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MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL

(PH-201)

PHYSICS - I

Time Allotted : 1 Hours

Full Marks : 50

The questions are of equal value.
The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.
All symbols are of usual significance.

GROUP A
(Multiple Choice Type Questions)

1. Answer any ten questions. [10 × 1 = 10]

(i) Time period of a simple pendulum having infinite length will be
(A) finite non-zero value (B) infinite
(C) zero (D) cannot be determined

(ii) The quality factor (Q) for an L-C-R circuit is
(A) $\frac{\omega R}{L}$ (B) $\frac{\omega L}{R}$
(C) $\frac{\omega}{LR}$ (D) $\frac{R}{\omega L}$

(iii) Which of the following is a dimensionless quantity?
(A) Wave number (B) Atomic number
(C) Atomic weight (D) Molecular weight

(iv) The energy relaxation time (τ_1) of a damped oscillator with damping coefficient γ is
(A) $\tau_1 = \gamma^2$ (B) $\tau_1 = 1/2\gamma$
(C) $\tau_1 = \gamma$ (D) $\tau_1 = 2\gamma$

(v) In Young's double slit experiment the two coherent sources are produced by
(A) division of wave front (B) division of amplitude
(C) both (A) and (B) (D) none of these

(vi) The resolving power of a grating having number of rulings 'N' and order 'n' is
(A) n (B) n^2N
(C) N (D) nN

(vii) Which of these light is incident on a prism diffracting grating the central maximum will be
(A) Black (B) White
(C) Blue (D) Red

(viii) "Newton's ring experiment is based on
(A) division of amplitude (B) division of wave front
(C) division of frequency (D) division of phase angle

(ix) According to Wien's displacement law
(A) $\lambda_m T^2$ = constant (B) $\frac{\lambda_m}{T}$ = Constant
(C) $\lambda_m T$ = Constant (D) $\frac{\lambda_m}{T^2}$ = Constant

(x) According to Moseley's law, frequency of a spectral line depends on
(A) mass (B) atomic number
(C) atomic weight (D) molecular weight

(xi) The energy relaxation time (τ_1) of a damped oscillator with damping coefficient γ is
(A) $\tau_1 = \gamma^2$ (B) $\tau_1 = 1/2\gamma$
(C) $\tau_1 = \gamma$ (D) $\tau_1 = 2\gamma$

(xii) In Young's double slit experiment the two coherent sources are produced by
(A) division of wave front (B) division of amplitude
(C) both (A) and (B) (D) none of these

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(C) N (D) nN

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(xvi) According to Wien's displacement law
(A) $\lambda_m T^2$ = constant (B) $\frac{\lambda_m}{T}$ = Constant
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(xvii) Polarization simultaneously proves that light waves are
(A) longitudinal (B) progressive
(C) transverse (D) stationary

(xviii) The relativistic energy-momentum relation is
(A) $E^2 = p^2c^2 + m_0^2c^4$ (B) $E^2 = p^2c^2 + m_0^2c^2$
(C) $E^2 = p^2c^2 - m_0^2c^4$ (D) $p^2 = E^2c^2 - m_0^2c^4$

(xix) An α-particle of 4 MeV has the same kinetic energy as a proton. If a proton and an α-particle are moving with the same velocity then the De-Broglie wavelengths are related?
(A) $\lambda_p = \lambda_\alpha$ (B) $\lambda_p = \lambda_\alpha / 2$
(C) $\lambda_p = \lambda_\alpha / 4$ (D) $\lambda_p = 4\lambda_\alpha$

(xx) A resolving disk (for electron in a cylindrical slit opening of equal size and kinetic energy) of size 'd' is placed in front of the screen. The distance between the first minima from the central maximum is
(A) $\frac{\pi d}{\lambda D}$ (B) $\sqrt{3}\frac{\pi d}{\lambda}$
(C) $\sqrt{3}\frac{\pi d}{\lambda D}$ (D) $\frac{\pi d}{2\sqrt{3}D}$

(xxi) In Young's lattice, the wavefunction is zero when
(A) the number of atoms present in the crystal is zero
(B) the symmetry of the crystal is high
(C) both (A) and (B)
(D) none of these

(xxii) If we measure the energy of a particle accurately then the uncertainty of the measurement of time becomes
(A) 0 (B) ∞
(C) $\frac{\hbar}{2}$ (D) ∞

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GROUP B
(Short Answer Type Questions)

Answer any eleven questions. [11 × 5 = 55]

2. (a) Draw and explain the electrical equivalent circuit with modelling for damped vibrations. 3
(b) What is critical damping? 1
(c) Establish the relation between the logarithmic decrement and quality factor of a damped oscillatory system. 1

3. (a) What is meaning unit in double slit diffraction pattern? Explain why. 2
(b) What do you mean by resolving power for plane transmission grating? 1
(c) Write the Rayleigh criterion of resolution? 1

4. (a) The reflective indices of double reflecting crystal for ordinary and extraordinary rays are 1.544 and 1.553 respectively for wavelength 5 × 10⁻⁵ cm. Determine the thickness of the crystal to produce half wave plate. 3
(b) Discuss briefly the production of circularly polarized light. 2

5. (a) What is Fraunhofer diffraction? 1
(b) A photon of wavelength 1Å is scattered by an electron. Explain the origin of modified wavelength. Find the maximum wavelength. 3+1

6. (a) A cylinder atomic radius (let a) is crystal. What is Bragg's law? 1+1
(b) The compton wavelength of a photon is 1.2 Å and the angle for the second order Bragg's reflection is 30°. Determine the energy of the X-ray photon used. 3

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GROUP C
(Long Answer Type Questions)

Answer any three questions. [3 × 15 = 45]

7. (a) Derive and explain the electrical equivalent circuit with modelling for damped vibrations. 10
(b) What is critical damping? 1
(c) Establish the relation between the logarithmic decrement and quality factor of a damped oscillatory system. 4

8. (a) What is meaning unit in double slit diffraction pattern? Explain why. 2
(b) What do you mean by resolving power for plane transmission grating? 3
(c) Write the Rayleigh criterion of resolution? 4

9. (a) The reflective indices of double reflecting crystal for ordinary and extraordinary rays are 1.544 and 1.553 respectively for wavelength 5 × 10⁻⁵ cm. Determine the thickness of the crystal to produce half wave plate. 5
(b) Discuss briefly the production of circularly polarized light. 10

10. (a) What is Fraunhofer diffraction? 2
(b) A photon of wavelength 1Å is scattered by an electron. Explain the origin of modified wavelength. Find the maximum wavelength. 5+3

11. (a) A cylinder atomic radius (let a) is crystal. What is Bragg's law? 2+2
(b) The compton wavelength of a photon is 1.2 Å and the angle for the second order Bragg's reflection is 30°. Determine the energy of the X-ray photon used. 6

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