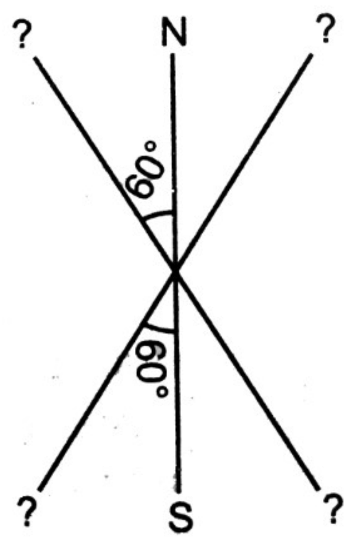
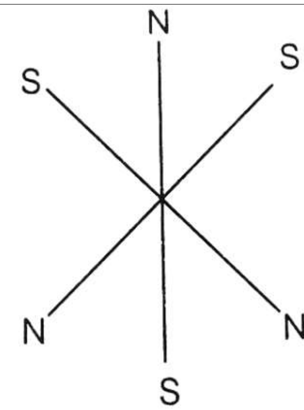
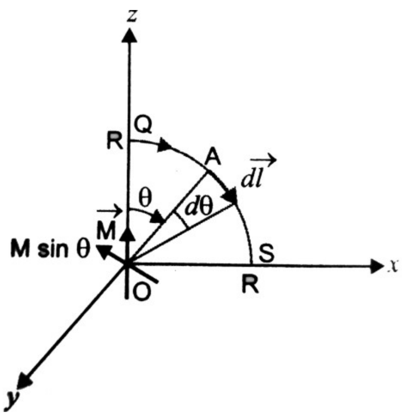
1.	Consider the two idealized systems: (i) a parallel plate capacitor with large plates and small separation and (ii) a long solenoid of length L>>R, radius of cross-section. In (i) $\vec{E}$ is ideally treated as a constant between plates and zero outside. In (ii) magnetic field is constant inside the solenoid and zero outside. These idealised assumptions, however, contradict fundamental law as below: (a) Case (i) contradicts Gauss's law for electrostatic fields. (b) Case (ii) contradicts Gauss's law for magnetic fields. (c) Case (i) agrees with $\oint E.dl=0$. (d) Case (ii) contradicts $\oint H.dl=I_{enc}$
2.	At a point on the right bisector of a magnetic dipole the magnetic potential (a) potential varies as $\frac{1}{r^2}$ (b) potential is zero at all points on the right bisector (c) field varies as r^3 (d) field is perpendicular to the axis of dipole
3.	In a permanent magnet at room temperature. (a) magnetic moment of each molecule is zero (b) the individual molecules have non-zero magnetic moment which are all perfectly aligned (c) domains are partially aligned (d) domains are all perfectly aligned
4.	A magnet with moment Pm is given. If it is bent into a semi-circular form, it's new magnetic moment will be (a) $\frac{P_m}{\pi}$ (b) $\frac{P_m}{2}$ (c) P_m (d) $2(\frac{P_m}{\pi})$
	Short Answer Type Qs (2 & 3 Marks)
5.	A proton has spin and magnetic moment just like an electron. Why then its effect is neglected in magnetism of materials?
6.	Three identical bar magnets are riveted together at centre in the same place as shown in figure. This system is placed at rest in a slowly varying magnetic field. It is found that the system of magnets does not show any motion. The north-south poles of one magnet are shown in figure. Determine the poles of the remaining two.



7.	Suppose we want to verify the analogy between electrostatic and magneto static by an explicit experiment. Consider the motion of (i) electric dipole p in an electrostatic field E and (ii) magnetic dipole M in a magnetic field B. Write down a set of conditions on E, B, p, M so that the two motions are verified to be identical. (Assume identical initial conditions).
8.	Use (i) the Ampere's law for H and (ii) continuity of lines of B, to conclude that inside a bar magnet, (a) lines of H run from the N pole to S pole while (b) lies of B must run from the S pole to N pole.
9.	Explain quantitatively the order of magnitude difference between the diamagnetic susceptibility of $N_2(5\times10^{-9})$ (at STP) and $Cu(10^{-5})$.
10.	Verify the Gauss's law for magnetic field of a point dipole of dipole moment M at the origin for the surface which is a sphere of radius R.
11.	A bar magnet of magnetic moment M and moment of inertia I (about centre, perpendicular to length) is cut into two equal pieces, perpendicular to length. Let T be the period of oscillation of the original magnet about an axis through the midpoint, perpendicular to length, in a magnetic field B. What would be the similar period T' for each piece?
12.	A solenoid has a core of a material with relative permeability 400. The windings of the solenoid are insulated from the core and carry a current of 2A. If the number of turns is 1000 per metre, calculate (a) H (b) B (c) M and (d) the magnetising current I_M.
	Long Answer Type Qs (5 Marks)

13.	(a) Show that the time period (T) of oscillations of a freely suspended magnetic dipole of magnetic moment (m) in a uniform magnetic field (B) is given by $T=2\pi\sqrt{\frac{1}{mB}}$ Where I is moment of inertia of the magnetic dipole. (b) Identify the following magnetic materials : (i) A material having susceptibility $X_m=-0.00015$. (ii) A material having susceptibility $X_m=10^{-5}$.
14.	Verify the Ampere's law for magnetic field of a point dipole moment $m=m\hat{\mathbf{k}}$. Take C as the closed curve running clockwise along (a) The z-axis from z=a>0 to z= R. (b) along the quarter circle of radius R and centre at the origin, in the first quadrant of x-z plane, (c) Along the x-axis from x=R to x= a. (d) Along the quarter circle of radius a and centre at the origin in the first quadrant of x-y plane.
15.	What are the dimensions of χ, the magnetic susceptibility? Consider an H-atom. Guess an expression for χ, up to a constant by constructing a quantity of dimensions of χ, out of parameters of the atom: e, m, v, R and μ_0. Here, m is the electronic mass, v is electronic velocity, R is Bohr radius. Estimate the number so obtained and compare with the value of $\|\chi\|\sim10^{-5}$ for many solid materials.

	HINTS AND ANSWER
1.	(b)
2.	(b)
3.	(d)
4.	(d)
5.	The effect of magnetic moment of proton is neglected ass compared to that of electron.
6.	
7.	P=m/c
8.	(A) The lines of B must run from south poles(S) to north pole (N) inside the bar magnet. (B) The line of H must run from N pole to S pole inside the bar magnet.
9.	The order of magnitude difference between the diamagnetic susceptibility of N_2 and Cu is 10^{-4}.
10.	It is a **Derivation type** where you verify Gauss's law for magnetic fields, which states that the net magnetic flux through a closed surface is zero.
11.	T'=T/2
12.	(A) 2×10^3 A/m (B) 1.0 T (C) 8×10^5 A/m (D) I_m=794A.
13.	**(A) Derivation Type** $T = \frac{2\pi}{\omega} = 2\pi\sqrt{\frac{I}{mB}}.$ (B) (i) Diamagnetic (ii) Paramagnetic
14.	**Part of Derivation** (A)

	$\frac{\mu_0 M}{4\pi}\left(\frac{1}{a^2}-\frac{1}{R^2}\right)$ (B)  (C) $\int_S^T \vec{B}.\,\vec{dl}=\int_R^a -\frac{\mu_0\vec{M}}{4\pi x^3}.\,\vec{dl}=0$ (D)0
15.	X = 35 |χ′|

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