[This question paper contains 4 printed pages.]

Sr. No. of Question Paper : 799 **E** **Your Roll No.....**

Unique Paper Code : 222251

Name of the Course : **B.Sc. (Hons.) Chemistry**

Name of the Paper : Physics - I (PHCT - 201)

Semester : II

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **five** questions in all.
3. Attempt **at least one** question each from Section.

Section A

1. If $\vec{a},\vec{b}$ & $\vec{c}$ are three arbitrary vector in three dimensions. then prove that :

(a) $\vec{a}\bullet(\vec{b}\times\vec{c})=\begin{vmatrix} a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \\ c_1 & c_2 & c_3 \end{vmatrix}$

(b) $(\vec{a}\times\vec{b})\times\vec{c}=\vec{b}(\vec{a}\bullet\vec{c})-\vec{a}(\vec{b}\bullet\vec{c})$

(c) $(\vec{a}\times\vec{b})\bullet(\vec{c}\times\vec{d})=\begin{vmatrix} \vec{a}\bullet\vec{c} & \vec{a}\bullet\vec{d} \\ \vec{b}\bullet\vec{c} & \vec{b}\bullet\vec{d} \end{vmatrix}$ (3×5=15)

2. Prove that :

(a) $\vec{\nabla}\bullet(r^2\vec{r})=5r^2$ (7)

P.T.O.

(b) $\nabla^2 r^4 = 20r^2$ (8)

3. (a) Evaluate :

$$\int_C \vec{F} \cdot d\vec{r},$$

Where $\vec{F} = (5xy - 6x^2)\hat{i} + (2y - 4x)\hat{j}$ and C is the curve in the xy plane, $y = x^3$ from the point (1,1) to (2,8). (7)

(b) Evaluate :

$$\iint_S \vec{A} \cdot \hat{n}\, dS,$$

Where $\vec{A} = (x + y^2)\hat{i} - 2x\hat{j} + 2yz\hat{k}$ and S is the surface of the plane $2x + y + 2z = 6$. (8)

Section B

4. (a) State and prove the Work-energy theorem. (2,5)

(b) What are elastic and inelastic collisions? A particle of mass m_1, moving with velocity u_1 collides head-on with a particle of mass m_2 at rest, such that, after collision, they travel with velocities v_1 and v_2 respectively. If the collision is an elastic one, show that $v_2 = \dfrac{2u_1}{1 + \dfrac{m_2}{m_1}}$. (8)

5. (a) State and prove the theorem of perpendicular axes for a plane laminar body for moment of inertia. (2,5)

(b) Find the moment of inertia of a uniform hollow sphere (mass M and radius R) about its diameter. (8)

6. (a) What is a Lissajous Figure? If apartable undergoes two simultaneous & perpendicular SHMs: $x = A \sin \omega t$ and $y=B \sin (2\omega t + \alpha)$, draw the Lissajous Figure for the case : $\alpha = 0$. (5)

(b) The differential equation of particle of mass m oscillating about an equilibrium position under an external periodic force $F_0 \sin pt$ is given by:

$$m\frac{d^2x}{dt^2} = -kx - b\frac{dx}{dt} + F_0 \sin pt,$$

Where, the symbols have their usual meaning.

Find

(i) the steady-state solution of the above equation.

(ii) the maximum average power supplied by the external force. (10)

Section C

7. (a) Prove that the fringe width β of the interference fringes produced in wedge shaped film of refractive index μ *is* given by

$$\beta = \frac{\lambda}{2\tan\alpha\sqrt{\mu^2 - \sin^2 i}},$$

Where α is the angle of the wedge, i is the angle of incidence of the wave of wavelength λ. (7)

(b) What are coherent sources and how are they realised in Fresnel's bi-prism? Describe how you would find the wavelength of monochromatic light using Fresnel's biprism. (8)

8. (a) Define dispersive power and resolving power of a diffraction grating. Deduce expressions for these. What is the relation between them? (7)

(b) A parallel beam of monochromatic light of wavelength λ falls normally on a pair of parallel narrow slits, each of width 'e', and separated by a distance 'd'. Derive an expression for the resetland intensity distribution. (8)

9. (a) What do you understand by double refraction? What are ordinary and extra-ordinary rays in a uniaxial crystal? (5)

(b) What do you understand by quarter-wave and half-wave plates? (5)

(c) When sunlight falls on the surface of a liquid with an angle of incidence of 30°, the reflected light is found to be completely plane-polarised. Find the angle of refraction and the refractive index of the liquid. (5)