Magnetism and Matter

Question1

The magnetic potential energy, when a magnetic bar of magnetic moment $\vec{m}$ is placed perpendicular to the magnetic field $\vec{B}$ is

[NEET 2024 Re]

Options:

A.

$-\frac{mB}{2}$

B.

Zero

C.

−mB

D.

mB

Answer: B

Solution:

Potential energy stored in external magnetic field is given by $U = -\vec{m} \cdot \vec{B}$

$\because$ Angle between $\vec{m}$ and $\vec{B}$ is 90°

$\therefore U = -mB\cos 90^\circ$

$= 0$

Question2

The incorrect relation for a diamagnetic material (all the symbols carry their usual meaning and ε is a small positive number) is

[NEET 2024 Re]

Options:

A.

$\mu < \mu_0$

B.

$0 \le \mu_r < 1$

C.

$-1 \le \chi < 0$

D.

$1 < \mu_r < 1 + \varepsilon$

Answer: D

Solution:

For diamagnetic material,

$0 \le \mu_r < 1$

$\chi = \mu_r - 1$

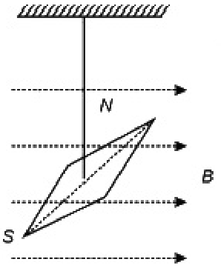
$\Rightarrow -1 \le \chi < 0$

$\mu_r = \dfrac{\mu}{\mu_0}$

$\Rightarrow \mu < \mu_0 \quad (\because \mu_r < 1)$

Question3

The magnetic moment and moment of inertia of a magnetic needle as shown are, respectively, 1.0×10^{-2} Am and $10^{-6}/\pi^2$. If it completes 10 oscillations in 10 s, the magnitude of the magnetic field is



[NEET 2024 Re]

Options:

A.

0.4T

B.

4T

C.

0.4mT

D.

4mT

Answer: C

Solution:

Time period of oscillation of magnet inside the magnetic field $T = 2\pi\sqrt{\frac{I}{MB}}$

$T = \frac{t}{n} = \frac{10}{10} = 1\,s$

$1 = 2\pi\sqrt{\frac{10^{-6}}{\pi^2 \times 1.0 \times 10^{-2} \times B}}$

$\frac{1}{4} = \frac{10^{-4}}{B} \Rightarrow B = 0.4\,\text{mT}$

Question4

The magnetic moment of an iron bar is M. It is now bent in such a way that it forms an arc section of a circle subtending an angle of 60∘ at the centre. The magnetic moment of this arc section is

[NEET 2024 Re]

Options:

A.

3M/π

B.

4M/π

C.

M/π

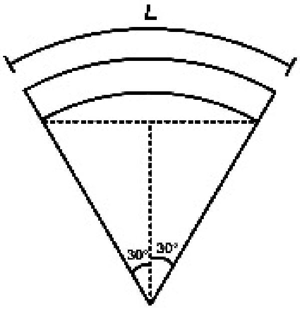
D.

2M/π

Answer: A

Solution:

$M = m . L$



$R\theta = L$

$\frac{R\pi}{3} = L$

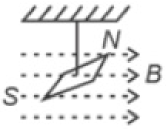
$R = \frac{3L}{\pi}$

$M' = m(2R) \sin 30^\circ$

$= m(2) \frac{3L}{\pi} \times \frac{1}{2} = \frac{3}{\pi} mL = \frac{3M}{\pi}$

Question5

In a uniform magnetic field of 0.049T, a magnetic needle performs 20 complete oscillations in 5 seconds as shown. The moment of inertia of the needle is 9.8×10^{-6} kgm^2. If the magnitude of magnetic moment of the needle is $x \times 10^{-5}$ Am^2, then the value of ' x ' is :



[NEET 2024]

Options:

A.

$5\pi^2$

B.

$128\pi^2$

C.

$50\pi^2$

D.

$1280\pi^2$

Answer: D

Solution:

Time period of Oscillation, $T = 2\pi\sqrt{\frac{1}{MB}}$

$$\Rightarrow \quad \frac{1}{4} = 2\pi\sqrt{\frac{9.8 \times 10^{-6}}{M \times 0.049}}$$

$$\Rightarrow \quad \frac{1}{16} = 4\pi^2 \times \frac{9.8 \times 10^{-6}}{M \times 49 \times 10^{-3}}$$

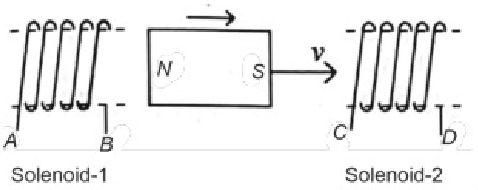
$$\Rightarrow \quad M = \frac{4\pi^2 \times 9.8 \times 10^{-6}}{49 \times 10^{-3}} \times 16$$

$$= \frac{4\pi^2 \times 9.8 \times 16 \times 10^{-3}}{49}$$

$$= 12.8\pi^2 \times 10^{-3} \times 10^{-2} \times 10^2$$

$$= 1280\pi^2 \times 10^{-5}\text{Am}^2$$

Question6



In the above diagram, a strong bar magnet is moving towards solenoid-2 from solenoid-1. The direction of induced current in solenoid-1 and that in solenoid-2, respectively, are through the directions:

[NEET 2024]

Options:

A.

AB and DC

B.

BA and CD

C.

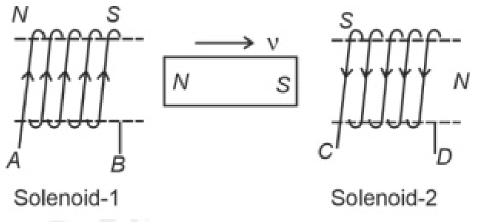
AB and CD

D.

BA and DC

Answer: A

Solution:



North of magnet is moving away from solenoid 1 so end B of solenoid 1 is South and as south of magnet is approaching solenoid 2 so end C of solenoid 2 is South.

Question7

Match List-I with List-II.

	List-I (Material)		List-II (Susceptibility (χ))
A.	Diamagnetic	I.	$\chi = 0$
B.	Ferromagnetic	II.	$0 > \chi \geq -1$
C.	Paramagnetic	III.	$\chi >> 1$
D.	Non-magnetic	IV.	$0 < \chi < \varepsilon$ (a small positive number)

Choose the correct answer from the options given below.

[NEET 2024]

Options:

A.

A-II, B-III, C-IV, D-I

B.

A-II, B-I, C-III, D-IV

C.

A-III, B-II, C-I, D-IV

D.

A-IV, B-III, C-II, D-I

Answer: A

Solution:

	(Material)		(Susceptibility (χ))
A.	Diamagnetic	II.	$0 > \chi \geq -1$
B.	Ferromagnetic	III.	$\chi >> 1$
C.	Paramagnetic	IV.	$0 < \chi < \varepsilon$ (a small positive number)
D.	Non-magnetic	I	$\chi = 0$

Question8

A sheet is placed on a horizontal surface in front of a strong magnetic pole. A force is needed to:
A. hold the sheet there if it is magnetic.
B. hold the sheet there if it is non-magnetic.
C. move the sheet away from the pole with uniform velocity if it is conducting.
D. move the sheet away from the pole with uniform velocity if it is both, non-conducting and non-polar.

Choose the correct statement(s) from the options given below:

[NEET 2024]

Options:

A.

B and D only

B.

A and C only

C.

A, C and D only

D.

C only

Answer: B

Solution:

A. A magnetic pole will repel or attract magnetic sheet so force is need.

B. If sheet is non-magnetic, no force needed.

C. If it is conducting, then there will be addy current in sheet, which opposes the motion. So forces is needed move sheet with uniform speed.

D. The non-conducting and non-polar sheet do not interact with magnetic field of magnet.

Question9

An iron bar of length L has magnetic moment M. It is bent at the middle of its length such that the two arms make an angle 60° with each other. The magnetic moment of this new magnet is :

[NEET 2024]

Options:

A.

M

B.

M/2

C.

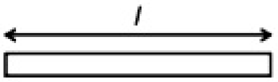
2M

D.

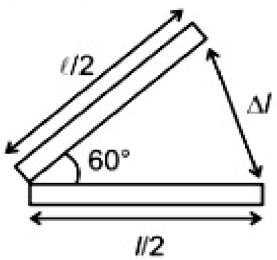
M/√3

Answer: B

Solution:



$M = ml.$



$\Delta l = 2\frac{l}{2} sin\ 30^{\circ}$

$= \frac{l}{2}$

$M' = ml/2$

$= M/2$

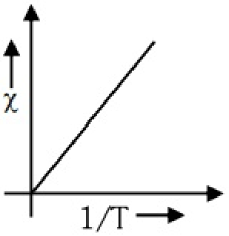
Question10

The variation of susceptibility (χ) with absolute temperature (T) for a paramagnetic material is represented as :

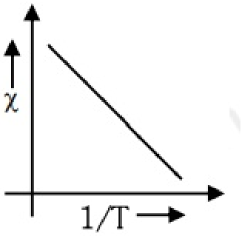
[NEET 2023 mpr]

Options:

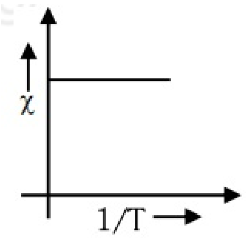
A.



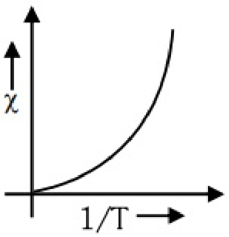
B.



C.



D.



Answer: A

Solution:

By magnetic property

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

χ vs $\frac{1}{T}$ graph will be straight line.

Question11

The dimensions $[M\,L\,T^{-2}A^{-2}]$ belong to the [NEET-2022]

Options:

A. Magnetic flux

B. Self inductance

C. Magnetic permeability

D. Electric permittivity

Answer: C

Solution:

Dimensional formula of magnetic permeability is $[MLT^{-2}A^{-2}]$

Question12

A long solenoid of radius 1mm has 100 turns per mm. If 1 A current flows in the solenoid, the magnetic field strength at the centre of the solenoid is [NEET-2022]

Options:

A. 6.28×10^{-2}T

B. 12.56×10^{-2}T

C. 12.56×10^{-4}T

D. 6.28×10^{-4}T

Answer: B

Solution:

Solution:

We know, magnetic field at centre of solenoid

$$B = \mu_0 \frac{N}{\ell} I = \mu_0 nI \quad \left[n = \frac{N}{\ell}\right]$$

$$= 4\pi \times 10^{-7} \times 100 \times 10^{3} \times 1 \quad \left[n = \frac{100}{10^{-3}}\right]$$

$$= 4\pi \times 10^{-2} T$$

$$B = 12.56 \times 10^{-2} T$$

Question13

A uniform conducting wire of length 12a and resistance 'R' is wound up as a current carrying coil in the shape of,
(i) an equilateral triangle of side 'a'.
(ii) a square of side 'a'.
The magnetic dipole moments of the coil in each case respectively are [NEET 2021]

Options:

A. 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

Answer: A

Solution:

Current in the loop will be $\frac{V}{R} = I$ which is same for both loops.

Now magnetic moment of Triangle loop = NIAM $_1$ = $\left(\frac{12a}{3a}\right) . I . \frac{\sqrt{3}}{4} a^2 = \sqrt{3} / a^2$

and magnetic moment of square loop $= N'IA'$

$= \left(\frac{12a}{4a}\right) . I . a^2$

$M_2 = 3I\,a^2$

Question14

An iron rod of susceptibility 599 is subjected to a magnetising field of $1200Am^{-1}$. The permeability of the material of the rod is :
($\mu_0 = 4\pi \times 10^{-7} T\,mA^{-1}$)
(2020)

Options:

A. $8.0 \times 10^{-5} T\,mA^{-1}$

B. $2.4\pi \times 10^{-5} T\,mA^{-1}$

C. $2.4\pi \times 10^{-7} T\,mA^{-1}$

D. $2.4\pi \times 10^{-4} T\,mA^{-1}$

Answer: D

Solution:

(d) Given : Magnetic susceptibility of iron, $\chi_m = 599$
Using, $\mu_r = 1 + \chi_m = 600$
$\mu = \mu_r\mu_0 = 600 \times 4\pi \times 10^{-7} = 2400\pi \times 10^{-7}$
Hence, permeability of the material of the rod, $\mu = 2.4\pi \times 10^{-4} T\, mA^{-1}$

Question15

At a point A on the earth's surface the angle of dip, $\delta = +25^\circ$. At a point B on the earth's surface the angle of dip, $\delta = -25^\circ$. We can interpret that
(NEET 2019)

Options:

A. A and B are both located in the southern hemisphere.

B. A and B are both located in the northern hemisphere.

C. A is located in the southern hemisphere and B is located in the northern hemisphere.

D. A is located in the northern hemisphere and B is located in the southern hemisphere.

Answer: D

Solution:

Solution:
At a point A, the angle of dip is positive and the earth's magnetic north pole is in northern hemisphere. So, point A is located in the northern hemisphere and B is located in the southern hemisphere.

Question16

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)

Options:

A. The current source

B. The magnetic field

C. The lattice structure of the material of the rod

D. The induced electric field due to the changing magnetic field

Answer: A

Solution:

Energy of current source will be converted into gravitational potential energy of the rod.

Question17

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 0 is given by (2017 NEET)

Options:

A. $\tan^2\theta = \tan^2\theta_2 + \tan^2\theta_2$

B. $\cot^2\theta = \cot^2\theta_1 - \cot^2\theta_2$

C. $\tan^2\theta = \tan^2\theta_2 - \tan^2\theta_2$

D. $\cot^2\theta = \cot^2\theta_1 + \cot^2\theta_2$

Answer: D

Solution:

Solution:

Let B_H and B_V be the horizontal and vertical components of earth's magnetic field $\vec{B}$. Since θ is the angle of dip

$\therefore \tan\theta \frac{B_V}{B_H}$ or $\cos\theta = \frac{B_H}{B_V}$......(i)

Suppose planes 1 and 2 are two mutually perpendicular planes and respectively make angles θ and $90° - \theta$ with the magnetic meridian. The vertical components of earth's magnetic field remain same in the two planes but the effective horizontal components in the planes will be

$B_1 = B_H \cos\theta$

and $B_2 = B_H \sin\theta$

The angles of dip θ_1 and θ_2 in the two planes are given by

$\tan\theta_1 = \frac{B_V}{B_1}$

$\tan\theta_1 = \frac{B_V}{B_H \cos\theta}$

or $\cot\theta_1 = \frac{B_H \cos\theta}{B_V}$.....(ii)

Similarly,

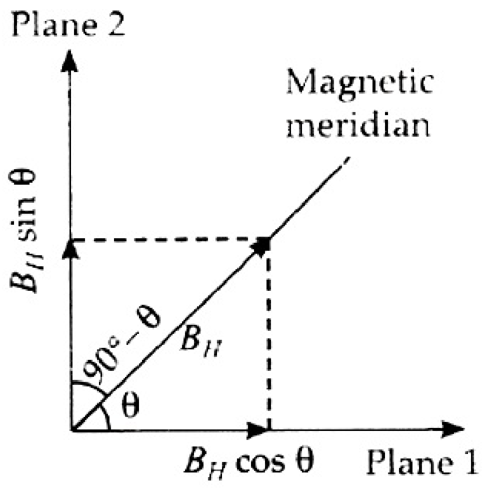
$\cot\theta_2 = \frac{B_H \sin\theta}{B_V}$...........(iii)

From eqns. (ii) and (iii)

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

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

[from eqn. (i)]



Question18

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
(2017 NEET)

Options:

A. 4.55 µJ

B. 2.3 µJ

C. 1.15 µJ

D. 9.1 µJ

Answer: D

Solution:

Work done in a coil
$W = mB(\cos\theta_1 - \cos\theta_2)$
When it is rotated by angle 180° then
$W = 2mB = 2(N I A)B$.......(i)
Given $N = 250$, $I = 85\mu A = 85 \times 10^{-6} A$
$A = 1.25 \times 2.1 \times 10^{-4} m^2 \approx 2.5 \times 10^{-4} m^2$
$B = 0.85T$
Puttin these values in eqn. (i), we get
$W = 2 \times 250 \times 85 \times 10^{-6} \times 2.5 \times 10^{-4} \times 0.85$
$\approx 9.1 \times 10^{-6J\ =\ 9.1\mu J}$

Question19

The magnetic susceptibility is negative for
(2016 NEET Phase-I)

Options:

A. ferromagnetic material only

B. paramagnetic and ferromagnetic materials

C. diamagnetic material only

D. paramagnetic material only

Answer: C

Solution:

Solution:
Magnetic susceptibility is negative for diamagnetic material only.

Question20

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 (2016 NEET Phase-II)

Options:

A. $\frac{W}{\sqrt{3}}$

B. $\sqrt{3}W$

C. $\frac{\sqrt{3}W}{2}$

D. $\frac{2W}{\sqrt{3}}$

Answer: B

Solution:

At equilibrium, potential energy of dipole
$U_i = -MB_H$
Final potential energy of dipole,
$U_f = -MB_H\cos60° = -\frac{MB_H}{2}$
$W = U_f - U_i = \frac{-MB_H}{2} - (-MB_H) = \frac{MB_H}{2}$......(i)

Required torque, $\tau = MB_H\sin60°$

$\tau = 2W \times \frac{\sqrt{3}}{2}$ (Using eqn.(i))

$= \sqrt{3}W$

Question21

A rectangular coil of length 0.12 m and width 0.1 m having 50 turns of wire is suspended vertically in a uniform magnetic field of strength $0.2 Weber/m^2$.Thecoil carries a current of 2 A. If the plane of the coil is inclined at an angle of 30° with the direction of the field, the torque required to keep the coil in stable equilibrium will be (2015)

Options:

A. 0.24 Nm

B. 0.12 Nm

C. 0.15 Nm

D. 0.20 Nm

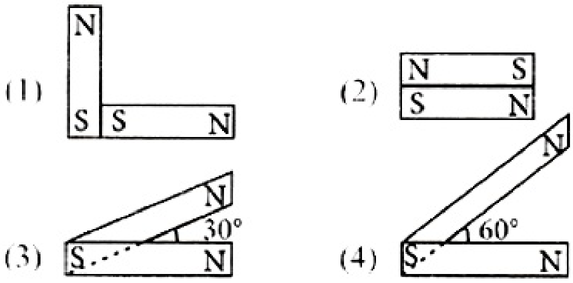
Answer: D

Solution:

Solution:
The required torque is $\tau = N I AB \sin\theta$
where N is the number of turns in the coil, I is the current through the coil, B is the uniform magnetic field, A is the area of the coil and 0 is the angle between the direction of the magnetic field and normal to the plane of the coil.
Here,
$N = 50, I = 2A, A = 0.12m \times 0.1m = 0.012m^2$
$B = 0.2\frac{Wb}{m^2}$ and $\theta = 90° - 30° = 60°$
$\therefore \tau = (50)(2A)(0.012m^2)\left(0.2\frac{Wb}{m^2}\right)\sin 60°$
$= 0.20 N m$

Question22

Following figures show the arrangement of bar magnets in different configurations. Each magnet has magnetic dipole moment $\vec{m}$.Which configuration has highest net magnetic dipole moment?



(2014)

Options:

A. (1)

B. (2)

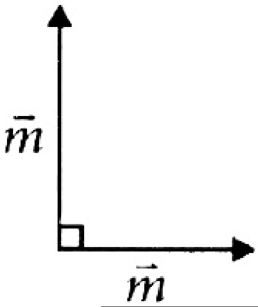
C. (3)

D. (4)

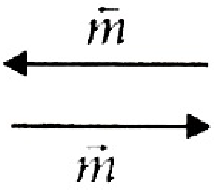
Answer: C

Solution:

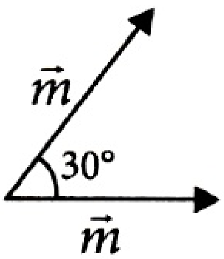
Solution:
The direction of magnetic dipole moment is from south to north pole of the magnet.
In configuration (1),



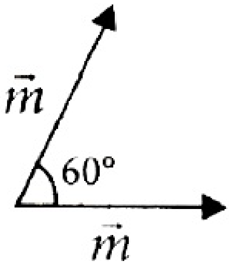
$m_{net} = \sqrt{m^2 + m^2 + 2mm\cos 90°}$
$\sqrt{m^2 + m^2} = m\sqrt{2}$
In configuration (2),



$m_{net} = m - m = 0$
In configuration (3),



$m_{net} = \sqrt{m^2 + m^2 + 2mm\cos 30°}$
$= \sqrt{2m^2 + 2m^2\left(\frac{\sqrt{3}}{2}\right)} = m\sqrt{2 + \sqrt{3}}$
In configuration (4),



$m_{net} = \sqrt{m^2 + m^2 + 2mm\cos 60°}$

$= \sqrt{2m^2 + 2m^2\left(\frac{1}{3}\right)} = m\sqrt{3}$

Question23

A current loop in a magnetic field (2013 NEET)

Options:

A. can be in equilibrium in two orientations, both the equilibrium states are unstable

B. can be in equilibrium in two orientations, one stable while the other is unstable.

C. experiences a torque whether the field is uniform or non uniform in all orientations.

D. can be in equilibrium in one orientation.

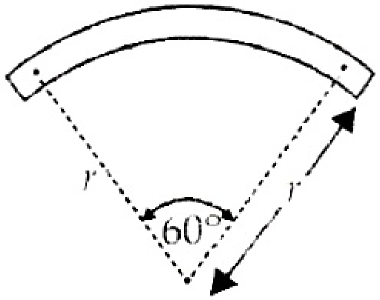
Answer: B

Solution:

Solution:
When a current loop is placed in a magnetic field it experiences a torque. It is given by
$\vec{\tau} = \vec{M} \times \vec{B}$
Where $\vec{M}$ is the magnetic moment of the loop and $\vec{B}$ is the magnetic field.
or $\tau = M B\sin\theta$ where θ is angle between $\vec{M}$ and $\vec{B}$
When $\vec{M}$ and $\vec{B}$ are parallel (i.e. $\theta = 0°$) the equilibrium is stable and when they are antiparallel (i.e. $\theta = \pi$) the equilibrium is unstable.

Question24

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



(2013 NEET)

Options:

A. $\frac{2}{\pi}M$

B. $\frac{M}{2}$

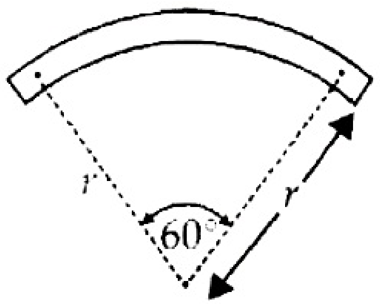
C. M

D. $\frac{3}{\pi}M$

Answer: D

Solution:

Solution:
Let m be strength of each pole of bar magnet of length l. Then
$M = m \times l$ ....(i)
When the bar magnet is bent in the form of an arc as shown in figure
Then $l = \frac{\pi}{3} \times r = \frac{\pi r}{3}$
or $r = \frac{3l}{\pi}$
New magnetic dipole moment
$M' = m \times 2r\sin 30°$
$= m \times 2 \times \frac{3l}{\pi} \times \frac{1}{2} = \frac{3ml}{\pi} = \frac{3M}{\pi}$ (Using (i))



Question25

A bar magnet of magnetic moment M is placed at right angles to a magnetic induction B. If a force F is experienced by each pole of the magnet, the length of the magnet will be
(KN NEET 2013)

Options:

A. M B / F

B. BF / M

C. M F / B

D. F / M B

Answer: A

Solution:

$$\text{Torque } F L = M B \Rightarrow L = \frac{M B}{F}$$

Question26

A compass needle which is allowed to move in a horizontal plane is taken to a geomagnetic pole. It
(2012)

Options:

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

Answer: B

Solution:

Solution:
A compass needle which is allowed to move in a horizontal plane is taken to a geomagnetic pole. It will stay in any position as the horizontal component of earth’s magnetic field becomes zero at the geomagnetic pole.

Question27

A magnetic needle suspended parallel to a magnetic field requires $\sqrt{3}$J of work to turn it through 60°. The torque needed to maintain the needle in this position will be
(2012 Mains)

Options:

A. $2\sqrt{3}J$

B. 3J

C. $\sqrt{3}J$

D. $\frac{3}{2}J$

Answer: B

Solution:

Solution:
Work done in changing the orientation of a magnetic needle of magnetic moment M in a magnetic field B from position θ_1 to θ_2 is given by
$W = M B(\cos\theta_1 - \cos\theta_2)$
Here, $\theta_1 = 0°, \theta_2 = 60°$
$\therefore W = M B(\cos 0° - \cos 60°)$
$= M B\left(1 - \frac{1}{2}\right) = \frac{M B}{2}$.........(i)
The torque on the needle is $\vec{\tau} = \vec{M} \times \vec{B}$
In magnitude,
$\tau = M B\sin\theta = M B\sin 60° = \frac{\sqrt{3}}{2} M B$........(ii)
Dividing (ii) by (i), we get
$\frac{\tau}{W} = \sqrt{3} \quad \tau = \sqrt{3}W = \sqrt{3} \times \sqrt{3}J = 3J$

Question28

There are four light-weight-rod samples A, B, C, D separately suspended by threads. 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?
(2011)

Options:

A. B is of a paramagnetic material

B. C is of a diamagnetic material

C. D is of a ferromagnetic material

D. A is of a non-magnetic material

Answer: A

Solution:

Diamagnetic will be feebly repelled.
Paramagnetic will be feebly attracted.
Ferromagnetic will be strongly attracted
Therefore, A is of diamagnetic material. B is of paramagnetic material. C is of ferromagnetic material. D is of non-magnetic material.

Question29

A short bar magnet of magnetic moment $0.4 J T^{-1}$ is placed in a uniform magnetic field of 0.16 T. The magnet is in stable equilibrium when the potential energy is
(2011 Mains)

Options:

A. 0.064 J

B. -0.064 J

C. zero

D. -0.082 J

Answer: B

Solution:

Here, Magnetic moment,
$M = 0.4 J T^{-1}$
Magnetic field, $B = 0.16T$
When a bar magnet of magnetic moment $\vec{M}$ is placed in a uniform magnetic field $\vec{B}$,its potential energy is
$U = -\vec{M} \cdot \vec{B} = -M B\cos\theta$
For stable equilibrium,$\theta = 0°$
$\therefore U = -M B = -(0.4 J T^{-1})(0.6T) = -0.064J$

Question30

Electromagnets are made of soft iron because soft iron has
(2010)

Options:

A. low retentivity and high coercive force

B. high retentivity and high coercive force

C. low retentivity and low coercive force

D. high retentivity and low coercive force

Answer: C

Solution:

Electromagnets are made of soft iron because soft iron has low retentivity and low coercive force or low coercivity. Soft iron is a soft magnetic material.

Question31

A vibration magnetometer placed in magnetic meridian has a small bar magnet. The magnet executes oscillations with a time period of 2 sec in earth's horizontal magnetic field of 24 micro tesla. When a horizontal field of 18 micro tesla is produced opposite to the earth's field by placing a current carrying wire, the new time period of magnet will be (2010)

Options:

A. 1 s

B. 2 s

C. 3 s

D. 4 s

Answer: D

Solution:

Solution:
The time period T of oscillation of a magnet is given by
$T = 2\pi\sqrt{\frac{I}{MB}}$
Where,
I = Moment of inertia of the magnet about the axis of rotation
M = Magnetic moment of the magnet
B = Uniform magnetic field
As the I,B remains the same
$\therefore T \propto \frac{1}{\sqrt{B}}$ or $\frac{T_2}{T_1} = \sqrt{\frac{B_1}{B_2}}$
According to given problem,
$B_1 = 24\mu T$
$B_2 = 24\mu T - 18\mu T = 6\mu T$
$T_1 = 2s$
$\therefore T_2 = (2s)\sqrt{\frac{(24\mu T)}{(6\mu T)}} = 4s$

Question32

The magnetic moment of a diamagnetic atom is
(2010 Mains)

Options:

A. much greater than one

B. 1

C. between zero and one

D. equal to zero

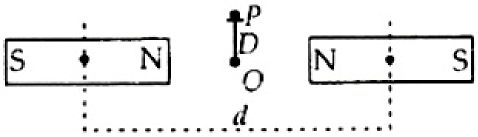
Answer: D

Solution:

Solution:
The magnetic moment of a diamagnetic atom is equal to zero.

Question33

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



The force on the charge Q is
(2010 Mains)

Options:

A. zero

B. directed along OP

C. directed along PO

D. directed perpendicular to the plane of paper

Answer: A

Solution:

Solution:
Magnetic field due to bar magnets exerts force on moving charges only. Since the charge is at rest, zero force acts on it.

Question34

If a diamagnetic substance is brought near the north or the south pole of a bar magnet, it is
(2009)

Options:

A. repelled by the north pole and attracted by the south pole

B. attracted by the north pole and repelled by the south pole

C. attracted by both the poles

D. repelled by both the poles

Answer: D

Solution:

Solution:
A diamagnet is always repelled by a magnetic field. Therefore, it is repelled by both the north pole as well as the south pole.

Question35

A bar magnet having a magnetic moment of $2 \times 10^4 \mathrm{J\,T^{-1}}$ is free to rotate in a horizontal plane. A horizontal magnetic field $B = 6 \times 10^{-4}\mathrm{T}$ 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
(2009)

Options:

A. 12 J

B. 6 J

C. 2 J

D. 0.6 J

Answer: B

Solution:

Here, $M = 2 \times 10^4 \mathrm{J\,T^{-1}}$
$B = 6 \times 10^{-4}\mathrm{T}$, $\theta_1 = 0°$, $\theta_2 = 60°$
$W = MB(\cos\theta_1 - \cos\theta_2) = MB(1 - \cos 60°)$
$W = 2 \times 10^4 \times 6 \times 10^{-4}\left(1 - \frac{1}{2}\right) = 6\mathrm{J}$

Question36

Curie temperature above which
(2008)

©

Options:

A. paramagnetic material becomes ferromagnetic material

B. ferromagnetic material becomes diamagnetic material

C. ferromagnetic material becomes paramagnetic material

D. paramagnetic material becomes diamagnetic material

Answer: C

Solution:

Solution:
At Curie temperature, there is a change from ferromagnetic to paramagentic behaviour. Above this temperature, the paramagentic substance obeys Curie Weiss law, even those resistances which are not ferromagnetic but only paramagnetic also obey Curie Weiss law above the Curie temperature only.

Question37

Nickel shows ferromagnetic property at room temperature. If the temperature is increased beyond Curie temperature, then it will show (2007)

©

Options:

A. anti ferromagnetism

B. no magnetic property

C. diamagnetism

D. paramagnetism.

Answer: D

Solution:

Solution:
Above Curie temperature , ferromagnetic material become paramagnetic.

Question38

A charged particle (charge q) is moving in a circle of radius R with uniform speedv. The associated magnetic moment μ is given by (2007)

Options:

A. qvR^2

B. $\frac{qvR^2}{2}$

C. qvR

D. $\frac{qvR}{2}$

Answer: D

Solution:

Magnetic moment $\mu = I A$

since $T = \frac{2\pi R}{v}$ Also, $I = \frac{q}{T} = \frac{qv}{2\pi R}$

$\therefore \mu = \left(\frac{qv}{2\pi R}\right)(\pi R^2) = \frac{qvR}{2}$.

Question39

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 (2005)

Options:

A. $\mu_d = 0$ and $\mu_p \neq 0$

B. $\mu_d \neq 0$ and $\mu_p = 0$

C. $\mu_d \neq 0$ and $\mu_f \neq 0$.

D. $\mu_p = 0$ and $\mu_f \neq 0$

Answer: A

Solution:

Materials with no unpaired, or isolated electrons are considered diamagnetic. Diamagnetic substances do not have magnetic dipole moments and have negative susceptibilities. However, materials having unpaired electrons whose spins do not cancel each other are called paramagnetic. These substances have positive magnetic moments and susceptibilities.
$\mu_d = 0, \mu_p \neq 0$

Question40

A coil in the shape of an equilateral triangle of side l is suspended between the pole pieces of a permanent magnet such that $\vec{B}$ is in plane of the coil. If due to a current i in the triangle a torque tau acts on it, the side l of the triangle is (2005)

Options:

A. $\frac{2}{\sqrt{3}}\left(\frac{\tau}{Bi}\right)$

B. $2\left(\frac{\tau}{\sqrt{3}Bi}\right)^{1/2}$

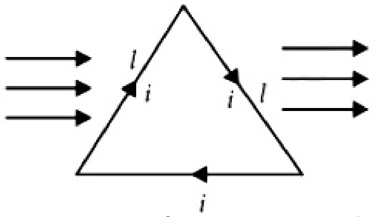
C. $\frac{2}{\sqrt{3}}\left(\frac{\tau}{Bi}\right)^{1/2}$

D. $\frac{1}{\sqrt{3}}\frac{\tau}{Bi}$

Answer: B

Solution:

Solution:
The current flowing clockwise in the equilateral triangle has a magnetic field in the direction $\hat{k}$



$\tau = BiN A \sin\theta = BiA \sin 90°$ (as it appears that $N = 1$)
$\tau = Bi \times \frac{\sqrt{3}}{4}l^2$ (area of equilateral triangle)
$= Bi\frac{\sqrt{3}}{4}l^2$
$\left(\frac{4\tau}{\sqrt{3}Bi}\right) = l^2 \Rightarrow l = 2\left(\frac{\tau}{Bi\sqrt{3}}\right)^{1/2}$

Question41

A diamagnetic material in a magnetic field moves (2003)

Options:

A. from stronger to the weaker parts of the field

B. from weaker to the stronger parts of the field

C. perpendicular to the field

D. in none of the above directions

Answer: A

Question42

According to Curie's law, the magnetic susceptibility of a substance at an absolute temperature T is proportional to
(2003)

Options:

A. $\frac{1}{T}$

B. T

C. $\frac{1}{T^2}$

D. T^2

Answer: A

Solution:

Solution:
According to Curie's law $\chi \propto \frac{1}{T}$

Question43

A bar magnet is oscillating in the Earth's magnetic field with a period T. What happens to its period and motion if its mass is quadrupled?
(2003, 1994)

Options:

A. motion remains simple harmonic with time period $= \frac{T}{2}$

B. motion remains S.H.M with time period $= 2T$

C. motion remains S.H.M with time $= 4T$

D. motion remains S.H.M and period remains nearly constant

Answer: B

Solution:

Initial mass of the magnet $(m_1) = m$ and final mass of the magnet $(m_2) = 4m$. The time period

$(T) = 2\pi\sqrt{\frac{I}{MB}} = 2\pi\sqrt{\frac{mk^2}{MB}} \propto \sqrt{m}$

Therefore $\frac{T_1}{T_2} = \frac{\sqrt{m_1}}{\sqrt{m_2}} = \frac{\sqrt{m}}{\sqrt{4m}} = \frac{1}{2}$

or $T_2 = 2T_1 = 2T$

Question44

Two bar magnets having same geometry with magnetic moments M and 2M , are firstly placed in such a way that their similar poles are in same side then its time period of oscillation is T_1. Now the polarity of one of the magnet is reversed then time period of oscillation is T_2 , then (2002)

Options:

A. $T_{1}

B. $T_1 = T_2$

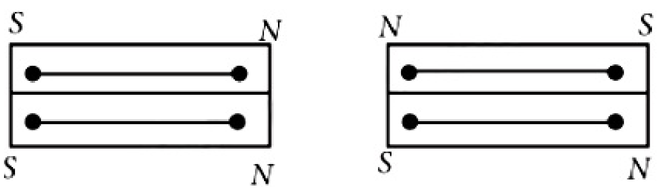
C. $T_1 > T_2$

D. $T_2 = \infty$

Answer: A

Solution:

Solution:



(i) $M = M_1 + M_2$

$I = I_1 + I_2$

(ii) $M = M_1 - M_2$

$I = I_1 + I_2$
(i) Similar poles are placed at the same side (sum position)
(ii) Opposite poles are placed at the same side (difference position)
I_1 and I_2 are the moments of inertia of the magnets and M_1 and M_2 are the moments of the magnets.
Here $M_1 = M$ and $M_2 = 2M$, $I_1 = I_2 = I$ (say), for same geometry.
For same position.

$$T_1 = 2\pi\sqrt{\frac{I_1 + I_2}{(M_1 + M_2)H}} = 2\pi\sqrt{\frac{2I}{(M + 2M)H}}$$

For difference position.

$$T_2 = 2\pi\sqrt{\frac{I_1 + I_2}{(M_2 - M_1)H}} = 2\pi\sqrt{\frac{2I}{(2M - M)H}}$$

$$\therefore \frac{T_1}{T_2} = \sqrt{\frac{M}{3M}} = \frac{1}{\sqrt{3}} < 1$$

$ ∴\ T_{1}

Question45

Among which the magnetic susceptibility does not depend on the temperature?
(2001)

Options:

A. diamagnetism

B. paramagnetism

C. ferromagnetism

D. ferrite.

Answer: A

Question46

Tangent galvanometer is used to measure
(2001)

Options:

A. potential difference

B. current

C. resistance

D. charge.

Answer: B

Solution:

$I = K \tan\theta$

Question47

A bar magnet of magnetic moment $\vec{M}$, is placed in a magnetic field of induction $\vec{B}$. The torque exerted on it is
(1999)

Options:

A. $\vec{M} \times \vec{B}$

B. $-\vec{M} \cdot \vec{B}$

C. $\vec{M} \cdot \vec{B}$

D. $-\vec{B} \times \vec{M}$

Answer: D

Question48

For protecting a sensitive equipment from the external magnetic field, it should be
(1998)

Options:

A. surrounded with fine copper sheet

B. placed inside an iron can

C. wrapped with insulation around it when passing current through it

D. placed inside an aluminium can

Answer: B

Question49

A bar magnet of magnetic moment M is cut into two parts of equal length. The magnetic moment of each part will be
(1997)

Options:

A. M

B. 2M

C. zero

D. 0.5 M

Answer: D

Solution:

Magnetic moment = pole strength × length
$\therefore M' = \frac{M}{2} = 0.5M$

Question50

The work done in turning a magnet of magnetic moment M by an angle of 90° from the meridian, is n times the corresponding work done to turn it through an angle of 60°. The value of n is given by
(1995)

Options:

A. $\frac{1}{2}$

B. $\frac{1}{4}$

C. 2

D. 1

Answer: C

Solution:

Angle of magnet $(\theta) = 90°$ and $60°$.
Work done in turning the magnet through $90°$.
$(W_1) = M\,B(\cos 0° - \cos 90°) = M\,B(1 - 0) = M\,B$

Similarly $W_2 = M\,B(\cos 0° - \cos 60°) = M\,B\left(1 - \frac{1}{2}\right) = \frac{M\,B}{2}$

Therefore $W_1 = 2W_2$ or $n = 2$
