



Time Allotted : 3 Hours

Full Marks : 70

The Figures in the margin indicate full marks.

Candidate are required to give their answers in their own words as far as practicable

Group-A (Very Short Answer Type Question)

1. Answer any ten of the following :

[1 x 10 = 10]

- (i) Give examples of bosons.
- (ii) Discuss the principle of conservation of angular momentum.
- (iii) The resolving power of a grating having N number of total rulings, in nth order is
- (iv) What is the unit of polarizability in SI system?
- (v) Write the expression of the Compton wavelength.
- (vi) Average energy of an electron in a metal at $T=0K$ is
- (vii) What is solenoidal vector?
- (viii) Phase velocity and group velocity are equal when the medium is
- (ix) Distinguish between conduction current and displacement current.
- (x) The Compton shift is maximum when the scattering angle is
- (xi) The number of macrostates for N particles in MB distribution are
- (xii) Give an example of non-inertial frame of reference.

Group-B (Short Answer Type Question)

Answer any three of the following :

[5 x 3 = 15]

2. Write down the differential equation of a damped harmonic motion. Plot displacement with time for a particle undergoing damped harmonic motion. [5]
3. Distinguish between positive and negative crystal related to polarisation of light. [5]
4. Define magnetization. Obtain a relation between magnetic permeability and magnetic susceptibility. [5]
5. An electron and a proton have the same de-Broglie wavelength. Prove that the energy of the electron is greater than that of the proton. [5]
6. What are Fermions and Bosons? Find out the number of possible arrangements of 3 particles in 3 cells according to B-E and F-D statistics. [5]

Group-C (Long Answer Type Question)

Answer any three of the following :

[15 x 3 = 45]

7. (a) State the characteristics of blackbody radiations. [3]
(b) Write the expression of Wien's radiation formula. What are the limitations of it? [2]
(c) Establish the Wien's displacement law from Planck's radiation law of a black body. [5]
(d) How Stefan-Boltzmann law can be derived from Planck's radiation law? [5]
8. (a) What is diffraction of light? Explain the difference between interference and diffraction of light. [5]
(b) Derive the expression of intensity at a point for Fraunhofer diffraction due to single slit. [5]
(c) Find the conditions of central maxima, secondary minima and secondary maxima for single slit Fraunhofer diffraction. [5]
9. (a) What is Bohr magneton? State and explain Curie's law for ferromagnetism. [5]
(b) What is Hysteresis? Explain Hysteresis curve with diagram for a sample of iron. [5]
(c) What is the difference between conduction current and displacement current? Write down the significance of displacement current. [5]
10. (a) Write down the expression of probability distribution of velocity of a gas obeying M.B statistics. From that expression derive the expression of most probable velocity. [5]
(b) Define Fermi energy. Starting from the expression of density of states of a fermi gas deduce the expression of Fermi energy. [5]

- (c) Using B.E statistics and density of states of photons establish Planck's radiation law for a black body. [5]
11. (a) Find the expression of energy and direction of recoil electron due to Compton scattering. [4+3]
- (b) X-rays of wavelength 1.2\AA undergo Compton scattering due to electrons. What is the maximum possible value of Compton shift if the Compton wavelength of electron is 0.02426\AA ? [4]
- (c) When a photon of wavelength $6\times 10^{-10}\text{m}$ strikes an electron at rest and rebounds at an angle of 150° to its original direction, find the velocity and wavelength of photon after collisions. [4]

*** END OF PAPER ***