PHYSICS

BOOKS - NCERT PHYSICS (HINGLISH)

MAGNETISM AND MATTER

Magnetism And Matter

1. A toroid of n turns, mean radius R and cross-sectional radius a carries current I. It is placed on a horizontal table taken as x-y plane. Its magnetic moment $\overrightarrow{M}$

A. It is non-zero and points in the z-direction by symmetry

B. points along the axis of the toroid (m=m ϕ)

C. is zero, otherwise there would be a field falling as $\frac{1}{r^3}$ at large distances outside the toroid

D. is pointing radially outwards.

Answer: C

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2. The magnetic field of the earth can be modelled by that of a point dipole placed at the centre of the earth. The dipole axis makes an angle of 11.3° with the axis of the earth. At mumbai, declination is nearlyzero, then.

A. the declination varies between $11.3^{\circ} CW$ to $11.3^{\circ} E$

B. the least declination is 0°

C. the plane defined by dipole axis the earth axis passes through Greenwich

D. declination averaged over the earth must be always negative

Answer:

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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

Answer:

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4. 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) $\overrightarrow{E}$ 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 law for electrostatic fields

B. case ii contradicts Gauss' law for magnetic fields

C. case i agrees with $\oint E$. Dil=0.

D. case ii contradicts $\oint H$,dil=I_{en}

Answer:

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5. A paramagnetic sample shows a net magnetisation of $8 Am^{-1}$ when placed in an external magnetic field of $0 \cdot 6T$ at a temperature of $4K$. When the same sample is placed in an external magnetic field of $0 \cdot 2T$ at a temperature of $16K$, the magnetisation will be

A. $\frac{32}{3} Am^{-1}$

B. $\frac{2}{3} Am^{-1}$

C. $6 Am^{-1}$

D. $2.4Am^{-1}$

Answer: B

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6. S is the surface of a lump of magnetic material.

A. Lines of B are necessarily continous across S

B. Some lines of B must be discontinous across S

C. Lines of H are necessarily continous across S

D. Lines of H cannot all be continous across S

Answer:

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7. The primary origin(s) of magnetism lies in

A. atomic currents and intrinsic spin of electrons

B. pauli exclusion principle

C. polar nature of molecules

D. electronegative nature of materials

Answer: A

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8. A long solenoid has 1000 turns per metre and carries a current of $1A$. It has a soft iron core of $\mu_r = 1000$. The core is heated beyond the Curie temperature, T_c.

A. The H field in the solenoid is (nearly) unchanged but the B field decreases drastically

B. The H and B fields in the solenoid are nearly unchanged

C. The magnetisation in the core reverses direction.

D. The magnetisation in the core diminishes by a factor of about 10^7

Answer: A

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9. Essential difference between electrostatic shielding by a conducting shell and magnetostatic shielding is due to

A. electrostatic field lines can end on charges and conductors have free charges

B. lines of B can also end but conductors cannot end them

C. lines of B cannot end on any material and perfect shieldin g is not possible

D. shells of high permeability can be used to divert lines of B from the interior region.

Answer:

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10. Let the magnetic field on earth be modelled by that of a point magnetic dipole at the centre of earth. The angle of dip at a point on the geographical equator

A. is always zero

B. can be zero at specific points

C. can b e positive or negative

D. is bounded.

Answer:

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11. A proton has spin and magnetic moment just like an electron. Why then its effect is neglected in magnetism of materials?

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12. A permanent magnet in the shape of a thin cylinder of length 10 cm has $M = 10^6 A/m$. Calculate the magnetisation current I_M.

A. $10^5 A$

B. $10^{12} A$

C. $2 \times 10^8 A$

D. $5 \times 10^{10} A$

Answer: A

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13. Explain quantitatively the order of magnitude difference between the diamagnetic susceptibility of $N_2(-5 \times 10^{-9})$ (at STP) and $Cu(-10^{-5})$.

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14. From molecular view point, discus the temperature dependence of susceptibility for diamagnetism, paramagnetism and ferromagnetism.

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15. A ball of superconducting material is dipped in liquid nitrogen and placed near a bar magnet. (i) In which direction will it move? (ii) What will be the direction of it's magnetic moment?

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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.

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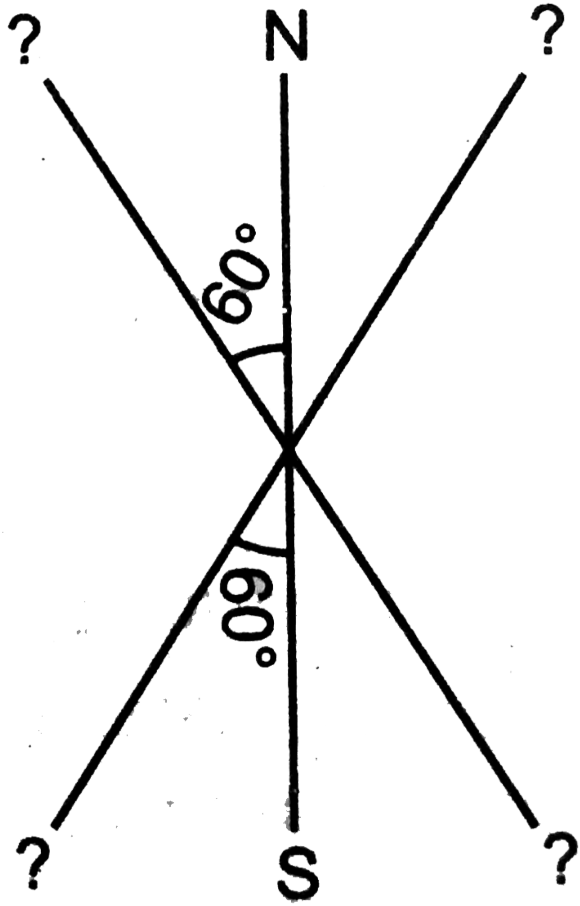
17. Three identical bar magnets are rivetted together at centre in the same place as shown in figure. This system is placed at rest in a slowly varying magnetic field. It is found that the system of magnets does not show any motion. The north-south poles of one magnet are shown in figure. Determine the poles of the remaining two.



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18. Suppose we want to verify the analogy between electrostatic and magnetostatic by an explicit experiment. Consider the motion of (i) electric dipole $\overrightarrow{p}$ in an electrostatic field $\overrightarrow{E}$ and (ii) magnetic dipole $\overrightarrow{M}$ in a magnetic field $\overrightarrow{B}$. Write down a set of conditions on $\overrightarrow{E}$, $\overrightarrow{B}$, $\overrightarrow{p}$, $\overrightarrow{M}$ so that the two motions are verified to be identical. (Assume identical initial conditions).

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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 oscillation of the original magnet about an axis through the mid point, perpendicular to length, in a magnetic field $\vec{B}$. What would be the similar period T' for each piece?

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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) lies of B must run from the S-pole to N -pole.

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21. Verify the Ampere's law for magnetic field of a point dipole moment $\overrightarrow{M} = M\hat{k}$. Take C as the closed curve running clockwise along (i) 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-y plane.

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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 $|\chi\lceil 10^{-5}$ for any solid material.

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23. Assume the dipole model of 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

$= \frac{\mu_0}{4\pi} \frac{\sin\theta M}{r^3}, \theta = 90^\circ$-latitude as measured from magnetic equator.

Find loci of points for which (i) $\left|\vec{B}\right|$ is minimum, (ii) dip angle is zero, and (iii) dip angle is $\pm 45^\circ$.

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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.

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25. There are two current carrying planar coils made each from identical wires of length L. C_1 is the 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 $\overrightarrow{B}$ and carry the same current i. Find a in terms of R.

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