PHYSICS

150144

Time : 3 hours *Full Marks* : 200

Instructions :

(1) Answer any five questions following the directions.

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

1. *(a)* Define conservative force with an example. Show that when a body is acted upon by a force or by a resultant force, then the work done by the resultant force is equal to the change in the kinetic energy of the body. A body is dropped from rest from a height h. What will be its kinetic energy and velocity when it just strikes the ground? Assume the force of gravity to be constant for distances above the surface of the earth. 3+12+5=20

(b) What do you understand by surface tension of a liquid? State its units. Establish the Bernoulli's equation in liquid. Two soap bubbles of radii a and b coalesce to a single bubble of radius r. If the external pressure is p, then find the expression of surface tension of the solution from which the soap bubble is formed. 3+10+7=20

2. *(a)* What are the differences between stationary wave and progressive wave? Find the expression of total energy of a progressive wave. 5+15=20

(b) What is damped oscillation? Find the expressions for the period and amplitude of damped harmonic oscillation. 5+15=20

3. *(a)* What do you mean by chromatic and spherical aberration? Calculate the longitudinal chromatic aberration of a thin lens. The objective glass of a telescope is an achromat of focal length 90 cm. If the magnitudes of the dispersive powers of the two lenses are 0·024 and 0·036, calculate their focal lengths. 4+10+6=20

(b) What are the differences between interference and diffraction? Explain the method of formation of Newton's rings by using a planoconvex lens. Then find the expression of diameter of nth bright ring. 4+8+8=20

4. *(a)* What are the postulates of special theory of relativity? Derive the Lorentz transformation equations in special theory of relativity. 4+16=20

(b) What is Fraunhofer diffraction? Explain the diffraction in a grating. A plane transmission grating having 6000 lines per cm is used to obtain a spectrum of light from sodium light in the second order. Find the angular separation between the two sodium lines whose wavelengths are 5890 Å and 5896 Å respectively. 4+10+6=20

5. (a) Write the postulates of kinetic theory of gases. Find the expression of pressure exerted by an ideal gas. Also find the relation between root-mean-square velocity and temperature. 5+10+5=20

(b) Write the first law of thermodynamics. Explain the determination of j by Joule's method. A car is brought to halt by applying brakes in 50 m. If the average friction force which is stopping the car is 7·5 kN, how much heat will be produced? 4+12+4=20

6. (a) What is electric field strength or intensity? Find the expression of electric field due to a line charge. Four charges $+4, -3, +2, +3$ coulombs are placed at the corners of a square of each side 1 m. Find the potential at the centre of the square. 4+10+6=20

(b) What do you mean by impedance of a circuit? Calculate the impedance of L, C and R in series of an AC circuit. What is series resonance? Find the expressions of resonance frequency and Q-factor of series L-C-R circuit. 2+8+3+7=20

7. (a) Explain the postulates of Bohr's atomic model and find the expression of electron energy in nth orbit of hydrogen atom. Define the different series of hydrogen spectra. What is space and spin quantisation? 8+6+6=20

(b) Explain the terms *(i)* decay constant, *(ii)* half-life and *(iii)* average life of a radioactive element and obtain the relation among them. Explain the law of successive disintegration. The activity of a radioactive substance decreases to 1/64 of its original value in 21 years. Calculate the half-life of the substance. 6+2+8+4=20

8. (a) Explain the classification of elementary particles. What are four fundamental forces? Explain the role, strength, range and particle affected by the four fundamental forces in nature. 8+4+8=20

(b) Explain development of potential barrier in a P-N junction. What is logic gate? Draw the diagram and write the truth table of a NOR gate. Simplify the logic expression $X = (A+B)\,AC + ABC$ and then draw with logic gates. 6+2+4+4+4=20

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