Chapter

5 MAGNETISM AND MATTER

1. The pattern of iron filling permit us

   (a) to plot North – South poles
   (b) to plot the geographic North- South poles
   (c) to plot the magnetic field lines
   (d) to plot the electric dipole

2. Magnetic field lines show the direction (at every point)along which a small magnetized needle aligns. Do the magnetic field lines also represent the lines of force on a moving charge at every point ?

   (a) No
   (b) Yes
   (c) Neither (a) nor (b)
   (d) Given information is not sufficient

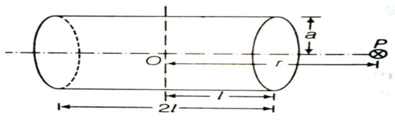
3. Cutting a bar magnet in half is like cutting a solenoid , such that we get two smaller solenoids with

   (a) Weaker magnetic properties
   (b) Strong magnetic properties
   (c) Constant magnetic properties
   (d) Both (a) and (b)

4. The magnitude of the magnetic moment of the solenoid is

   (a) $m = n\ (2l), I\ \ (\pi a^2)$
   (b) $m = n\ (4l), I\ \ (\pi a^2)$
   (c) $m = n\ (2l), 2\ I\ \ (\pi a^2)$
   (d) $m = n\ (2l^2), I\ \ (\pi a^2)$

5. In the given figure , the axial magnetic field at a point P , at a distance r from the centre O of a solenoid is (consider m as the magnitude of the magnetic moment of the solenoid).



   (a) B = $\frac{2\mu_0}{3\pi}\ \frac{2m}{r^3}$ (b) B = $\frac{4}{3}\ \frac{\mu_0}{\pi}\ \frac{2m}{r^3}$
   (c) B = $\frac{\mu_0}{4\pi}\ \frac{2m}{r^3}$ (d) B = $\frac{\mu_0}{2\pi}\ \frac{2m}{r^3}$

6. Two magnets have the same length and the same pole strength . But one of the magnets has a small hole at its centre . Then,

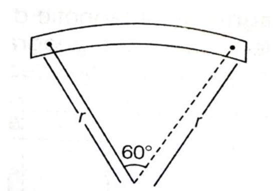
   (a) Both have equal magnetic moment

   (b) one with has small magnetic moment

   (c) one with hole has large magnetic moment

   (d) one with hole loses magnetism through the hole

7. A bar magnet of length l and magnetic dipole moment M is bent in the form of an arc shown in figure . The new magnetic dipole moment will be



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

8. A large magnet is broken into pieces so that their lengths are in the ratio 2:1 . The pole strengths of the two pieces will have ratio

   (a) 2 : 1 (b) 1 : 2 (c) 4 : 1 (d) 1 : 1

9. The length of a magnetized steel wire is l and the magnetic moment is m . It is bent in to the shape of L with two sides equal. The magnetic moment now will be

   (a) m/2 (b) 2m (c) $\sqrt{2}$ m (d) m/ $\sqrt{2}$

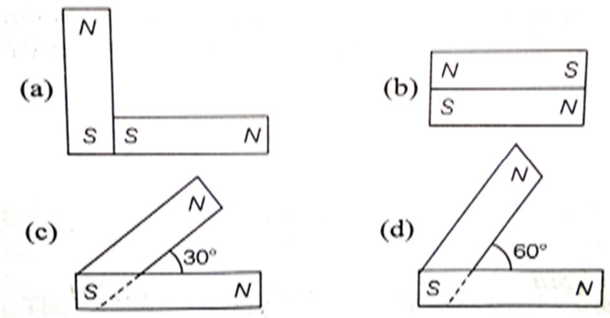
10. A magnet with moment P_m is given . If it is bent into a semi - circular form , its new magnetic moment will be

(a) $\frac{P_m}{\pi}$ (b) $\frac{P_m}{2}$ (c) P_m (d) $\frac{2\,P_m}{\pi}$

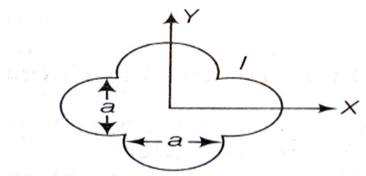
11. The areas of cross- section of three magnets of same length are $A, 2A$ and $6A$, respectively. The ratio of their magnetic moments will be

(a) 6 :2 : 1 (b) 1 :2: 6 (c) 2: 6: 1 (d) 1:1:1

12. Following figure show the arrangement of bar magnets in different configurations. Each magnet has magnetic dipole moment m. Which configuration has highest net magnetic dipole moment?



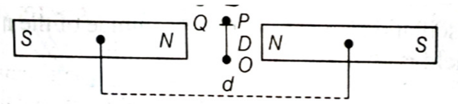
13. A loop carrying current I lies in the XY - plane as shown in figure . The unit vector $\hat{k}$ is coming out of the plane of the paper . The magnetic moment of the current loop is



(a) $a^2 I\hat{k}$ (b) $\left(\frac{\pi}{2}+1\right)a^2 I\hat{k}$

(c) - $\left(\frac{\pi}{2}+1\right)a^2 I\hat{k}$ (d) $(2\pi+1)a^2 I\hat{k}$

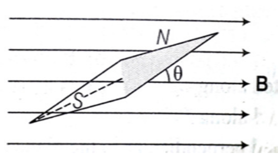
14. Two identical bar magnets are fixed with their with centres at a distance d apart. A stationary charge Q is placed at P in between the gap of the two magnets at a distance D from the centre O as shown in figure . the force on the charge Q is



(a) zero
(b) directed along OP
(c) directed along PO
(d) directed perpendicular to the plane of paper

15. **(A)**. A copper rod is suspended in a non-homogenous magnetic field region . The rod when in equilibrium will align itself
(a) In the region where magnetic field is stranger
(b) In the region where magnetic field is weaker and parallel to the direction of magnetic field there
(c) In the direction in which it was originally suspended
(d) In the region where magnetic field is weaker and perpendicular to the direction of magnetic field there

15.(B) . In the given figure , the magnetic needle has magnetic moment $6.7 \times 10^{-2} Am^2$ and moment of inertia $I = 7.5 \times 10^{-6}\, kg - m^2$. It performs 10 complete oscillations in 6.70 s. the magnitude of the magnetic field is



(a) 1.00 T (b) 0.67 T (c) 0.01 T (d) 1.50 T

16. A rectangular coil of length 0.12 m and width 0.1m having 50 turns of wire is suspended vertically in a uniform magnetic field of strength 0.2 Wbm^{-2} . The coil carries a current of 2A. If the plane of the coil is inclined at an angle of 30^o with the direction of the field , the torque required to keep the coil in stable equilibrium will be

(a) 0.15 Nm (b) 0.20 Nm
(c) 0.24 Nm (d) 0.12Nm

17. Rate of change of torque τ with deflection θ is maximum for a magnet suspended freely in a uniform magnetic field of induction B , when

(a) $\theta = 0^o$ (b) $\theta = 45^o$
(c) $\theta = 60^o$ (d) $\theta = 90^o$

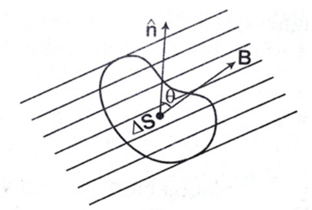
18. A thin bar magnet is placed in a uniform magnetic field and is aligned with the field. The needle is now rotated by an angle of 45^o and the work done is W . The torque on the magnetic needle at this position is

(a) Zero (b) $\frac{W}{\sqrt{2}-1}$ (c) $\frac{W}{\sqrt{2}}$ (d) $\sqrt{2}\,W$

19. A bar magnet having a magnetic moment of $2\times 10^{4} JT^{-1}$ is free to rotate in a horizontal plane . A horizontal magnetic field B = $6\times 10^{-4}T$ exists in the space. The work done in taking the magnetic slowly from a direction parallel to the field to a direction 60^o from the field is

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

20. Consider a small vector area element ΔS of a closed surface S as shown in figure . The magnetic flux through ΔS defined as $\Delta \phi_B$ is



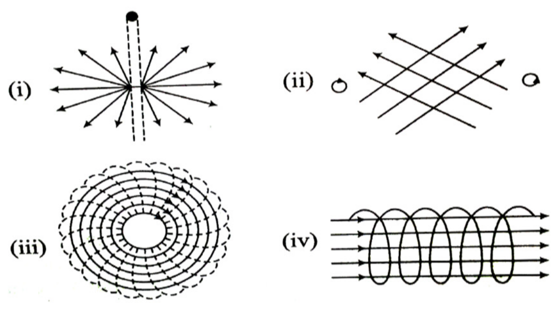
(a) B. ΔS (b) 2 B. ΔS

(c) B. 2 ΔS (d) B $\times$ ΔS

21. In the Gauss's law of electrostatics , the flux through a closed surface is given by

(a) $\frac{q}{\varepsilon_0}$ (b) $\frac{2q}{\varepsilon_0}$ (c) $\frac{q}{2\varepsilon_0}$ (d) $\frac{q}{4\varepsilon_0}$

22. Many of the diagrams given in figure , show magnetic field lines (think lines in the figure) . Point out which one is / are correct?



(a) Both (i) and (iv) (b) Both (ii) and (iv)

(c) Both (iii) and (iv) (d) Only (iii)

23. The strength of the earth's magnetic field varies from place to place on the earth's surface , its value being of the order of

(a) $10^5 T$ (b) $10^{-6} T$ (c) $10^{-5} T$ (d) $10^8 T$

24. The pole near the geographic North - pole of the earth is called the ….. magnetic pole and the pole near the geographic South - pole is called the …… magnetic pole.

(a) South - North (b) South - East

(c) North – East (d) North - South

25. The vertical plane containing the longitude circle and the axis of rotation of the earth is called the

(a) geographic meridian
(b) magnetic meridian
(c) magnetic declination
(d) magnetic inclination

26. The time of vibration of a magnetic needle vibrating in the vertical plane is 3s. When magnetic needle is made to vibrate in the horizontal plane , the time of vibration is $3\sqrt{2}$. then the angle of dip is

(a) 30^o (b) 45^o (c) 60^o (d) 90^o

27. The earth's magnetic induction at a certain point is $7\times 10^{-5} Wbm^{-2}$. This is to be annulled by the magnetic induction at the centre of a circular conducting loop of radius 15 cm. The required current in the loop is

(a) 0.56A (b) 5.6 A (c) 2.28 A (d)2.8 A

28. When a magnet is placed vertically on horizontal board , number of neutral points obtained on the board is

(a) four (b) three (c) two (d) one

29. 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?

(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

30. The core of a toroid having 3000 turns has inner and outer radii 11 cm and 12cm, respectively . The magnetic field in the core for a current of 0.70 A is 2.5 T . The relative permeability of the core is

(a) 658 (b) 880 (c) 448 (d) 790

31. The space inside a toroid is filled with tungsten whose susceptibility is 6.8×10^{-5}. The percentage increase in the magnetic field will be

(a) 0.0068 % (b) 0.068 %

(c) 0.68% (d) None of these

32. The most exotic diamagnetic materials are

(a) conductors (b) superconductors

(c) semiconductors (d) poor conductors

33. If superconductors are cooled to very low temperature , then the exhibit perfect

(a) conductivity (b) diamagnetism

(c) Both (a) and (b) (d) Neither (a) nor (b)

34. When will the field lines be completely expelled?

(a) x = - 1 and μ_r = 0 (b) - 1 $\leq x$ and μ_r >>1

(c) $x \leq$ 1 and << 1 (d) x = 1 and μ_r = 1

35. Above Curie temperature

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

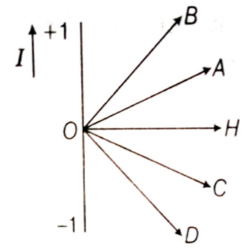
36. The susceptibility of magnesium at 300K is 1.2×10^{-5}. At what temperature will the susceptibility increase to 1.8×10^{-5}?

(a) 100 K (b) 200 K (c) 300K (d) 400 K

37. The coercivity of a small magnet where the ferromagnet gets demagnetized is $3 \times 10^3 Am^{-1}$. The current required to be passed in a solenoid of length 10 cm and number of t7urns 100 , so that the magnet gets demagnetised when inside the solenoid is

(a) 30 mA (b) 60 mA (c) 3A (d) 6A

38. The variation of the intensity of magnetization I with respect to the magnetizing field H in a diamagnetic substance is described by the graph in figure



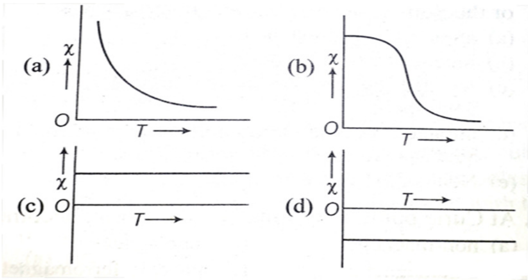
(a) OD (b) OC (c) OB (d) OA

39. The correct measure of magnetic hardness of a material is

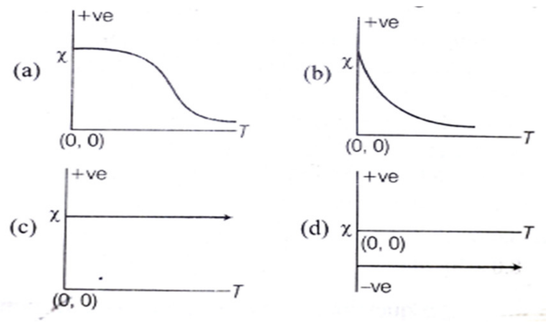
(a) remanent magnetism
(b) hysteresis loss
(c) Coercivity
(d) curie temperature

40. Liquid oxygen remains suspended between two poles of magnet because it is
(a) diamagnetic
(b) paramagnetic
(c) ferromagnetic
(d) anti - ferromagnetic

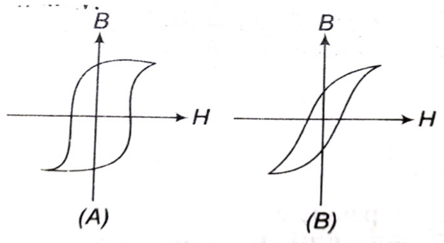
41. The variation of magnetic susceptibility (x) with temperature for a diamagnetic substance is best represented by figure



42. The variation of magnetic susceptibility (x) with absolute temperature T for ferromagnetic is given in figure by



43. Hysteresis loop for two magnetic materials A and B are as given below:



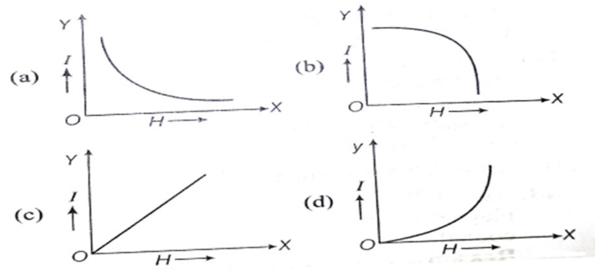
These materials are used to makes magnets for electric generators , transformer core and electromagnetic core . Then, it proper to use

(a) A for electric generators and transformers
(b) A for electromagnets and B for electric generators
(c) A for transformers and B for electric generators
(d) B for electromagnets and transformers

44. The susceptibility of a paramagnet material is K at $27^{o}C$. At what temperature will its susceptibility be $K/2$?

(a) $600^{o}C$ (b) $287^{o}C$ (c) $34^{o}C$ (d) $327^{o}C$

45. The current $I-H$ curve for a paramagnetic material is represented by figure.



Directions :

In the following questions (Q. Nos .46 -47)a statement of assertion is followed by a corresponding statement of reason . Of the following statements, choose the correct one.

(a) Both Assertion and Reason are correct and reason is correct explanation of Assertion.
(b) Both Assertion and Reason are correct Reason is not the correct explanation of Assertion .
(c) Assertion is correct but Reason is incorrect
(d) Assertion is incorrect but Reason is correct

46. **Assertion**

The true geographic North direction cannot be found by using a compass needle.

Reason

The magnetic meridian of the earth is along the axis of rotation of the earth.

47. **Assertion**

A paramagnetic sample displays greater magnetization (for the same magnetizing field) when cooled.

Reason

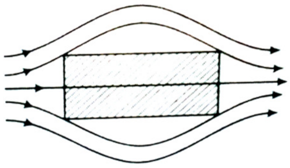
The magnetization does not depends on temperature

48. Consider the given statement with respect to the figure showing a bar of diamagnetic material placed in an external magnetic field.

I. The field lines are repelled or expelled and the field inside the material is reduced .

II. When placed in a non-uniform magnetic field, the bar will tend to move from high to low field.

III.Reduction the field inside the material slight , being one part in 10^5.

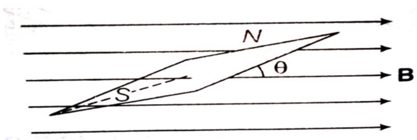


Choose the correct options from these given below.

(a) I,II are correct , III may be correct
(b) I, III are correct , II may be correct
(c) II, III are correct , I may be correct
(d) I,II and III are correct

Directions :

(Q . Nos . 49 -50) ***These questions are based on the following situation . Choose the correct option from those given below.***



To determine the magnitude of B accurately , a small compass needle of known magnetic moment m and moment of of inertia I is allowed to oscillate in the magnetic field . This arrangement is shown in figure.

49. Which of the following represents a simple harmonic motion ?

(a) $\frac{d^2\theta}{dt^2} = -\frac{mB}{I}\theta$ (b) $\frac{d\theta}{dt^2} = -\frac{mB}{I}\theta$

(c) $\frac{d^2\theta}{dt} = \frac{mB}{I}\theta$ (d) $\frac{d^2\theta}{dt^2} = \frac{mB}{I}\theta$

50. The magnetic potential energy U_m is given by

(a) U_m = − **m.B** (b) U_m = **m.B**

(c) U_m = **2m.B** (d) U_m = −**2 m.B**

Hints and Explanations

1. (c)
The pattern of iron filling permits to plot the magnetic field lines.

2. (a)
No , the magnetic force is always normal to B (remember magnetic force = $qv \times$ B. It is misleading to call magnetic field lines as lines of force.

3. (a)
Cutting a bar magnetic in half is like cutting a solenoid , such that we get two smaller solenoid with weaker magnetic properties .

4. (a)
The magnitude of the magnetic moment of the solenoid is $m = n\,(2\,l)\;(I)\;(\pi a^2)$, where $2l$ is the length and a is the radius of the solenoid.

5. (c)
Magnitude of the magnetic moment of the solenoid is,
$$M = n\,(2l)\,I\;(\pi a^2)$$
$$thus\;,\quad B = \frac{\mu_0}{4\pi}\cdot\frac{2\,M}{r^3}$$

6. (b)
As , we known , magnetic dipole moment m = m (2l) so, hole reduces the effective length of then magnet and hence magnetic moment reduces.

7. (b)
The magnetic moment , $M = ml$
$$l = \frac{\pi}{3}\times r \;\Rightarrow \text{r} = \frac{3\,l}{\pi}$$
∴ New magnetic moment
$$M'\,M \times r = M \times \frac{3\,l}{\pi} = \frac{3M}{\pi}$$

8. (d)
Pole strength does not depend on length , So, strength of the two pieces will remain same.

9. (d)

If q_m is strength of each pole , then $m = q_m \times l$. When the wire is bent into L shape effective distance between the poles

$$= \sqrt{(l/2)^2 + (l/2)^2} = l / \sqrt{2}$$

∴ m' = $q_m \times \frac{l}{\sqrt{2}} = \frac{m}{\sqrt{2}}$ (m will remain unchanged)

10. (d)

$P_m = q_m \times 2l$, $q_m = \frac{P_m}{2l}$.

q_m (and not m) denotes the pole strength as m denotes magnetic moment . Further, as π r $= 2l$ or r = $2l / \pi$

Distance between the two poles ,

$2l' = 2r = \frac{4l}{\pi}$

$Magnet\ moment\ \ P'_m = q_m \times 2l$

$= \left(\frac{P_m}{2l}\right)\left(\frac{4l}{\pi}\right) = 2P_m / \pi$

11. (b)

As magnetic moment ∝ pole strength ∝ area of cross - section i.e., m ∝ $q_m \propto A$.

$m_1 : m_2 : m_3$ = 1:2 :6

12. (c)

Magnetic moment is from S to N

$M_{net} = \sqrt{m^2 + m^2 + 2m^2 \cos\theta}$

M_{net} will be maximum , if $\cos\theta$ is maximum , $\cos\theta$ will be maximum when θ will be minimum so, at $\theta = 30^o$

M_{net} will be maximum .

13. (b)

Area of given loop is A

= (area of two circles of radius $\frac{a}{2}$ and area of square of side a)

$= 2\pi\left(\frac{a}{2}\right)^2 + a^2 = \left(\frac{\pi}{2}+1\right)a^2$

$|M| = IA = \left(\frac{\pi}{2}+1\right)a^2 I$

From screw law , direction of M is outwards or in positive Z – direction.

∴ M = $\left(\frac{\pi}{2}+1\right)a^2 I\,\hat{k}$

14. (d)

Magnetic field at equatorial line

$B_E = \frac{\mu_0 m}{4\pi r^3} = \frac{10^{-7}\times 0.4}{(0.5)^3} = \frac{10^{-7}\times 0.4}{0.125}$

$= 3.2 \times 10^{-7} T$

Magnetic field at axial line $B_A = \frac{\mu_0 2m}{4\pi r^3}$

$= 6.4 \times 10^{-7} T$

15. (d)

15 (A). (c)

The time period of oscillation is

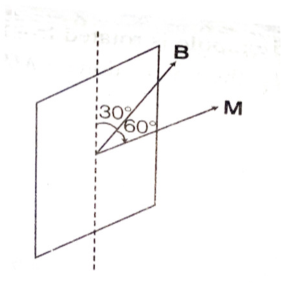
T = $\frac{6.70}{10}$ = 0.67 s

B = $\frac{4\pi^2 I}{mT^2} = \frac{4\times(3.14)^2\times 7.5\times 10^{-6}}{6.7\times 10^{-2}\times(0.67)^2} = 0.01\,T$

16. (b)

N = 50 , B = 0.2 Wbm^{-2} , $I = 2A$

$\theta = 60^o$, A = 0.12 × 0.1 = 0.012 m^2



Thus , torque required to keep the coil in stable equilibrium

i.e., $\tau = NIAB \sin\theta$

$= 50 \times 2 \times 0.012 \times 0.2 \times \sin 60^o$

$= 50 \times 2 \times 0.012 \times 0.2 \times \frac{\sqrt{3}}{2}$

= 0.20 Nm

17. (a)

As we know , torque i.e., τ = mB sin θ , $\frac{d\tau}{d\theta}$ $= mB\cos\theta$. It will be maximum when $\theta = 0^o$.

18. (b)

Work done = W and $\theta = 60^o$

We know that

$W = MB\,(1 - \cos\theta) = MB\,(1 - \cos 45^o)$

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

Hence, torque

$|T| = MB \sin 45^o = \frac{W\times\sqrt{2}}{\sqrt{2}-1} \times \frac{1}{\sqrt{2}} = \frac{W}{\sqrt{2}-1}$

19. (c)

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

$\theta_1 = 0^o$, $\theta_1 = 60^o$

$Magnetic\ moment\ ,\ M = 2\times 10^4\, JT^{-1}$

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

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

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

20. (a)

Consider a small vector area element ΔS of a closed surface S as shown in figure . The magnetic flux through ΔS is define as Δ_ϕ = B. ΔS where , B is the field at ΔS .

21. (a)

According to Gauss's law , electrostatic flux through a closed surface is given by , $\phi = \sum E.\Delta s = \frac{q}{\varepsilon_0}$

22. (d)

(a) **Wrong** Magnetic field lines can never emanate from a point , as shown in figure over any closed surface , the net flux of B must always be zero , i.e; pictorially as may field lines leaving it . The field lines shown , in fact , represent electric field of a long positively charged wire . The correct magnetic field lines are circling the straight conductor.

(b) **Wrong** Magnetic line as (like electric field lines) can never cross each other , because otherwise the direction of field at the point of intersection is ambiguous . Field at the point of intersection is ambiguous. There is further error in the figure magnetostatic field lines can never from closed loops around empty space .

A closed loop of static magnetic field line must enclose a region across which a current is passing . By contrast , electrostatic field lines can never from closed loops neither in empty space nor when the loop enclose charges.

(c) **Right** Magnetic lines are completely confined within a toroid . Nothing worng here in field lines forming closed loops, since the each loop encloses a region across which a current passes . Note , for clarity of figure only a few field lines within the toroid have been shown . Actually , the entire region enclosed by the windings contains magnetic field .

(d) **Wrong** Field lines due to a solenoid at it ends and outside cannot be so completely straight and confined ; such a thing violates Ampere's law . The lines should curve out at both ends meet eventually to from closed loops.

23. (c)

Earth's magnetic field is of the order of $10^{-5} T$.

24. (d)

The pole near the geographic North - pole of the earth is called the North magnetic pole . Likewise , the pole near the geographic South - pole is called the South magnetic pole.

25. (a)

26. (c)

Time of vibration ,

$t_1 = 3 = 2\pi\sqrt{\frac{I}{MR}}$ ---------(i)

$R\ is\ resultant$ intensity of earth's field and time of vibration of magnetic needle

$t_2 = 3\sqrt{2} = 2\pi\sqrt{\frac{I}{MR}}$ ---------- (ii)

$On\ dividing\ equation$

$\sqrt{\frac{1}{2}} = \sqrt{\frac{H}{R}} = \sqrt{\frac{R\cos\delta}{R}} = \sqrt{\cos\delta} \Longrightarrow \frac{1}{2} \Longrightarrow \delta = 60^o$

27. (b)

According to magnetic field , induced at the centre of a circular loop i.e.,

B = $\frac{\mu_0 i}{2\,r} \Longrightarrow 7 \times 10^{-5} = \frac{4\pi \times 10^{-7} \times i}{2 \times 5 \times 10^{-2}}$

∴ Current in the circular loop

$i.e.,$ $i = \frac{7 \times 10^{-5}}{4\pi \times 10^{-6}}$ = 5.6 A

28. (d)

At one point only , horizontal component of earth's magnetic field may balance the field due to vertical magnet (Which is vertical being along the axis of the magnet).

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

30. (a)

Mean radius of the toroid ,

$R = \frac{(11 + 12)cm}{2}$ = 11.5 cm = $11.5 \times 10^{-2}\ m$

I = 0.70 A , B = 2.5 T , N = 3000

$B = \mu H$, $H = nI$

$\mu_r = \mu / \mu_0$, $B = \mu_r \mu_0 nI$

$\mu_r = \frac{B}{\mu_0\ nI} = \frac{B}{\mu_0\ (N/2\pi R}$

31. (a)

When space inside the toroid is filled with air

$B_0 = \mu_0 H$

When filled with tungsten ,

B = $\mu H = \mu_0\mu_r H = \mu_0 (1 + x_m) H$

Percentage increase in magnetic field

= $\frac{(B - B_0) \times 100}{B_0} = \frac{\mu_0 x_m H \times 100}{\mu_0 H} = x_m \times 100$

= $6.8 \times 10^{-5} \times 100$ = 0.0068 %

32. (b)

The most exotic diamagnetic material are superconductors.

33. (c)

If superconductors are cooled to very low temperature , then they exhibit both perfect conductivity and perfect diamagnetism .

34. (a)

The field lines are completely expelled when x = -1 and μ_r = 0 .

35. (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.

36. (b)

$x_m = \frac{C}{T}$, $\frac{x_m}{x_m} = \frac{T\prime}{T}$

or temperature of magnesium i.e.,

$T' = \left(\frac{x_m}{x_m}\right) T = \left(\frac{1.2 \times 10^5}{1.8 \times 10^5}\right) 300 = 200\ K$

37. (c)

For solenoid , the magnetic field and needed to be magnetized the magnet

$B = \mu_0 nI$

$\Rightarrow 3 \times 10^3 = \frac{100}{0.1} \times I \quad \Rightarrow I = 3A$

38. (b)

For a diamagnetic substance , I is negative and $-I \times H$. Therefore , the variation is represented by $OC\ or\ OD$. As magnetization is small . So , OC is better choice than OD.

39. (c)

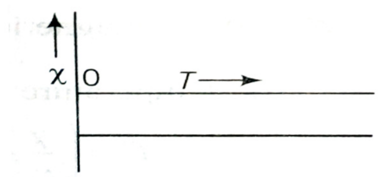
The correct measure of hardness of a material is its coercivity ; i.e., the field strength required to be applied in opposite direction to reduce the residual magnetism of the specimen to zero.

40. (b)

Liquid oxygen is paramagnetic because its atoms possess permanent magnetic dipole moment .

41. (d)

For diamagnetic substance, the magnetic susceptibility is negative , and it is independent of temperature . Therefore, choice (d) is correct in . Figure



42. (a)