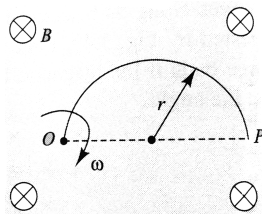


Quiz #2

Problem 1. A wire is in the form of a semicircle of radius r . One end is attached to an axis about which it rotates with an angular speed ω . The axis is normal to the plane of the semicircle. The wire is immersed in a uniform magnetic field B parallel to the axis. Find the induced emf between points O and P of the semicircle.



- i) $\frac{B\omega a^2}{2}$ ii) $B\omega a^2$ iii) $2B\omega a^2$ iv) $\frac{B\omega a^2}{4}$

Problem 2. In a plane electromagnetic wave, the electric field oscillates sinusoidally at a frequency of 2.0×10^{16} Hz and amplitude 48 Vm^{-1} . What is the amplitude of the oscillating magnetic field?

- i) $2.7 \times 10^{-7} \text{ T}$ ii) $1.6 \times 10^{-7} \text{ T}$ iii) $1.6 \times 10^{-8} \text{ T}$ iv) $2.7 \times 10^{-8} \text{ T}$

Problem 3. Which of the following is not correct about the magnetic field lines?

- i) The magnetic field lines of a magnet form continuous closed loops
- ii) The tangent to the field line at a given point represents the direction of the net magnetic field B at that point.
- iii) The larger the number of field lines crossing per unit area, the stronger is the magnitude of the magnetic field B .
- iv) The magnetic field lines may intersect to each other in certain conditions.

Problem 4. Two short bar magnets of magnetic moments m each are arranged at the opposite corners of a square of side d such that their centers coincide with the corners and their axes are parallel. If the like poles are in the same direction, the magnetic induction at any of the other corners of the square is:

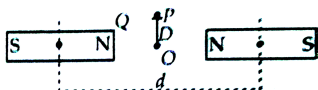
- i) $\frac{\mu_0 m}{4\pi d^3}$ ii) $\frac{\mu_0 2m}{4\pi d^3}$ iii) $\frac{\mu_0 m}{4\pi 2d^3}$ iv) $\frac{\mu_0 m^3}{4\pi 2d^3}$

Problem 5. If two charged particles traverse identical helical paths in a opposite sense in a uniform magnetic field $\vec{B} = B_0 \hat{K}$, what must be true about them?

- i) They have equal z - components of momenta.
- ii) They necessarily represent a particle-antiparticle pair.
- iii) They must have equal charges.
- iv) Their charge to mass ratio satisfies:

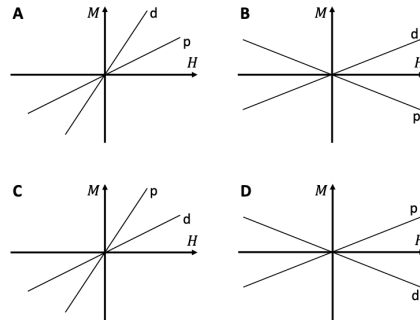
$$\left(\frac{q_1}{m_1} \right) + \left(\frac{q_2}{m_2} \right) = 0.$$

Problem 6. Two identical bar magnets are fixed with their centres at a distance d apart. A stationary charge Q is placed at P in between the gap of the two magnets at distance D from the centre O as shown in the figure. The force on the charge Q is:



- i) zero ii) directed along OP iii) directed along PO
 iv) directed perpendicular to the plane of paper

Problem 7. Consider a paramagnetic (p) material and a diamagnetic (d) material. Which of the following plots describes the correct trend of magnetization $\vec{M}$ versus applied $\vec{H}$ field for the two materials?



Problem 8. Consider the function $\psi = A(Bx + Ct)^2 + D \sin(Ex + Ft)$. For which of the following conditions is ψ a solution of the wave equation?

- i) $C = F$ and $A = D$ ii) $\frac{C}{B} = \frac{F}{E}$ iii) $B = E$ and $A = D$ iv) $\frac{C}{B} = \frac{E}{F}$

Problem 9. Compute the intensity of the standing electromagnetic wave given by

$$E_y(x, t) = 2E_0 \cos kx \cos \omega t, \quad B_z(x, t) = 2B_0 \sin kx \sin \omega t$$

Problem 10. In the circuit shown below, suppose the circuit is initially open. At time $t = 0$ it is thrown closed. What is the current in the inductor at a later time t ?

