory.

(2) Draw neat and labelled diagrams wherever necessary.

EITHER

1. (A) What are Lissajous' figures ? Obtain an expression for resultant of two SHMs acting mutually perpendicular to each other having different amplitudes and phases but frequencies in the ratio 1 : 2. 5

(B) (i) Define angular SHM. Obtain its differential equation. 3

(ii) A spring of force constant 1200N/m is mounted on horizontal table. A mass of 3 kg is attached to the free end of the spring which is pulled side ways to a distance of 2 cm and released. What is the frequency of oscillation of the mass and the maximum acceleration ? 2

OR

(C) Obtain differential equation of motion of a damped harmonic oscillator. 2½

(D) Obtain an expression for power dissipated in damped harmonic oscillator. 2½

(E) Explain the use of Lissajous' figures to determine the frequency of unknown tuning fork. 2½

(F) Lissajous' figures are produced with two tuning forks having their beat frequency 4 beats per second, when one of them is in unison with 1.20 m length of wire and the other with 1.25 of it. Calculate the frequencies of the forks. 2½

EITHER

2. (A) Write down the differential equation for the motion of a particle executing forced vibrations and obtain its steady state solution. 5

(B) (i) What is sharpness of resonance ? Explain the effect of damping on sharpness of resonance. 3

(ii) If the resonant frequency of an acoustic system is 280 Hz and half power frequencies are 200 Hz and 360 Hz respectively, calculate the quality factor. 2

OR

(C) State the assumptions of Kinetic Theory of Gases. 2½

(D) Define mean free path of gas molecule and deduce an expression for the mean free path of a gas molecule. 2½

(E) State law of equipartition energy and prove that the average kinetic energy per molecule per degree of freedom is equal to ½RT. 2½

(F) Calculate the molecular diameter of Benzene, if n = 2.79×10^{19} molecules per cc and mean free path for Benzene is 2.2×10^{-6} cm. 2½

EITHER

3. (A) Explain the transport phenomena in gases. Obtain an expression for coefficient of thermal conductivity of gas in terms of mean free path of molecules. 5

(B) (i) Derive an expression for the coefficient of viscosity (η) of a gas in terms of mean free path of its molecules. 3

(ii) The R.M.S. velocity of gas molecule is 4.50 m/s and density of gas is 0.1 kg/m^3. Calculate the coefficient of viscocity of the gas, if mean free path of the gas molecule is 15×10^{-6} m. 2

OR

(C) Obtain values of critical termperature, critical pressure and critical volume of real gases. 2½

(D) What is a heat engine. Define its efficiency ? On what factors does it depend ? 2½

(E) Find the efficiency of a carnot's engine working between 127^0C and 27^0C. It absorbs 80 calories of heat. How much heat is rejected ? 2½

(F) Apply the first law of thermodynamics to explain :

(a) Adiabatic process and

(b) Isobaric process. 2½

EITHER

4. (A) What is entropy ? Discuss its physical significance. Show that change in entropy in a reversible cyclic process is zero. 5

(B) (i) Calculate the temperature of inversion of helium gas, if a = 0.0341 atm $litre^2/mole^2$, b= 0.0237 litre/mole, and R = 8.31 J/mole K. 2

(ii) Explain the method of liquefaction of helium gas by regenerative cooling. 3

OR

(C) What is Joule-Thomson effect ? Explain experimental arrangement to study Joule-Thomson effect. 2½

(D) Show that the thermodynamic scale and ideal gas scale of temperature are identical. 2½

(E) Water boils at 100^0C under normal atmospheric pressure. If the pressure on water is made 2 atmosphere, find boiling point.

(Given sp volume of steam at 100^0C = 1676×10^{-3} m^3/kg. 1 atm = 10^5 N/m^2, latent heat at steam is $540 \times 4.2 \times 10^3$ J/kg) 2½

(F) Explain the concept of air conditioning. 2½

5. Attempt any **ten** questions (**1** mark each).

(i) Define S.H.M. and write general differential equation of S.H.M.

(ii) What are damped oscillations ?

(iii) A mass of 4 kg is attached to a spring of stiffness constant of 25 Nm. Calculate its natural frequency.

(iv) What is the physical significance of Q value ?

(v) Distinguish between free and forced vibrations.

(vi) The average velocity of nitrogen molecule at NTP is 4.93×10^4 cm/sec and mean free path is 7.89×10^{-8} m. Find the collision frequency of the molecule.

(vii) State zeroth law of thermodynamics.

(viii) Calculate the coefficient of diffusion of the oxygen gas if the mean free path between molecules is 9.95×10^{-8} m and average speed of oxygen molecule is 424.9 m/s.

(ix) Define reversible process.

(x) What is Boyle's temperature ?

(xi) What is T-S diagram ? What is its importance ?

(xii) What is regenerative cooling ? 1×10=10