SA

5.16 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.

5.17 Three identical bar magnets are rivetted together at centre in the same plane as shown in Fig. 5.1. 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 is shown in the Fig. 5.1. Determine the poles of the remaining two.

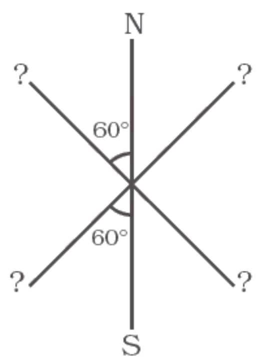

Fig. 5.1

5.18 Suppose we want to verify the analogy between electrostatic and magnetostatic 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.)

5.19 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 oscillations of the original magnet about an axis through the mid point, perpendicular to length, in a magnetic field B. What would be the similar period T' for each piece?

5.20 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) lines of B must run from the S pole to N pole.

LA

5.21 Verify the Ampere's law for magnetic field of a point dipole of dipole moment $\mathbf{m} = m\hat{k}$. Take C as the closed curve running clockwise along (i) the z-axis from z = a > 0 to z = R; (ii) along the quarter circle of radius R and centre at the origin, in the first quadrant of x-z plane; (iii) along the x-axis from x = R to x = a, and (iv) along the quarter circle of radius a and centre at the origin in the first quadrant of x-z plane.

5.22 What are the dimensions of χ, the magnetic susceptibility? Consider an H-atom. Guess an expression for χ, upto 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 $|\chi| : 10^{-5}$ for many solid materials.

5.23 Assume the dipole model for earth's magnetic field B which is given by B_V = vertical component of magnetic field $= \frac{\mu_0}{4\pi}\frac{2m\cos\theta}{r^3}$

B_H = Horizontal component of magnetic field $= \frac{\mu_0}{4\pi}\frac{\sin\theta m}{r^3}$

Θ = 90° – lattitude as measured from magnetic equator.

Find loci of points for which (i) B is minimum; (ii) dip angle is zero; and (iii) dip angle is ± 45°.

5.24 Consider the plane S formed by the dipole axis and the axis of earth. Let P be point on the magnetic equator and in S. Let Q be the point

of intersection of the geographical and magnetic equators. Obtain the declination and dip angles at P and Q.

5.25 There are two current carrying planar coils made each from identical wires of length L. C_1 is circular (radius R) and C_2 is square (side a). They are so constructed that they have same frequency of oscillation when they are placed in the same uniform B and carry the same current. Find a in terms of R.