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Magnetism and Matter

TOPIC 1

Bar Magnet and Magnetic Dipole

01 A uniform conducting wire of length 12a and resistance R is wound up as a current (I) carrying coil in the shape of

1. an equilateral triangle of side a.
2. a square of side a.

The magnetic dipole moments of the coil in each case respectively are **[NEET 2021]**

(a) $\sqrt{3}\,Ia^2$ and $3\,Ia^2$ b) $3\,Ia^2$ and Ia^2
(c) $3\,Ia^2$ and $4\,Ia^2$ (d) $4\,Ia^2$ and $3\,Ia^2$

Ans. ***(a)***

Given, the length of a uniform conducting wire, $L = 12a$

The resistance of a uniform conducting wire $= R$

We know that, magnetic dipole moment, $M = nIA$

Here, I is the current in the loop,

A is the area of the coil,

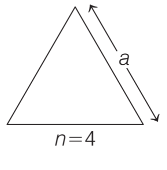
n is the number of loops.

For case (1):

An equilateral triangle of side a.

Total wire length $= n \times$ Perimeter of the triangle

$$12a = n \times 3a \Rightarrow n = 4$$



Area of the triangle, $A = \frac{\sqrt{3}}{4}a^2$

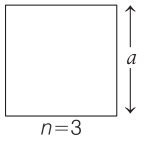
Magnetic dipole moment, $M = nIA$

$$\Rightarrow \quad M = 4I \times \frac{\sqrt{3}}{4}a^2 \Rightarrow M = \sqrt{3}Ia^2$$

For case (2) : A square of side a.

Total wire length $= n \times$ Perimeter of the square

$$12a = n \times 4a \Rightarrow n = 3$$



Area of the square loop, $A = a^2$

Magnetic dipole moment,

$$M = nIA \Rightarrow M = 3Ia^2$$

02 A wire of length L metre carrying a current of I ampere is bent in the form of a circle. Its magnetic moment is **[NEET (Oct.) 2020]**

(a) $IL^2/4\,\text{Am}^2$ (b) $I\pi L^2/4\,\text{Am}^2$
(c) $2IL^2/\pi\,\text{Am}^2$ (d) $IL^2/4\pi\,\text{Am}^2$

Ans. ***(d)***

When wire of length L is bent in the form of a circle of radius R, then

$$L = 2\pi R$$

$$\Rightarrow \quad R = \frac{L}{2\pi}$$

$\therefore$ Magnetic moment, $M = IA = I(\pi R^2)$

$$= I \cdot \pi\left(\frac{L}{2\pi}\right)^2 = \frac{I\pi L^2}{4\pi^2} = \frac{IL^2}{4\pi}\,\text{Am}^2$$

03 A 250-turn rectangular coil of length 2.1 cm and width 1.25 cm carries a current of 85 μA and subjected to a magnetic field of strength 0.85 T. Work done for rotating the coil by 180° against the torque is **[NEET 2017]**

(a) 9.1 μJ (b) 4.55 μJ
(c) 2.3 μJ (d) 1.5 μJ

Ans. ***(a)***

Work done for rotating the coil

$$W = MB(\cos\theta_1 - \cos\theta_2)$$

where, $M =$ magnetic moment

$B =$ magnetic field

Given, $\theta_1 = 0°, \theta_2 = 180°$

$$\Rightarrow \quad W = MB(\cos 0° - \cos 180°)$$

$$= 2MB = 2 \times NIA \times B$$

$$= 2 \times 250 \times 85 \times 10^{-6} \times (2.1 \times 1.25 \times 10^{-4}) \times 0.85$$

$$= 9.48 \times 10^{-6}\text{ J}$$

$$\approx 9.5 \times 10^{-6}\text{ J} = 9.5\,\mu\text{J}$$

The closest option is (a).

04 A bar magnet is hung by a thin cotton thread in a uniform horizontal magnetic field and is in equilibrium state. The energy required to rotate it by 60° is W. Now the torque required to keep the magnet in this new position is **[NEET 2016]**

(a) $\frac{W}{\sqrt{3}}$ (b) $\sqrt{3}\,W$
(c) $\frac{\sqrt{3}\,W}{2}$ (d) $\frac{2\,W}{\sqrt{3}}$

Ans. ***(b)***

$\because$ Work done in rotating the magnet

$$W = MB(\cos\theta_0 - \cos\theta)$$

Where, $M =$ magnetic moment of the magnet

$B =$ magnetic field

$$W = MB(\cos 0° - \cos 60°)$$

$$= MB\left(1 - \frac{1}{2}\right) = \frac{MB}{2}$$

$$\therefore \quad MB = 2W \quad \text{...(i)}$$

Torque on a magnet in this position is given by,

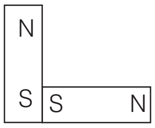
$$\tau = \mathbf{M} \times \mathbf{B}$$

$$= MB \cdot \sin\theta = 2W \cdot \sin 60^\circ \quad \text{[from Eq. (i)]}$$

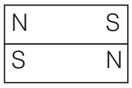
$$= 2W \frac{\sqrt{3}}{2} = W\sqrt{3}$$

05 Following figures show the arrangement of bar magnets in different configurations. Each magnet has magnetic dipole moment M. Which configuration has highest net magnetic dipole moment? **[CBSE AIPMT 2014]**

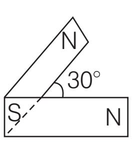
(i)



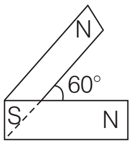
(ii)



(iii)



(iv)



(a) (i) (b) (ii)
(c) (iii) (d) (iv)

Ans. *(c)*

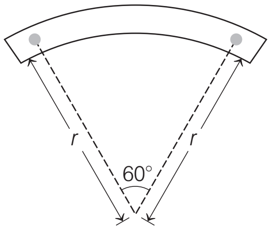
Magnetic moment is from S to N

So, $M_{\text{net}} = \sqrt{M^2 + M^2 + 2M^2 \cos\theta}$

M_{net} will be maximum if $\cos\theta$ is maximum. $\cos\theta$ will be maximum when θ will be minimum.

So, at $\theta = 30^\circ$, M_{net} will be maximum.

06 A bar magnet of length l and magnetic dipole moment M is bent in the form of an arc as shown in figure. The new magnetic dipole moment will be **[NEET 2013]**



(a) M (b) $\frac{3}{\pi}M$

(c) $\frac{2}{\pi}M$ (d) $\frac{M}{2}$

Ans. *(b)*

The magnetic moment, $M = ml$

$$\begin{pmatrix} m = \text{pole strength} \\ l = \text{length of magnet} \end{pmatrix}$$

According to question,

$$l = \frac{\pi}{3} \times r$$

So, $r = \frac{3l}{\pi}$

New magnetic moment, $M' = m \times r$

$$= m \times \frac{3l}{\pi} = \frac{3}{\pi} \cdot ml = \frac{3M}{\pi}$$

07 A compass needle which is allowed to move in a horizontal plane is taken to a geomagnetic pole. It **[CBSE AIPMT 2012]**

(a) will become rigid showing no movement
(b) will stay in any position
(c) will stay in North-South direction only
(d) will stay in East-West direction only

Ans. *(c)*

It will stay in any position at geomagnetic North and South poles.

08 A bar magnet having a magnetic moment of $\mathbf{2 \times 10^4\ J\ T^{-1}}$ is free to rotate in a horizontal plane. A horizontal magnetic field $B = \mathbf{6 \times 10^{-4}\ T}$ exists in the space. The work done in taking the magnet slowly from a direction parallel to the field to a direction 60° from the field is **[CBSE AIPMT 2009]**

(a) 0.6 J (b) 12 J
(c) 6 J (d) 2 J

Ans. *(c)*

When magnetic dipole is rotated from initial position θ_1 to final position θ_2, then work done $= MB(\cos\theta_1 - \cos\theta_2)$

Given, $\theta_1 = 0^\circ, \theta_2 = 60^\circ$

Magnetic moment, $M = 2 \times 10^4$ J/T

Magnetic field, $B = 6 \times 10^{-4}$ T

So, $W = MB\left(1 - \frac{1}{2}\right) \quad \begin{bmatrix} \because \cos 0^\circ = 1 \\ \text{and } \cos 60^\circ = 1/2 \end{bmatrix}$

$$= \frac{2 \times 10^4 \times 6 \times 10^{-4}}{2} = 6\text{ J}$$

09 A charged particle (charge q) is moving in a circle of radius R with uniform speed v. The associated magnetic moment μ is given by **[CBSE AIPMT 2007]**

(a) $\frac{qvR}{2}$ (b) qvR^2 (c) $\frac{qvR^2}{2}$ (d) qvR

Ans. *(a)*

As revolving charge is equivalent to a current, so

$$= qf = q \times \frac{\omega}{2\pi}$$

But, $\omega = \frac{v}{R}$

where, R is radius of circle and v is uniform speed of charged particle.

Therefore, $i = \frac{qv}{2\pi R}$

Now, magnetic moment associated with charged particle is given by

$$\mu = iA = i \times \pi R^2$$

or $\mu = \frac{qv}{2\pi R} \times \pi R^2 = \frac{1}{2} qvR$

Alternative

Current produced due to circular motion of charge q is given by

$$i = \frac{q}{T} \quad \begin{bmatrix} T = \text{Time period} \\ \text{of revolution} \end{bmatrix}$$

Now $T = \frac{2\pi R}{v}$

So, $i = \frac{q}{2\pi R} \times v$

Now, magnetic moment (μ) is given by

$$\mu = iA$$

So $\mu = \frac{qv}{2\pi R} \times \pi R^2 \Rightarrow \mu = \frac{qvR}{2}$

10 A bar magnet of magnetic moment $\mathbf{M}$ is placed in a magnetic field of induction $\mathbf{B}$. The torque exerted on it is **[CBSE AIPMT 1999]**

(a) $\mathbf{M} \cdot \mathbf{B}$ (b) $-\mathbf{M} \cdot \mathbf{B}$
(c) $\mathbf{M} \times \mathbf{B}$ (d) $-\mathbf{M} \times \mathbf{B}$

Ans. *(c)*

When a bar magnet is placed in an external magnetic field $\mathbf{B}$, a magnetic torque τ acts on it, which is given by $\tau = \mathbf{M} \times \mathbf{B} = |\mathbf{M}| \times |\mathbf{B}| \sin\theta$

(θ = angle between $\mathbf{M}$ and $\mathbf{B}$)

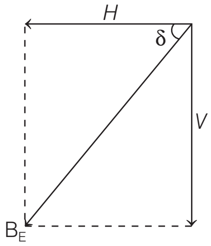
TOPIC 2
Earth Magnetism

11 The relations amongst the three elements earth's magnetic field, namely horizontal component H, vertical component V and dip δ are, (B_E = total magnetic field) **[NEET (Odisha) 2019]**

(a) $V = B_E \tan\delta, H = B_E$
(b) $V = B_E \sin\delta, H = B_E \cos\delta$
(c) $V = B_E \cos\delta, H = B_E \sin\delta$
(d) $V = B_E, H = Be_E \tan\delta$

Ans. *(b)*

Let B_E be the net magnetic field at same point. H and V be the horizontal and vertical components of B_E. Let δ be the angle of dip, which is the angle between direction of earth's magnetic field B_E and horizontal line in the magnetic meridian.



Thus, from figure, we can see that

$$H = B_E \cos\delta \text{ and } V = B_E \sin\delta$$

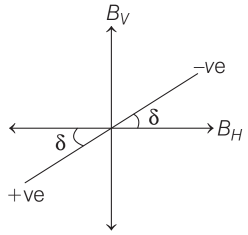
12 At a point A on the earth's surface the angle of dip, $\delta = +25°$.
At a point B on the earth's surface the angle of dip, $\delta = -25°$.
We can interpret that **[NEET (National) 2019]**

(a) A is located in the southern hemisphere and B is located in the northern hemisphere.
(b) A is located in the northern hemisphere and B is located in the southern hemisphere.
(c) A and B are both located in the southern hemisphere.
(d) A and B are both located in the northern hemisphere.

Ans. *(b)*

The angle of dip (δ) is the angle between the horizontal component of earth's magnetic field and the total magnetic field of the earth. Its value is different at different places. It is zero at equator, as the dip neddle becomes parallel to horizontal component. It varies from $-90°$ in South pole to $+90°$ in the North pole.

This means the values δ is positive in northern hemisphere and is negative in southern hemisphere.



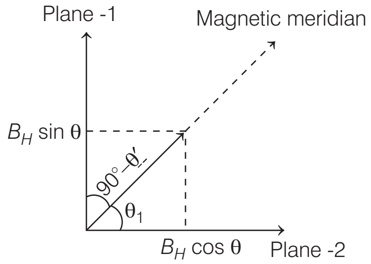
$\therefore$ For point A, $\delta = +25°$,
So, A lies in the northern hemisphere.
Similarly, for B, $\delta = -25°$, so
B lies in the southern hemisphere.

13 If θ_1 and θ_2 be the apparent angles of dip observed in two vertical planes at right angles to each other, then the true angle of dip θ is given by **[NEET 2017]**

(a) $\cot^2\theta = \cot^2\theta_1 + \cot^2\theta_2$
(b) $\tan^2\theta = \tan^2\theta_1 + \tan^2\theta_2$
(c) $\cot^2\theta = \cot^2\theta_1 - \cot^2\theta_2$
(d) $\tan^2\theta = \tan^2\theta_1 - \tan^2\theta_2$

Ans. *(a)*

Let the B_H and B_V be the horizontal and vertical component of earth's magnetic field B.



$$\tan\theta = \frac{B_V}{B_H} \Rightarrow \cot\theta = \frac{B_H}{B_V} \quad \text{...(i)}$$

Let, plane 1 and 2 are mutually perpendicular planes making angle θ and $(90° - \theta)$ with magnetic meridian. The vertical component of earth of earth's magnetic field remain same in two plane but effective horizontal components in the two planes is given by

$$B_1 = B_H \cos\theta' \quad \text{...(ii)}$$

and $$B_2 = B_H \sin\theta' \quad \text{...(iii)}$$

Then, $$\tan\theta_1 = \frac{B_V}{B_1} = \frac{B_V}{B_H \cos\theta'}$$

$$\cot\theta_1 = \frac{B_H \cos\theta'}{B_V} \quad \text{...(iv)}$$

Similarly,

$$\Rightarrow \tan\theta_2 = \frac{B_V}{B_2} = \frac{B_V}{B_H \sin\theta'}$$

$$\Rightarrow \cot\theta_2 = \frac{B_H \sin\theta'}{B_V} \quad \text{...(v)}$$

From Eq. (iv) and Eq. (v)

$$\Rightarrow \cot^2\theta_1 + \cot^2\theta_2 = \frac{B_H^2 \cos^2\theta'}{B_V^2} + \frac{B_H^2 \sin^2\theta'}{B_V^2}$$

$$\Rightarrow \cot^2\theta_1 + \cot^2\theta_2 = \frac{B_H^2}{B_V^2}(\cos^2\theta' + \sin^2\theta')$$

$$\Rightarrow \cot^2\theta_1 + \cot^2\theta_2 = \cot^2\theta$$

14 A vibration magnetometer placed in magnetic meridian has a small bar magnet. The magnet executes oscillations with a time period of 2 s in the earth's horizontal magnetic field of 24 μT. When a horizontal field of 18 μT is produced opposite to the earth's field by placing a current carrying wire, the new time period of magnet will be **[CBSE AIPMT 2010]**

(a) 1 s (b) 2 s
(c) 3 s (d) 4 s

Ans. *(b)*

Problem Solving Strategy Find out the relation of time period with the earth's horizontal magnetic field and then compare it for the two given cases.

Time period in vibration magnetometer is given by

$$T = 2\pi\sqrt{\frac{I}{M \times B_H}}$$

$$\Rightarrow T \propto \frac{1}{\sqrt{B_H}}$$

So, for two different cases

$$\Rightarrow \frac{T_1}{T_2} = \sqrt{\frac{(B_H)_2}{(B_H)_1}}$$

$$\Rightarrow \frac{2}{T_2} = \sqrt{\frac{18}{24}}$$

$$\therefore T = 2.3 \text{ s} \approx 2 \text{ s}$$

15 Two bar magnets having same geometry with magnetic moments M and $2M$, are firstly placed in such a way that their similar poles are on the same side, then its period of oscillation is T_1. Now, the polarity of one of the magnets is reversed the time period of oscillations becomes T_2. Then, **[CBSE AIPMT 2002]**

(a) $T_1 < T_2$ (b) $T_1 > T_2$
(c) $T_1 = T_2$ (d) $T_2 = \infty$

Ans. *(a)*

The time period of bar magnet is

$$T = 2\pi\sqrt{\frac{I}{MH}}$$

where, M = magnetic moment of magnet
I = moment of inertia
and H = horizontal component of magnetic field

When same poles of magnets are placed on same side, then net magnetic moment

$$M_1 = M + 2M = 3M$$

$$\therefore \quad T_1 = 2\pi\sqrt{\frac{I}{M_1H}}$$

$$= 2\pi\sqrt{\frac{I}{3MH}} \qquad \text{...(i)}$$

When opposite poles of magnets are placed on same side, then net magnetic moment

$$M_2 = 2M - M = M$$

$$\therefore \quad T_2 = 2\pi\sqrt{\frac{I}{M_2H}} = 2\pi\sqrt{\frac{I}{MH}} \qquad \text{...(ii)}$$

From Eqs. (i) and (ii), we observe that

$$T_1 < T_2$$

16 Due to the earth's magnetic field, charged cosmic ray particles **[CBSE AIPMT 1997]**

(a) can never reach the poles
(b) can never reach the equator
(c) require less kinetic energy to reach the equator than the poles
(d) require greater kinetic energy to reach the equator than the poles

Ans. *(d)*

Earth's magnetic field at poles is vertical (perpendicular to the earth's surface) and horizontal (parallel to the earth's surface) at equator.

Cosmic rays are positively charged particles and its velocity is parallel to the earths magnetic field. So, no magnetic force acts on cosmic ray particles coming at poles, i.e. force

$$(F) = qvB\sin\theta$$

At poles angle between v and B is $\theta = 0°$,
So, $F = 0$
At equator $\theta = 90°$,
So, Force $= qvB\sin 90° = qvB$

This force is maximum and deflects the particles sideways.

Hence, only high energy particles can reach the equator.

17 A bar magnet is oscillating in the earth's magnetic field with a period T. What happens to its period of motion, if its mass is quadrupled? **[CBSE AIPMT 1994]**

(a) Motion remains simple harmonic with new period $= \frac{T}{2}$
(b) Motion remains simple harmonic with new period $= 2T$
(c) Motion remains simple harmonic with new period $= 4T$
(d) Motion remains simple harmonic and the period stays nearly constant

Ans. *(b)*

The time period of a bar magnet in a magnetic field is given by

$$T = 2\pi\sqrt{\left(\frac{I}{MB}\right)}$$

where, I is moment of inertia of bar magnet, M is magnetic moment and B is magnetic induction.

When mass is made 4 times, moment of inertia

I becomes 4 times (as $I = mr^2$, $I \propto m$).
From the above equation of time period $T \propto \sqrt{I}$. So, T becomes twice as mass is quadrupled.

TOPIC 3

Magnetic Materials

18 An iron rod of susceptibility 599 is subjected to a magnetising field of 1200 A m^{-1}. The permeability of the material of the rod is
(Take, $\mu_0 = 4\pi \times 10^{-7}$ T m A^{-1}) **[NEET (Sep.) 2020]**

(a) 8.0×10^{-5} T m A^{-1}
(b) $2.4\pi \times 10^{-5}$ T m A^{-1}
(c) $2.4\pi \times 10^{-7}$ T m A^{-1}
(d) $2.4\pi \times 10^{-4}$ T m A^{-1}

Ans. *(d)*

Given, susceptibility, $\chi = 599$

Magnetic field, $B = 1200$ Am^{-1}

Permeability of the material of the rod = ?

$$\text{As, } \mu_m = \mu_0(1 + \chi)$$
$$= 4\pi \times 10^{-7}(1 + 599)$$
$$= 2.4\pi \times 10^{-4}\,\text{TmA}^{-1}$$

Hence, correct option is (d).

19 A thin diamagnetic rod is placed vertically between the poles of an electromagnet. When the current in the electromagnet is switched on, then the diamagnetic rod is pushed up, out of the horizontal magnetic field. Hence, the rod gains gravitational potential energy. The work required to do this comes from **[NEET 2018]**

(a) the lattice structure of the material of the rod
(b) the magnetic field
(c) the current source
(d) the induced electric field due to the changing magnetic field

Ans. *(c)*

As the source of current is switched on, a magnetic field sets up in between the poles of the electromagnet.

As we know that a diamagnetic substance when placed in a magnetic field acquires a feeble magnetism opposite to the direction of magnetic field.

Also, in the presences of the field (non-uniform), these substances are attracted towards the weaker field, i.e. they move from stronger to weaker magnetic field.

Due to these reasons, the rod is repelled by the field produced to the current source. Hence, it is pushed up, out of horizontal field and gains gravitational potential energy.

20 The magnetic susceptibility is negative for **[NEET 2016]**

(a) paramagnetic material only
(b) ferromagnetic material only
(c) paramagnetic and ferromagnetic materials
(d) diamagnetic material only

Ans. *(d)*

As we know the relation between the magnetic permeability and susceptibility of material, i.e.

$$\mu_r = 1 + \chi_m \qquad \text{...(i)}$$

$\because$ For diamagnetic substances, $\mu_r < 1$
So, according to equation (i), the magnetic susceptibility (χ_m) of diamagnetic substance will be negative. While in the case of para and ferromagnetic substances, diamagnetic susceptibility is positive.

21 There are four light weight rod samples A, B, C and D separately suspended by thread. A bar magnet is slowly brought near each sample and the following observations are noted

(i) A is feebly repelled
(ii) B is feebly attracted
(iii) C is strongly attracted
(iv) D remains unaffected

Which one of the following is true? **[CBSE AIPMT 2011]**

(a) C is of a diamagnetic material
(b) D is of a ferromagnetic material
(c) A is of a non-magnetic material
(d) B is of a paramagnetic material

Ans. *(d)*

Paramagnetic material will be feebly attracted, diamagnetic material will be feebly repelled and ferromagnetic material will be strongly attracted.

22 If a diamagnetic substance is brought near the North or the South pole of a bar magnet, it is **[CBSE AIPMT 2009]**

(a) repelled by both the poles
(b) repelled by the North pole and attracted by the South pole
(c) attracted by the North pole and repelled by the South pole
(d) attracted by both the poles

Ans. *(a)*

Diamagnetic substances are weakly magnetised in a direction opposite to that of applied magnetic field. These are repelled in an external magnetic field i.e. have a tendency to move from high to low field region, i.e. it is repelled by both North and South poles of a bar magnet.

23 Nickel shows ferromagnetic property at room temperature. If the temperature is increased beyond Curie temperature, then it will show **[CBSE AIPMT 2007]**

(a) paramagnetism
(b) anti-ferromagnetism
(c) no magnetic property
(d) diamagnetism

Ans. *(a)*

Nickel exhibits ferromagnetism because of a quantum physical effect called exchange coupling in which the electron spins of one atom interact with those of neighbouring atoms. The result is alignment of the magnetic dipole moments of the atoms, in spite of the randomising tendency of atomic collisions. This persistent alignment is what gives ferromagnetic materials their permanent magnetism.

If the temperature of a ferromagnetic material is raised above a certain critical value, called the Curie temperature, the exchange coupling ceases to be effective.

Most such materials become simply paramagnetic, i.e. the dipoles still tend to align with an external field but much more weakly and thermal agitation can now more easily disrupt the alignment.

24 Above Curie temperature **[CBSE AIPMT 2006]**

(a) a ferromagnetic substance becomes paramagnetic
(b) a paramagnetic substance becomes diamagnetic
(c) a diamagnetic substance becomes paramagnetic
(d) a paramagnetic substance becomes ferromagnetic

Ans. *(a)*

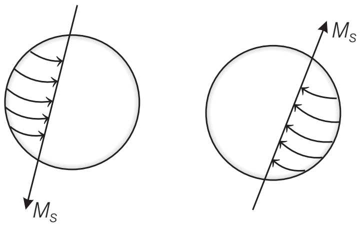
Ferromagnetism decreases with rise in temperature. If we heat a ferromagnetic substance, then at a definite temperature, the ferromagnetic property of the substance suddenly disappears and the substance becomes paramagnetic. The temperature above which a ferromagnetic substance becomes paramagnetic is called the Curie temperature of the substance.

25 If the magnetic dipole moment of an atom of diamagnetic material, paramagnetic material and ferromagnetic material are denoted by μ_d, μ_p and μ_f respectively, then **[CBSE AIPMT 2005]**

(a) $\mu_d \neq 0$ and $\mu_f \neq 0$
(b) $\mu_p = 0$ and $\mu_f \neq 0$
(c) $\mu_d = 0$ and $\mu_p \neq 0$
(d) $\mu_d \neq 0$ and $\mu_p = 0$

Ans. *(c)*

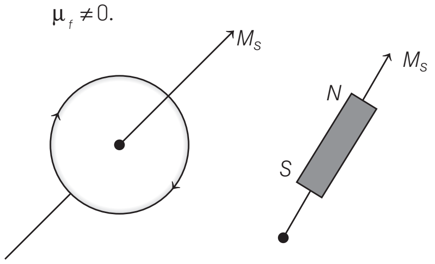
In diamagnetic substances, in each pair of electrons, the spin of both the electrons are in opposite directions. Hence, the electrons of each pair completely cancel the magnetic moment of each other. Thus, the net magnetic moment of each atom of such substances is zero, i.e. $\mu_d = 0$.



The property of paramagnetism is bound in those substances whose atoms or molecules have an excess of electrons spinning in same direction.

Hence, atoms of paramagnetic substances have permanent magnetic moment i.e. $\mu_p \neq 0$.

The property of ferromagnetism is found in substances which acquire very strong magnetism when placed in an external magnetic field. Like the paramagnetic substances each atom of ferromagnetic substances also has a permanent magnetic moment i.e. $\mu_f \neq 0$.



26 According to Curie's law, the magnetic susceptibility of a paramagnetic substance at an absolute temperature T is proportional to **[CBSE AIPMT 2003]**

(a) $\frac{1}{T^2}$
(b) T^2
(c) $\frac{1}{T}$
(d) T

Ans. *(c)*

According to Curie's law, magnetic susceptibility (χ_m) of a paramagnetic substance is inversely proportional to absolute temperature (T) i.e.

$$\chi_m \propto \frac{1}{T}$$

27 A diamagnetic material in a magnetic field moves **[CBSE AIPMT 2003]**

(a) perpendicular to the field
(b) from weaker to the stronger parts of the field

(c) from stronger to the weaker parts of the field

(d) None of the above

Ans. *(c)*

When a diamagnetic material is placed in an external magnetic field, the spin motion of electrons is so modified that the electrons which produce the magnetic moments in the direction of external field slow down while the electrons which produce magnetic moments in opposite direction get accelerated.

Thus, a net magnetic moment is induced in the opposite direction of applied magnetic field. Hence, the substance is magnetised opposite to the external field. Thus, it moves from stronger to weaker parts of the magnetic field.

Diamagnetism is present in all the substances. However, its effect is so weak in most cases that it gets shifted by other effects like paramagnetism, ferromagmetism etc.

28 In which type of material the magnetic susceptibility does not depend on temperature? **[CBSE AIPMT 2001]**

(a) Diamagnetic (b) Paramagnetic

(c) Ferromagnetic (d) Ferrite

Ans. *(a)*

The magnetic susceptibility of a material is a measure of the ease with which a specimen of that material can be magnetised in a magnetising field. For a diamagnetic substance, magnetic susceptibility (χ_m) is independent of temperature.

29 A diamagnetic substance is brought near a strong magnet, then it is **[CBSE AIPMT 1999]**

(a) attracted by a magnet

(b) repelled by a magnet

(c) repelled by North pole and attracted by South pole

(d) attracted by North pole and repelled by South pole

Ans. *(b)*

When diamagnetic substances are placed in magnetic field of a strong magnet, then it is feebly magnetised in the opposite direction of field or it is repelled by strong magnet.

30 For protecting a sensitive equipment from the external magnetic field, it should be **[CBSE AIPMT 1998]**

(a) placed inside an aluminium can

(b) placed inside an iron can

(c) wrapped with insulation around it when passing current through it

(d) surrounded with fine copper sheet

Ans. *(b)*

Iron is a ferromagnetic substance. There are no magnetic lines of force inside a ferromagnetic substance. So, equipment may be protected by placing it inside the can made of a ferromagnetic substance. Hence, it is placed inside an iron can.