940223

PHYSICS

Paper-II

Time: 3 Hours | Full Marks: 100

Insturctions : *(1) Answer any **five** questions.*

(2) The figures in the right-hand margin indicate full marks for the questions.

1. (a) State and prove Bernoulli's theorem and mention its applications. 10

(b) Answer the following questions : 2×5=10

(i) What do you mean by Reynolds number?

(ii) Explain the phenomenon of surface tension.

(iii) How are Gauss's and Coulomb's laws related?

(iv) Explain why a large e.m.f is induced in a circuit at break than that at make.

(v) Obtain the integral and differential forms of Faraday's law.

2. Write short notes on the following : 4×5=20

(a) Conservative and non-conservative forces

(b) Wien's displacement law

(c) Q-value of nuclear reactions

(d) Zener diode

(e) Frequency modulation

3. (a) What do you mean by linear, surface and volume expansions of solid? Obtain expressions for the linear and volume expansion coefficients and establish a relation between them. 10

(b) If the density of mercury at 0°C is 13.6 kg / litre, while at 100°C it is 13.5 kg / litre. What is the coefficient of real expansion of mercury? 10

4. (a) Show that the probability of a gas molecule with x component of velocity between v_x and $v_x + dv_x$ is given by $P(v_x)\,dv_x = \left(\frac{m}{2\pi kT}\right)^{\frac{1}{2}} e^{-mv_x^2/2kT}\,dv_x$, where the symbols have their usual meanings. 10

(b) Calculate the probability that the speed of oxygen molecule lies between 99.5 and 100.5 m/s at 200 K. 10

5. (a) Two equal plates with thermal conductivities k_1 and k_2 are joined together to form a single plate of double thickness. Calculate the equivalent thermal conductivity of the composite plate so formed. 10

(b) In an Ingenhousz experiment, three identical rods of different materials are coated with wax and placed with one end inserted in an oil-bath containing hot water when steady state is reached; wax on the rods is found melted up to lengths l_1, l_2 and l_3. Compare the thermal conductivities of the materials of the rods. 10

6. (a) What is a harmonic oscillator? Establish its differential equation and find the expressions for its velocity, displacement and period. 10

(b) Two masses of 10 g and 90 g are connected by a spring of length 10 cm and force constant 10^3 Nm^{-2}. Calculate the frequency of the oscillator. 10

7. (a) Explain the phenomenon of interference of light. Describe and explain Young's experiment demonstrating interference of light. 10

(b) In a Young's double slit experiment, the separation of four bright fringes is 2.5mm, when the wavelength used is 6.25×10^{-5} cm. The distance from the slits to the screen is 80 cm. Calculate the separation of the two slits. 10

8. (a) Discuss the Lenz's law. How would you determine the direction of induced current using Lenz's law? 10

(b) Deduce an expression for the Compton shift and calculate numerical value of the Compton wavelength. 5

(c) Using Bohr atomic model, calculate the wavelength of the emitted photon when a hydrogen atom makes transition from $n = 6$ to $n = 3$ state. 5

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