1. A 0.5 m long straight wire in which a current of 1.2 A is flowing is kept a right angles to a uniform magnetic field of 2.0 tesla. The force acting on the wire will be –

(a) 2N (b) 2.4 N
(c) 1.2 N (d) 3 N

2. A current-carrying, straight wire is kept along the axis of a circular loop carrying a current. The straight wire

(a) will exert an inward force on the circular loop
(b) will exert an outward force on the circular loop
(c) will not exert any force on the circular loop
(d) will exert a force on the circular loop parallel to itself.

3. A circular loop of area 1 cm^2, carrying a current of 10 A, is placed in a magnetic field of 0.1 T perpendicular to the plane of the loop. The torque on the loop due to the magnetic field is

(a) zero (b) 10^{-4} N-m
(c) 10^{-2} N-m (d) 1 N-m

4. Current is flowing in a coil of area A and number of turns N, then magnetic moment of the coil M is equal to:

(a) NiA (b) $\frac{Ni}{A}$
(c) $\frac{Ni}{\sqrt{A}}$ (d) N^2Ai

5. 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 :

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

6. Select the incorrect alternative (s) :

When a ferromagnetic material goes through a complete cycle of magnetisation, the magnetic susceptibility :
(a) has a fixed value (b) may be zero
(c) may be infinite (d) None of these

7. A steel wire of length *l* has magnetic moment M. It is bent into a semi-circle. Now its magnetic moment is

(a) $\frac{2M}{\pi}$ (b) $\frac{3M}{2\pi}$
(c) $\frac{M}{\pi}$ (d) $\frac{M}{2\pi}$

8. Consider a long, straight wire of cross-section area A carrying a current i. Let there be n free electrons per unit volume. An observer places himself on a trolley moving in the direction opposite to the current with a speed $\upsilon = (i/nAe)$ and separated from the wire by a distance r. The magnetic field seen by the observer is

(a) $\frac{\mu_0 i}{2\pi r}$ (b) zero

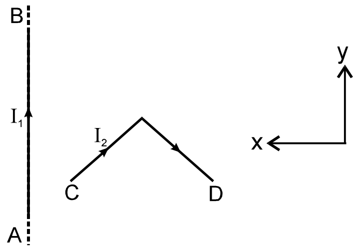
(c) $\frac{\mu_0 i}{\pi r}$ (d) $\frac{2\mu_0 i}{\pi r}$

9. A proton, a deuteron and an α-particle having the same kinetic energy are moving in circular trajectories in a constant magnetic field. If r_p, r_d and r_α denote respectively the radii of the trajectories of these particles then

(a) $r_\alpha = r_p < r_d$ (b) $r_\alpha > r_d > r_p$

(c) $r_\alpha = r_d > r_p$ (d) $r_p = r_d = r_\alpha$

10. In the figure shown a current I_1 is established in the long straight wire AB. Another wire CD carrying current I_2 is placed in the plane of the paper. The line joining the ends of this wire is perpendicular to the wire AB. The resultant force on the wire CD is:



(a) towards negative x-axis

(b) towards positive y-axis

(c) somewhere between –x axis and + y axis

(d) somewhere between +x axis and + y axis

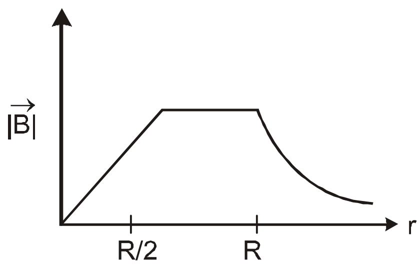
11. A circular coil of radius 20 cm and 20 turns of wire is mounted vertically with its plane in magnetic meridian. A small magnetic needle (free to rotate about vertical axis) is placed at the center of the coil. It is deflected through 45° when a current is passed through the coil in equilibrium Horizontal component of earth's field is 0.34×10^{-4} T. The current in coil is:

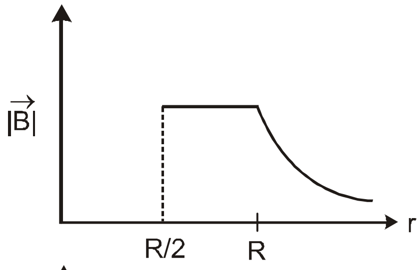
(a) $\frac{17}{10\pi}$ A (b) 6A

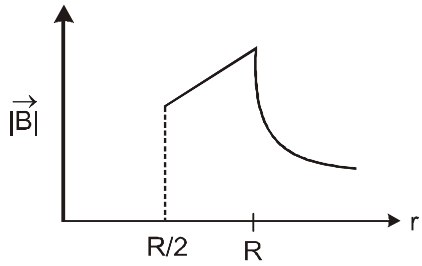
(c) 6×10^{-3} A (d) $\frac{3}{50}$ A

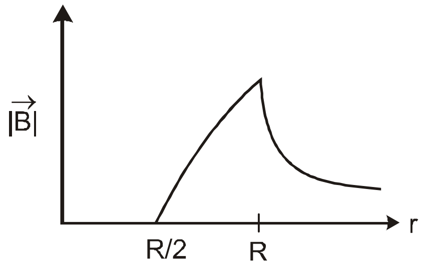
12. An infinitely long hollow conducting cylinder with inner radius R/2 and outer radius R carries a uniform current density along is length. The magnitude of the magnetic field, $|\vec{B}|$ as a function of the radial distance r from the axis is best represented by :

(a)



(b) 

(c) 

(d) 

13. If $A_1 = 24$ and $q_1 = e$ and $A_0 = 22$ and $q_2 = 2e$ ions enter a uniform perpendicular magnetic field with same speed, the ratio of radius their circular paths will be

(a) 12/11 (b) 24/11
(c) 11/12 (d) 11/24

14. For paramagnetic materials magnetic susceptibility is related with temperature as :
(a) $\chi \propto T^2$ (b) $\chi \propto T^1$
(c) $\chi \propto T^{-1}$ (d) $\chi \propto T^2$

15. On a magnetic needle placed in a uniform magnetic field :
(a) $F \neq 0, \tau \neq 0$ (b) $F \neq 0, \tau = 0$
(c) $F = 0, \tau \neq 0$ (d) $F = 0, \tau = 0$

16. Two concentric circular coils of ten turns each are situated in the same plane. Their radii are 20 cm and 40 cm and they carry respectively 0.2A and 0.3A currents in opposite direction. The magnetic field in tesla at the centre is

(a) $\frac{35\mu_0}{4}$ (b) $\frac{\mu_0}{80}$
(c) $\frac{7\mu_0}{80}$ (d) $\frac{5\mu_0}{4}$

17. There are 50 turns of a wire in every cm length of a long solenoid. If 4A currents is flowing in the solenoid, the approximate value of magnetic field along its axis at an internal point and at one end will be respectively :

(a) 12.6×10^{-3} Wb/m^2 , 6.3×10^{-3} Wb/m^2
(b) 12.6×10^{-3} Wb/m^2, 25.1×10^{-3} Wb/m^2
(c) 25.1×10^{-3} Wb/m^2, 12.6×10^{-3} Wb/m^2
(d) 25.1×10^{-5} Wb/m^2, 12.6×10^{-5} Wb/m^2

18. Two magnets are kept in a vibration magnetmeter and vibrate in earth's magnetic field. There are 12 vibrations per minute when like poles kept together, but only 4 vibrations per minute when opposite poles kept together then ratio of magnetic moments wil be :

(a) 3 : 1 (b) 1 : 3
(c) 3 : 5 (d) 5 : 4

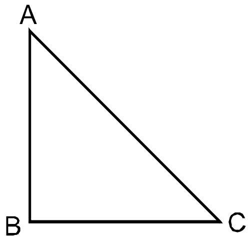
19. A rectangular loop of length 20 cm, along y -axis and breadth 10 cm along z-axis carries a current of 12 A. If a unifrom magnetic field $(0.3\hat{i} + 0.4\hat{j})$ acts on the loop, the torque acting on it is

(a) 9.6×10^{-4} Nm along x - axis
(b) 9.6×10^{-3} Nm along y - axis
(c) 9.6×10^{-2} Nm along z - axis
(d) 9.6×10^{-3} Nm along z – axis

20. Relative permittivity and permeability of a material are ε_r and μ_r, respectively. Which of the following values of these quantities are allowed for a diamagnetic material ?
(a) $\varepsilon_r = 1.5$, $\mu_r = 0.5$ (b) $\varepsilon_r = 0.5$, $\mu_r = 0.5$
(c) $\varepsilon_r = 1.5$, $\mu_r = 1.5$ (d) $\varepsilon_r = 0.5$, $\mu_r = 1.5$

21. A square current carrying loop is suspended in a uniform magnetic field acting in the plane of the loop. If the force on one arm of the loop is $\vec{F}$, the net force on the remaining three arms of the loop is
(a) $3\vec{F}$ (b) $-\vec{F}$
(c) $-3\vec{F}$ (d) $\vec{F}$

22. A current carrying loop in the form of a right angle isosceles triangle ABC is placed in a uniform magnetic field acting along AB. If the magnetic force on the arm BC is $\vec{F}$, the force on the arm AC is :



(a) $-\sqrt{2}\,\vec{F}$ (b) $-\vec{F}$
(c) $\vec{F}$ (d) $\sqrt{2}\,\vec{F}$

23. A compass needle which is allowed to move in a horizontal plane is taken to a geomagnetic pole. It :

(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

24. A proton carrying 1 MeV kinetic energy is moving in a circular path of radius R in uniform magnetic field. What should be the energy of an α - particle to describe a circle of same radius in the same field ?
(a) 2 MeV (b) 1 MeV

(c) 0.5 MeV (d) 4 MeV

25. Two identical long conducting wires AOB and COD are placed at right angle to each other, with one above other such that 'O' is their common point for the two. The wires carry I_1 and I_2 currents, respectively. Point 'I' is lying at distance 'd' from 'O' along a direction perpendicular to the plane containing the wires. The magnetic field at the point 'P' will be :

(a) $\frac{\mu_0}{2\pi d}\left(\frac{I_1}{I_2}\right)$ (b) $\frac{\mu_0}{2\pi d}(I_1 + I_2)$

(c) $\frac{\mu_0}{2\pi d}(I_1^2 - I_2^2)$ (d) $\frac{\mu_0}{2\pi d}(I_1^2 + I_2^2)^{1/2}$

26. The magnetic susceptibility negative for

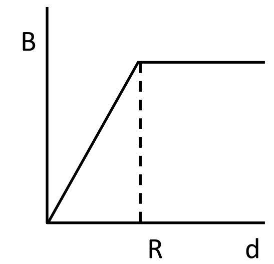
(a) paramagnetic and ferromagnetic materials
(b) diamagnetic material only
(c) paramagnetic material only
(d) ferromagnetic material only

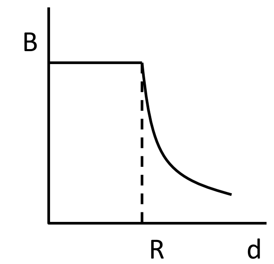
27. A long wire carrying a steady current is bent into a circular loop of one turn. The magnetic field at the centre of the loop is B. It is then bent into a circular coil of n turns. The magnetic field at the centre of this coil of n turns will be :

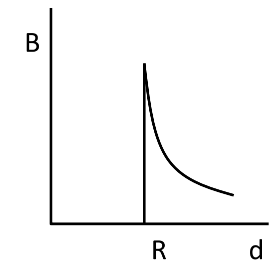
(a) $2n^2$ B (b) nB

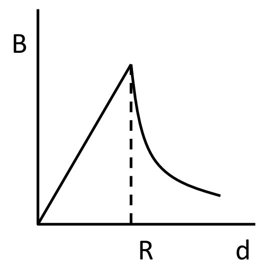
(c) n^2B (d) 2nB

28. A cylindrical conductor of radius R is carrying constant current. The plot of the magnitude of the magnetic field, B with the distance, d from the centre of the conductor, is correctly represented by the figure :

(a)


(b)


(c)


(d) 

29. Ionized hydrogen atoms and α-particle with momenta enters perpendicular to a constant magnetic field, B. The ratio of their radii of their paths $r_H : r_\alpha$ will be :

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

30. An electric charge +q moves with velocity $\vec{v} = 3\hat{i} + 4\hat{j} - 3\hat{k}$, in an electromagnetic field given by :

$\vec{E} = 3\hat{i} + \hat{j} + 2\hat{k}$ and $\vec{B} = \hat{i} + \hat{j} + 3\hat{k}$. The y - component of the force experienced by + q is :

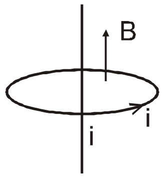
(a) 11 q (b) 5 q
(c) 3 q (d) 2 q

1. (c) $i = 1.2A$, $\ell = 0.5$, $B = 2.0T$

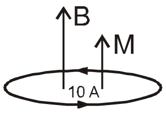
$F = Bi\ell = 1.2 \times 0.5 \times 2 = 1.2N$

2. (c) Field produced by loop at the centre will be along the axis of the loop i.e. || to st. wire .

So $F = i(\vec{\ell} \times \vec{B}) = 0$



3. (a)



$\vec{\tau} = \vec{M} \times \vec{B} = 0$

4. (a) If there are N turns in a coil, i is the current flowing and A is the area of the coil then magnetic dipole moment or simply magnetic moment of the coil is

$M = NiA$

5. (a) As revolving charge is equivalent to a current, so

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

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

$I = \frac{qv}{2\pi R}$

Now, magnetic moment associated with charged particle is given by

$\mu = IA = I \times \pi R^2$

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

$= \frac{1}{2} qvR$

6. (a)

7. (a) initialy

$M = m\ell$

For semi circle

$\pi R = \ell$

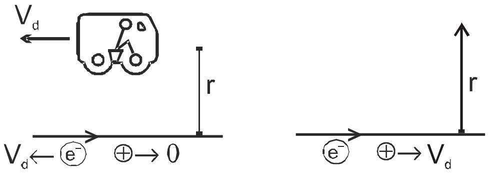
$R = \frac{\ell}{\pi}$

$M' = m(2R)$

$= 2m\frac{\ell}{\pi}$

$M' = \frac{2M}{\pi}$

8. (a)In observer frame of refernece



$B = \frac{\mu_0 i}{2\pi r}$

9. (a)Radius of the circular path is given by

$r = \frac{mV}{Bq} = \frac{\sqrt{2Km}}{Bq}$

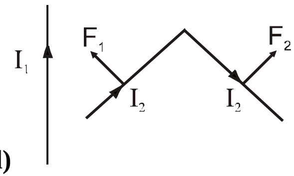
Here K is the kinetic energy to the particle

So, $r \propto \frac{\sqrt{m}}{q}$ if K and B are same

$\therefore \quad r_p ; r_d : r_\alpha = \frac{\sqrt{1}}{1} : \frac{\sqrt{2}}{1} : \frac{\sqrt{4}}{2} = 1 : \sqrt{2} : 1$

Hence $r_\alpha = r_p < r_d$

10. **(d)**

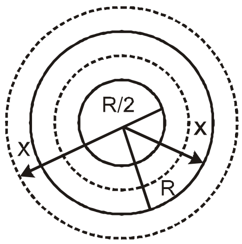


Resulted force will be at on angle with x as well as y axis

11. (a)$B_H \tan\theta = \frac{\mu_0 N i}{2r}$

$i = \frac{0.34 \times 10^{-4} \times 2 \times .2}{4\pi \times 10^{-7} \times 20} = \frac{17}{10\pi}$ Ans. (a)

12. **(d)Case-I** $x < \frac{R}{2}$



$|B| = 0$

Case-II $\frac{R}{2} \le x < R$

$\int \vec{B} . d\vec{\ell} = \mu_0 I$

$|B|\ 2\pi x = \mu_0 \left[\pi x^2 - \pi\left(\frac{R}{2}\right)^2\right] J$

$|B| = \frac{\mu_0 J}{2x}\left(x^2 - \frac{R^2}{4}\right)$

Case-III $x \geq R$

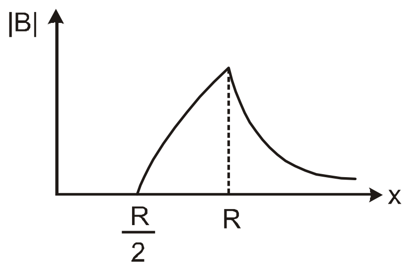
$\int \vec{B}.\, d\vec{\ell} = \mu_0 I$

$|B|\ 2\pi x = \mu_0 \left[\pi R^2 - \pi\left(\frac{R}{2}\right)^2\right] J$

$|B| = \frac{\mu_0 J}{2x}\frac{3}{2} R^2$

$|B| = \frac{3\mu_0 J R^2}{8x}$

so



13. (b)

14. (c)For paramagnetic materials, magnetic suspectibility is inversely proportional to the temperature i.e,, proportional to T^{-1}.

15. (c)In a uniform magnetic field, the torque acts on a magnetic needle but forcedoes not. Therefore $\tau \neq 0$, F = 0

16. (d)Magnetic field at the centre of circular coil of n turns and radius r is

$$B = \frac{\mu_0 ni}{2r}$$

for first coil, $B_1 = \frac{\mu_0 n i_1}{2r_1}$

For second coil, $B_2 = \frac{\mu_0 n i_2}{2r_2}$

Hence, resultant magnetic field at the centre of concentric loop is

$$B = \frac{\mu_0 n i_1}{2r_1} - \frac{\mu_0 n i_2}{2r_2}$$

Given, n = 10, i_1 = 0.2A, r_1 = 20cm = 0.20m,

i_2 = 0.3A, r_2 = 40cm = 0.40m

$\therefore \quad B = \mu_0\left[\frac{10\times 0.2}{2\times 0.20} - \frac{10\times 0.3}{2\times 0.40}\right] = \frac{5}{4}\mu_0$

17. (c)Given, N = 50 turns/cm = 5000 turns/m

I = 4A

Magnetic field at an internal point $= \mu_0 nI$

$= 4\pi \times 10^{-7} \times 5000 \times 4$

$= 8\pi \times 10^{-3}$

$= 25.12 \times 10^{-3}$ Wb/m^2

Magnetic field at one end $= \frac{\mu_0 nI}{2} = \frac{25.12 \times 10^{-3}}{2} = 12.56 \times 10^{-3}$ Wb/m^2

Magnetic field at an internal point $= \mu_0 nI$

18. (d)$T_1 = \frac{1}{f_1} = 2\pi\sqrt{\frac{I}{(M_1 + M_2)B}} = \frac{1}{12}$

$T_2 = \frac{1}{f_2} = 2\pi\sqrt{\frac{I}{(M_1 - M_2)B}} = \frac{1}{4}$

Divinding eq. (a) by eq. (b)

$\frac{M_1}{M_2} = \frac{5}{4}$

19. (c)Area of loop = 20 × 10 = 200 cm^2

$= 2 \times 10^{-2}$ m^2

$\vec{A} = (2\times10^{-2}\text{m}^2)\,\hat{i}$ (as loop is in yz plane).

so. $\vec{\tau} = \vec{M}\times\vec{B}\; i\,(\vec{A}\times\vec{B}) = 1$

$= 12 \times 2 \times 10^{-2}\,(\hat{i}) \times (0.3\hat{i} + 0.4\hat{j})$

$= 12 \times 2 \times 0.4 \times 10^{-2} \times 10^{-2}\,(\hat{k}) = 9.6 \times 10^{-2}\hat{k}$ (Nm)

20. (a)

21. (b)Net force on a current carrying loop is zero in uniform magnetic field

22. (b)Net force on a current carrying loop is zero in uniform magnetic field

23. (b) Since magnetic field is in vertical direction and Needle is free to totate in horizontal plane only so magnitic force can not rotate the needle in horizontal plane so needle can stay in any position.

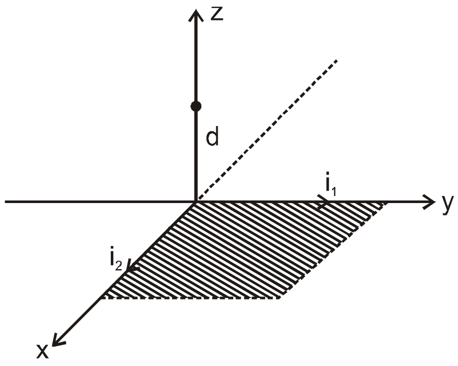
24. (b)$R = \frac{\sqrt{2mK}}{qB}$

$q_\alpha = 2q,\ m_\alpha = 4m$

$R_\alpha = \frac{\sqrt{2(4m)K'}}{2qB}$

$\frac{R}{R_\alpha} = \sqrt{\frac{K}{K'}}$ but $R = R_\alpha$

then $K = K' = 1$ MeV



25. (d)

$\vec{B}$ due to wire (a) $\vec{B}_1 = \left(\frac{\mu_0 i_1}{2\pi d}\right)\hat{i}$

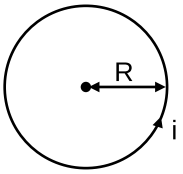
$\vec{B}$ due to wire (b) $\vec{B}_2 = \left(\frac{\mu_0 i_2}{2\pi d}\right)(-\hat{j})$

$|B_{net}| = \frac{\mu_0}{2\pi d}\sqrt{i_1^2 + i_2^2}$

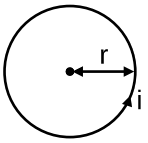
26. (b) $\mu_r = 1 + x$

appropriate is diamagnetic

27. (c)



$B = \frac{\mu_0 i}{2R} = \frac{\mu_0 i(2\pi)}{2(\ell)} = \frac{\mu_0 \pi i}{2\ell}$



$B' = \frac{\mu_0 ni}{2r} = \frac{\mu_0 ni}{2\left(\frac{\ell}{2n\pi}\right)} = \frac{n^2\mu_0 \pi i}{2\ell} = n^2 B$

28. (d)From ampere circuital law

$\oint B.d\ell = \mu_0 I' \quad \Rightarrow I' = \frac{I}{\pi R^2} \times \pi r^2$

$B 2\pi r = \mu_0 \frac{I}{\pi R^2} \times \pi r^2$

$B = \frac{\mu_0 I}{2\pi R^2} r$

$B_{insdie} \propto r$

$B_{outside}$

$\oint B.d\ell = \mu_0 I k$

$B2\pi r = \mu_0 I$

$B = \frac{\mu_0 I}{2\pi r}$

$B \alpha \frac{1}{r}$

29. (b) $r = \frac{mv}{qB} = \frac{p}{qB}$ $\Rightarrow$ $r \alpha \frac{1}{q}$

$\frac{r_n}{r_\alpha} = \frac{q_\alpha}{q_n}$

$= \frac{2}{1}$

$= 2 : 1$

30. (a) $\vec{F} = q[\vec{E} + \vec{v} \times \vec{B}]$

$$= q\left[3\hat{i} + \hat{j} + \hat{k} + \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 3 & 4 & 1 \\ 1 & 1 & -3 \end{vmatrix}\right]$$

$= q\ [3\hat{i} + \hat{j} + 2\hat{k} + \hat{i}) - 12 - 1) - \hat{j}(-9 - 1) + \hat{k}(3 - 4)]$

$= q\ [3\hat{i} + \hat{j} + 2\hat{k} - 13\hat{i} + 10\hat{j} - \hat{k}]$

$= q\ [-10\hat{i} + 11\hat{j} + \hat{k}]$

$= F_y = 11q\,\hat{j}$.