Critical Thinking

Objective Questions

1. A circular current carrying coil has a radius R. The distance from the centre of the coil on the axis where the magnetic induction will be $\frac{1}{8}th$ to its value at the centre of the coil, is **[MP PMT 1997]**

(a) $\frac{R}{\sqrt{3}}$ (b) $R\sqrt{3}$

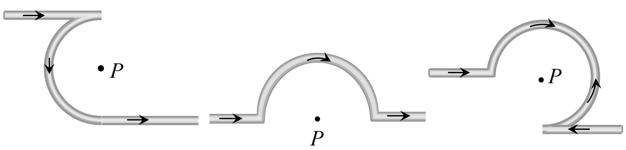
(c) $2\sqrt{3}\,R$ (d) $\frac{2}{\sqrt{3}}R$

2. The field normal to the plane of a wire of n turns and radius r which carries a current i is measured on the axis of the coil at a small distance h from the centre of the coil. This is smaller than the field at the centre by the fraction

(a) $\frac{3}{2}\frac{h^2}{r^2}$ (b) $\frac{2}{3}\frac{h^2}{r^2}$

(c) $\frac{3}{2}\frac{r^2}{h^2}$ (d) $\frac{2}{3}\frac{r^2}{h^2}$

3. The magnetic field at the centre of a circular coil of radius r is π times that due to a long straight wire at a distance r from it, for equal currents. Figure here shows three cases : in all cases the circular part has radius r and straight ones are infinitely long. For same current the B field at the centre P in cases 1, 2, 3 have the ratio **[CPMT 1989]**



(1) (2) (3)

(a) $\left(-\frac{\pi}{2}\right):\left(\frac{\pi}{2}\right):\left(\frac{3\pi}{4}-\frac{1}{2}\right)$

(b) $\left(-\frac{\pi}{2}+1\right):\left(\frac{\pi}{2}+1\right):\left(\frac{3\pi}{4}+\frac{1}{2}\right)$

(c) $-\frac{\pi}{2}:\frac{\pi}{2}:3\frac{\pi}{4}$

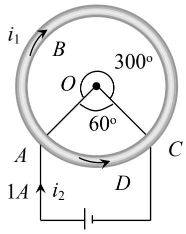
(d) $\left(-\frac{\pi}{2}-1\right):\left(\frac{\pi}{2}-\frac{1}{4}\right):\left(\frac{3\pi}{4}+\frac{1}{2}\right)$

4. Two straight long conductors AOB and COD are perpendicular to each other and carry currents i_1 and i_2. The magnitude of the magnetic induction at a point P at a distance a from the point O in a direction perpendicular to the plane $ACBD$ is **[MP PMT 1994]**

(a) $\frac{\mu_0}{2\pi a}(i_1+i_2)$ (b) $\frac{\mu_0}{2\pi a}(i_1-i_2)$

(c) $\frac{\mu_0}{2\pi a}(i_1^2+i_2^2)^{1/2}$ (d) $\frac{\mu_0}{2\pi a}\frac{i_1 i_2}{(i_1+i_2)}$

5. A cell is connected between the points A and C of a circular conductor $ABCD$ of centre O with angle $AOC = 60^o$. If B_1 and B_2 are the magnitudes of the magnetic fields at O due to the currents in ABC and ADC respectively, the ratio $\frac{B_1}{B_2}$ is



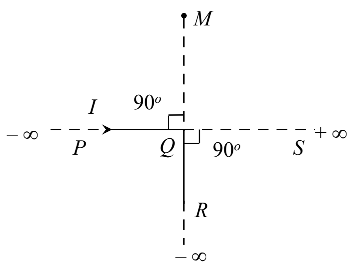
(a) 0.2

(b) 6

(c) 1

(d) 5

6. An infinitely long conductor PQR is bent to form a right angle as shown. A current I flows through PQR The magnetic field due to this current at the point M is H_1. Now another infinitely long straight conductor QS is connected at Q so that the current is $I/2$ in QR as well as in QS, The current in PQ remaining unchanged. The magnetic field at M is now H_2. The ratio H_1/H_2 is given by **[IIT-JEE (Screening) 2000]**



(a) $\frac{1}{2}$

(b) 1

(c) $\frac{2}{3}$

(d) 2

7. Two coaxial solenoids 1 and 2 of the same length are set so that one is inside the other. The number of turns per unit length are n_1 and

n_2. The currents i_1 and i_2 are flowing in opposite directions. The magnetic field inside the inner coil is zero. This is possible when

(a) $i_1 \neq i_2$ and $n_1 = n_2$

(b) $i_1 = i_2$ and $n_1 \neq n_2$

(c) $i_1 = i_2$ and $n_1 = n_2$

(d) $i_1 n_1 = i_2 n_2$

8. A coil having N turns is wound tightly in the form of a spiral with inner and outer radii a and b respectively. When a current I passes through the coil, the magnetic field at the centre is

(a) $\frac{\mu_0 NI}{b}$ (b) $\frac{2\mu_0 NI}{a}$

(c) $\frac{\mu_0 NI}{2(b-a)}\ln\frac{b}{a}$ (d) $\frac{\mu_0 I^N}{2(b-a)}\ln\frac{b}{a}$

9. A non-planar loop of conducting wire carrying a current I is placed as shown in the figure. Each of the straight sections of the loop is of length $2a$. The magnetic field due to this loop at the point P $(a, 0, a)$ points in the direction

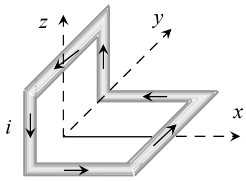
[IIT-JEE (Screening) 2001]

(a) $\frac{1}{\sqrt{2}}(-\hat{j}+\hat{k})$

(b) $\frac{1}{\sqrt{3}}(-\hat{j}+\hat{k}+\hat{i})$

(c) $\frac{1}{\sqrt{3}}(\hat{i}+\hat{j}+\hat{k})$

(d) $\frac{1}{\sqrt{2}}(\hat{i}+\hat{k})$



10. A long straight wire along the z-axis carries a current I in the negative z direction. The magnetic vector field $\vec{B}$ at a point having coordinates (x, y) in the $z = 0$ plane is

[IIT-JEE (Screening) 2002]

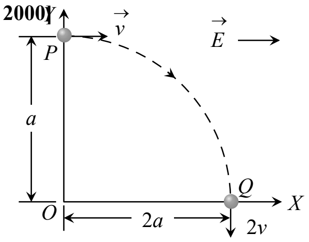
(a) $\frac{\mu_o I(y\hat{i}-x\hat{j})}{2\pi(x^2+y^2)}$ (b) $\frac{\mu_o I(x\hat{i}+y\hat{j})}{2\pi(x^2+y^2)}$

(c) $\frac{\mu_o I(x\hat{j}-y\hat{i})}{2\pi(x^2+y^2)}$ (d) $\frac{\mu_o I(x\hat{i}-y\hat{j})}{2\pi(x^2+y^2)}$

11. A particle of charge $+q$ and mass m moving under the influence of a uniform electric field $E\hat{i}$ and a uniform magnetic field $B\hat{k}$ follows trajectory from P to Q as shown in figure. The velocities at P and Q are $v\hat{i}$ and $-2v\hat{j}$ respectively. Which of the following statement(s) is/are correct

[IIT 1991; BVP 2003]

[Roorkee 2000]



(a) $E = \frac{3}{4}\frac{mv^2}{qa}$

(b) Rate of work done by electric field at P is $\frac{3}{4}\frac{mv^3}{a}$

[IIT-JEE (Screening) 2001]

(c) Rate of work done by electric field at P is zero

(d) Rate of work done by both the fields at Q is zero

12. H^+, He^+ and O^{++} ions having same kinetic energy pass through a region of space filled with uniform magnetic field B directed perpendicular to the velocity of ions. The masses of the ions H^+, He^+ and O^{++} are respectively in the ratio $1:4:16$. As a result

(a) H^+ ions will be deflected most

(b) O^{++} ions will be deflected least

(c) He^+ and O^{++} ions will suffer same deflection

(d) All ions will suffer the same deflection

13. An ionized gas contains both positive and negative ions. If it is subjected simultaneously to an electric field along the $+x$ direction and a magnetic field along the $+z$ direction, then

[IIT-JEE (Screening) 2000]

(a) Positive ions deflect towards $+y$ direction and negative ions towards $-y$ direction

(b) All ions deflect towards $+y$ direction

(c) All ions deflect towards $-y$ direction

(d) Positive ions deflect towards $-y$ direction and negative ions towards $+y$ direction

14. An electron moves with speed 2×10^5 *m/s* along the positive x-direction in the presence of a magnetic induction $B = \hat{i}+4\hat{j}-3\hat{k}$ (in *Tesla*.) The magnitude of the force experienced by the electron in Newton's is (charge on the electron $= 1.6 \times 10^{-19}\, C$) **[EAMCET 2001]**

(a) 1.18×10^{-13} (b) 1.28×10^{-13}

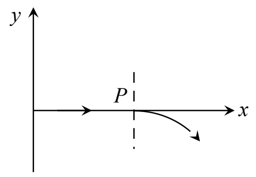
(c) 1.6×10^{-13} (d) 1.72×10^{-13}

15. A particle of mass *m* and charge *q* moves with a constant velocity *v* along the positive *x* direction. It enters a region containing a uniform magnetic field *B* directed along the negative *z* direction, extending from $x = a$ to $x = b$. The minimum value of *v* required so that the particle can just enter the region $x > b$ is **[IIT-JEE (Screening) 2002]**

(a) qbB/m (b) $q(b-a)B/m$

(c) qaB/m (d) $q(b+a)B/2m$

16. For a positively charged particle moving in a *x*-*y* plane initially along the *x*-axis, there is a sudden change in its path due to the presence of electric and/or magnetic fields beyond P. The curved path is shown in the *x*-*y* plane and is found to be non-circular. Which one of the following combinations is possible **[IIT-JEE (Screening) 2003]**



(a) $\vec{E} = 0; \vec{B} = b\hat{i} + c\hat{k}$ (b) $\vec{E} = a\hat{i}; \vec{B} = c\hat{k} + a\hat{i}$

(c) $\vec{E} = 0; \vec{B} = c\hat{j} + b\hat{k}$ (d) $\vec{E} = a\hat{i}; \vec{B} = c\hat{k} + b\hat{j}$

17. A horizontal rod of mass 10 *gm* and length 10 *cm* is placed on a smooth plane inclined at an angle of $60°$ with the horizontal, with the length of the rod parallel to the edge of the inclined plane. A uniform magnetic field of induction *B* is applied vertically downwards. If the current through the rod is 1.73 *ampere*, then the value of *B* for which the rod remains stationary on the inclined plane is

(a) 1.73 *Tesla* (b) $\frac{1}{1.73}$ *Tesla*

(c) 1 *Tesla* (d) None of the above

18. Two long wires are hanging freely. They are joined first in parallel and then in series and then are connected with a battery. In both cases, which type of force acts between the two wires **[MP PET 1993]**

(a) Attraction force when in parallel and repulsion force when in series

(b) Repulsion force when in parallel and attraction force when in series

(c) Repulsion force in both cases

(d) Attraction force in both cases

19. A wire of length *L metre* carrying a current of *I ampere* is bent in the form of a circle. Its magnitude of magnetic moment will be **[MP PET 1995; MH CET 2004]**

(a) $\frac{IL}{4\pi}$ (b) $\frac{IL^2}{4\pi}$

(c) $\frac{I^2L^2}{4\pi}$ (d) $\frac{I^2L}{4\pi}$

20. A thin circular wire carrying a current *I* has a magnetic moment *M*. The shape of the wire is changed to a square and it carries the same current. It will have a magnetic moment **[MP PET 2003; MP PMT 2004]**

(a) *M* (b) $\frac{4}{\pi^2}M$

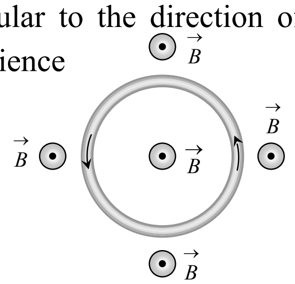
(c) $\frac{4}{\pi}M$ (d) $\frac{\pi}{4}M$

21. A particle of charge *q* and mass *m* moves in a circular orbit of radius *r* with angular speed ω. The ratio of the magnitude of its magnetic moment to that of its angular momentum depends on **[IIT-JEE (Screening) 2000]**

(a) ω and q (b) ω q and m

(c) q and m (d) ω and m

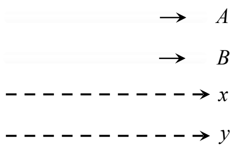
22. An elastic circular wire of length *l* carries a current *I*. It is placed in a uniform magnetic field $\vec{B}$ (Out of paper) such that its plane is perpendicular to the direction of $\vec{B}$. The wire will experience **[MP PET 2000]**



(a) No force (b) A stretching force

(c) A compressive force (d) A torque

23. A and B are two conductors carrying a current i in the same direction. x and y are two electron beams moving in the same direction [Karnataka CET (Engg./Med.) ...]



(a) There will be repulsion between A and B attraction between x and y
(b) There will be attraction between A and B, repulsion between x and y
(c) There will be repulsion between A and B and also x and y
(d) There will be attraction between A and B and also x and y

24. Wires 1 and 2 carrying currents i_1 and i_2 respectively are inclined at an angle θ to each other. What is the force on a small element dl of wire 2 at a distance of r from wire 1 (as shown in figure) due to the magnetic field of wire1

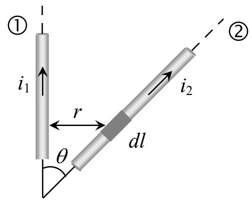
[AIEEE 2002]

(a) $\frac{\mu_0}{2\pi r} i_1 i_2\, dl \tan\theta$

(b) $\frac{\mu_0}{2\pi r} i_1 i_2\, dl \sin\theta$

(c) $\frac{\mu_0}{2\pi r} i_1 i_2\, dl \cos\theta$

(d) $\frac{\mu_0}{4\pi r} i_1 i_2\, dl \sin\theta$



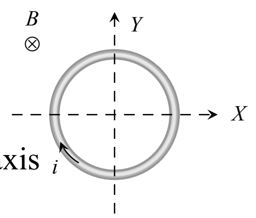
25. A conducting loop carrying a current I is placed in a uniform magnetic field pointing into the plane of the paper as shown. The loop will have a tendency to

[IIT-JEE (Screening) 2003]

(a) Contract

(b) Expand

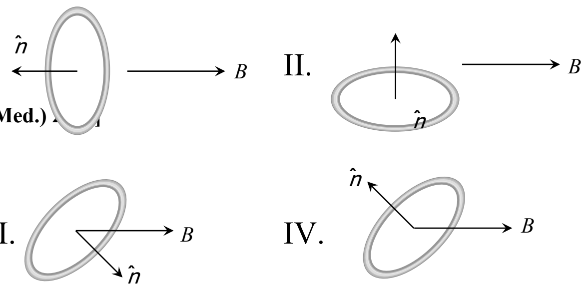
(c) Move towards +*ve* x -axis



(d) Move towards –*ve* x-axis

26. A current carrying loop is placed in a uniform magnetic field in four different orientations, I,II, III & IV arrange them in the decreasing order of potential Energy

[IIT-JEE (Screening) 2003]

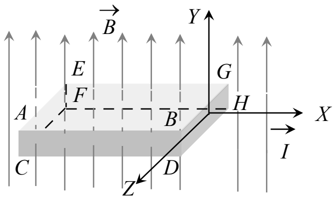


(a) I > III > II > IV (b) I > II >III > IV
(c) I > IV > II > III (d) III > IV > I > II

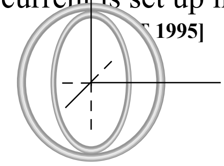
27. A metallic block carrying current I is subjected to a uniform magnetic induction $\vec{B}$ as shown in the figure. The moving charges experience a force $\vec{F}$ given by .... which results in the lowering of the potential of the face .... Assume the speed of the carriers to be v

[IIT 1996]

(a) $eVB\hat{k}$, $ABCD$
(b) $eVB\hat{k}$, $EFGH$
(c) $-eVB\hat{k}$, $ABCD$
(d) $-eVB\hat{k}$, $EFGH$



28. Two insulated rings, one of slightly smaller diameter than the other are suspended along their common diameter as shown. Initially the planes of the rings are mutually perpendicular. When a steady current is set up in each of them [IIT 1995]



(a) The two rings rotate into a common plane
(b) The inner ring oscillates about its initial position

(c) The inner ring stays stationary while the outer one moves into the plane of the inner ring

(d) The outer ring stays stationary while the inner one moves into the plane of the outer ring

29. Two particles each of mass m and charge q are attached to the two ends of a light rigid rod of length $2R$. The rod is rotated at constant angular speed about a perpendicular axis passing through its centre. The ratio of the magnitudes of the magnetic moment of the system and its angular momentum about the centre of the rod is **[IIT 1998]**

(a) $\frac{q}{2m}$ (b) $\frac{q}{m}$

(c) $\frac{2q}{m}$ (d) $\frac{q}{\pi m}$

30. Two very long, straight and parallel wires carry steady currents I and I respectively. The distance between the wires is d. At a certain instant of time, a point charge q is at a point equidistant from the two wires in the plane of the wires. Its instantaneous velocity v is perpendicular to this plane. The magnitude of the force due to the magnetic field acting on the charge at this instant is **[IIT 1998]**

(a) $\frac{\mu_0 Iqv}{2\pi d}$ (b) $\frac{\mu_0 Iqv}{\pi d}$

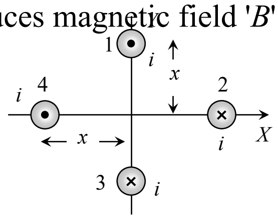
(c) $\frac{2\mu_0 Iqv}{\pi d}$ (d) 0

31. A ring of radius R, made of an insulating material carries a charge Q uniformly distributed on it. If the ring rotates about the axis passing through its centre and normal to plane of the ring with constant angular speed ω, then the magnitude of the magnetic moment of the ring is **[MP PET 2001]**

(a) $Q\omega R^2$ (b) $\frac{1}{2}Q\omega R^2$

(c) $Q\omega^2 R$ (d) $\frac{1}{2}Q\omega^2 R$

32. What will be the resultant magnetic field at origin due to four infinite length wires. If each wire produces magnetic field 'B' at origin



(a) $4B$ (b) $\sqrt{2}B$

(c) $2\sqrt{2}B$ (d) Zero

33. The ratio of the magnetic field at the centre of a current carrying circular wire and the magnetic field at the centre of a square coil made from the same length of wire will be

(a) $\frac{\pi^2}{4\sqrt{2}}$ (b) $\frac{\pi^2}{8\sqrt{2}}$

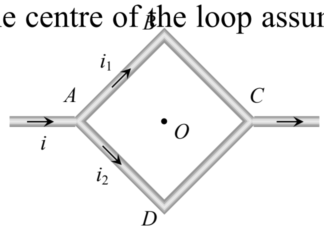
(c) $\frac{\pi}{2\sqrt{2}}$ (d) $\frac{\pi}{4\sqrt{2}}$

34. Two infinite length wires carries currents $8A$ and $6A$ respectively and placed along X and Y-axis. Magnetic field at a point $P(0, 0, d)m$ will be

(a) $\frac{7\mu_0}{\pi d}$ (b) $\frac{10\mu_0}{\pi d}$

(c) $\frac{14\mu_0}{\pi d}$ (d) $\frac{5\mu_0}{\pi d}$

35. Figure shows a square loop $ABCD$ with edge length a. The resistance of the wire ABC is r and that of ADC is $2r$. The value of magnetic field at the centre of the loop assuming uniform wire is



(a) $\frac{\sqrt{2}\mu_0 i}{3\pi a}\odot$ (b) $\frac{\sqrt{2}\mu_0 i}{3\pi a}\otimes$

(c) $\frac{\sqrt{2}\mu_0 i}{\pi a}\odot$ (d) $\frac{\sqrt{2}\mu_0 i}{\pi a}\otimes$

36. Figure shows the cross-sectional view of the hollow cylindrical conductor with inner radius 'R' and outer radius '$2R$', cylinder carrying uniformly distributed current along it's axis.

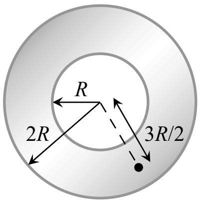
The magnetic induction at point 'P' at a distance $\frac{3R}{2}$ from the axis of the cylinder will be

(a) Zero

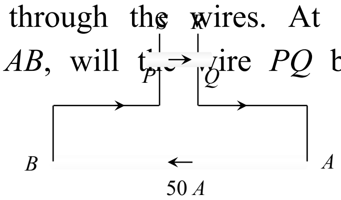
(b) $\frac{5\mu_0 i}{72\pi R}$

(c) $\frac{7\mu_0 i}{18\pi R}$

(d) $\frac{5\mu_0 i}{36\pi R}$



37. A long wire AB is placed on a table. Another wire PQ of mass 1.0 g and length 50 cm is set to slide on two rails PS and QR. A current of 50A is passed through the wires. At what distance above AB, will the wire PQ be in equilibrium



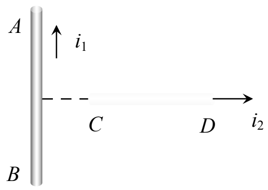
(a) 25 mm

(b) 50 mm

(c) 75 mm

(d) 100 mm

38. An infinitely long, straight conductor AB is fixed and a current is passed through it. Another movable straight wire CD of finite length and carrying current is held perpendicular to it and released. Neglect weight of the wire



(a) The rod CD will move upwards parallel to itself

(b) The rod CD will move downward parallel to itself

(c) The rod CD will move upward and turn clockwise at the same time

(d) The rod CD will move upward and turn anti – clockwise at the same time

39. A steady current i flows in a small square loop of wire of side L in a horizontal plane. The loop is now folded about its middle such that half of it lies in a vertical plane. Let $\vec{\mu_1}$ and $\vec{\mu_2}$ respectively denote the magnetic moments due to the current loop before and after folding. Then

[IIT-JEE 1993]

(a) $\vec{\mu_2} = 0$

(b) $\vec{\mu_1}$ and $\vec{\mu_2}$ are in the same direction

(c) $\frac{|\vec{\mu_1}|}{|\vec{\mu_2}|} = \sqrt{2}$

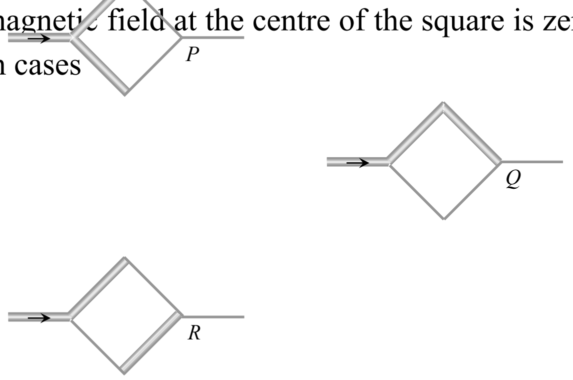
(d) $\frac{|\vec{\mu_1}|}{|\vec{\mu_2}|} = \left(\frac{1}{\sqrt{2}}\right)$

40. A current i is flowing in a straight conductor of length L. The magnetic induction at a point distant $\frac{L}{4}$ from its centre will be

(a) $\frac{4\mu_0 i}{\sqrt{5}\pi L}$ (b) $\frac{\mu_0 i}{2\pi L}$

(c) $\frac{\mu_0 i}{\sqrt{2}L}$ (d) Zero

41. Two thick wires and two thin wires, all of the same materials and same length form a square in the three different ways P, Q and R as shown in fig with current connection shown, the magnetic field at the centre of the square is zero in cases

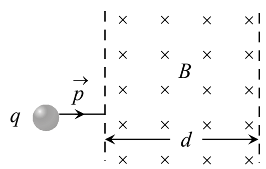


(a) In P only (b) In P and Q only

(c) In Q and R only (d) P and R only

42. A particle with charge q, moving with a momentum p, enters a uniform magnetic field normally. The magnetic field has magnitude B and is confined to a region of width d, where $d < \frac{p}{Bq}$, The particle is deflected by an angle θ in crossing the field

(a) $\sin\theta = \frac{Bqd}{p}$

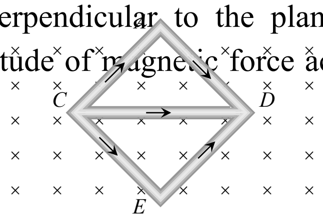


(b) $\sin\theta = \frac{p}{Bqd}$

(c) $\sin\theta = \frac{Bp}{qd}$

(d) $\sin\theta = \frac{pd}{Bq}$

43. Same current $i = 2A$ is flowing in a wire frame as shown in figure. The frame is a combination of two equilateral triangles ACD and CDE of side $1m$. It is placed in uniform magnetic field $B = 4T$ acting perpendicular to the plane of frame. The magnitude of magnetic force acting on the frame is



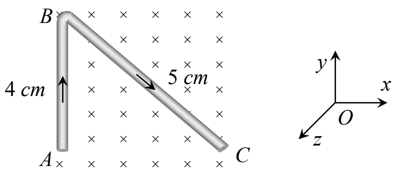
(a) 24 N

(b) Zero

(c) 16 N

(d) 8 N

44. A uniform conducting wire ABC has a mass of $10g$. A current of $2A$ flows through it. The wire is kept in a uniform magnetic field $B = 2T$. The acceleration of the wire will be



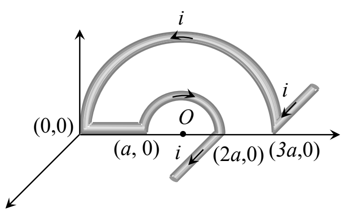
(a) Zero

(b) $12\,ms^{-2}$ along y-axis

(c) $1.2\times10^{-3}\,ms^{-2}$ along y-axis

(d) $0.6\times10^{-3}\,ms^{-2}$ along y- axis

45. In the given figure net magnetic field at O will be



(a) $\frac{2\mu_0 i}{3\pi a}\sqrt{4-\pi^2}$

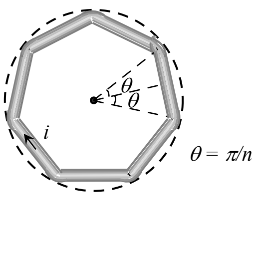
(b) $\frac{\mu_0 i}{3\pi a}\sqrt{4+\pi^2}$

(c) $\frac{2\mu_0 i}{3\pi a^2}\sqrt{4+\pi^2}$

(d) $\frac{2\mu_0 i}{3\pi a}\sqrt{(4-\pi^2)}$

46. In the following figure a wire bent in the form of a regular polygon of n sides is inscribed in a circle of radius a. Net magnetic field at centre will be

(a) $\frac{\mu_0 i}{2\pi a}\tan\frac{\pi}{n}$

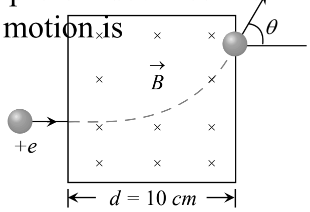


(b) $\frac{\mu_0 n i}{2\pi a}\tan\frac{\pi}{n}$

(c) $\frac{2}{\pi}\frac{ni}{a}\mu_0\tan\frac{\pi}{n}$

(d) $\frac{ni}{2a}\mu_0\tan\frac{\pi}{n}$

47. A proton accelerated by a potential difference $500\,KV$ moves though a transverse magnetic field of $0.51\,T$ as shown in figure. The angle θ through which the proton deviates from the initial direction of its motion is



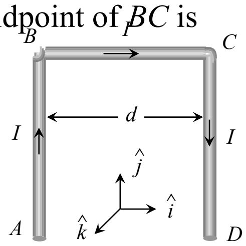
(a) 15^o

(b) 30^o

(c) 45^o

(d) 60^o

48. AB and CD are long straight conductor, distance d apart, carrying a current I. The magnetic field at the midpoint of BC is



(a) $\frac{-\mu_0 I}{2\pi d}\hat{k}$

(b) $\frac{-\mu_0 I}{\pi d}\hat{k}$

(c) $\frac{-\mu_0 I}{4\pi d}\hat{k}$

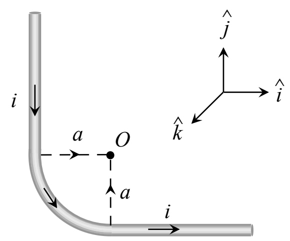
(d) $\frac{-\mu_0 I}{8\pi d}\hat{k}$

49. An electron is moving along the positive X-axis. You want to apply a magnetic field for a short time so that the electron may reverse its direction and move parallel to the negative X-axis. This can be done by applying the magnetic field along

(a) Y-axis (b) X-axis

(c) Y-axis only (d) None of these

50. The unit vectors $\hat{i}, \hat{j}$ and $\hat{k}$ are as shown below. What will be the magnetic field at O in the following figure



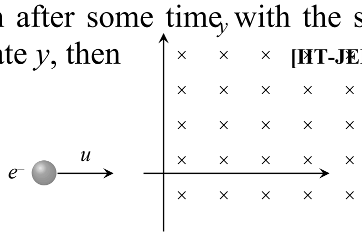
(a) $\frac{\mu_0}{4\pi}\frac{i}{a}\left(2-\frac{\pi}{2}\right)\hat{j}$

(b) $\frac{\mu_0}{4\pi}\frac{i}{a}\left(2+\frac{\pi}{2}\right)\hat{j}$

(c) $\frac{\mu_0}{4\pi}\frac{i}{a}\left(2+\frac{\pi}{2}\right)\hat{i}$

(d) $\frac{\mu_0}{4\pi}\frac{i}{a}\left(2+\frac{\pi}{2}\right)\hat{k}$

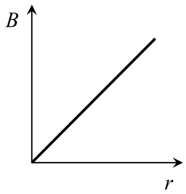
51. An electron moving with a speed u along the positive x-axis at $y = 0$ enters a region of uniform magnetic field $\vec{B} = -B_0\hat{k}$ which exists to the right of y-axis. The electron exits from the region after some time with the speed v at co-ordinate y, then **[IIT-JEE (Screening 2004)]**

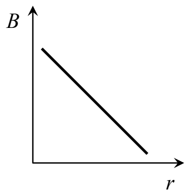


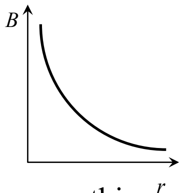
(a) $v > u, y < 0$ (b) $v = u, y > 0$
(c) $v > u, y > 0$ (d) $v = u, y < 0$

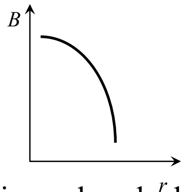
Graphical Questions

1. Which of the following graphs shows the variation of magnetic induction B with distance r from a long wire carrying current **[NCERT 1984; MNR 1998; MP PMT 1999]**

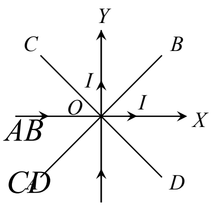
(a)


(b)


(c)


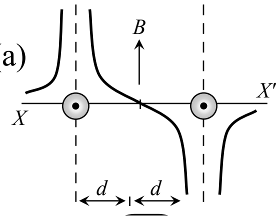
(d)


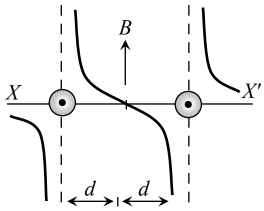
2. Two very thin metallic wires placed along X and Y-axis carry equal currents as shown here. AB and CD are lines at $45°$ with the axes with origin of axes at O. The magnetic field will be zero on the line **[MP PMT 1995; CBSE PMT 1996]**

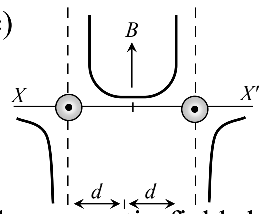


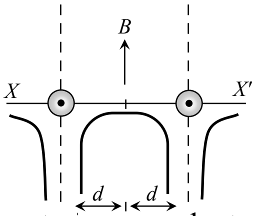
(a) AB
(b) CD
(c) Segment OB only of line AB
(d) Segment OC only of line CD

3. Two long parallel wires are at a distance $2d$ apart. They carry steady equal currents flowing out of the plane of the paper, as shown. The variation of the magnetic field B along the line XX' is given by **[IIT-JEE (Screening) 2000]**

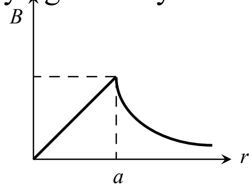
(a)


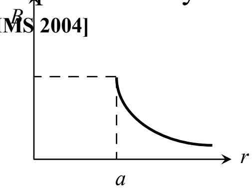
(b)


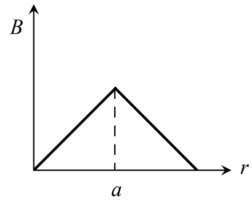
(c)


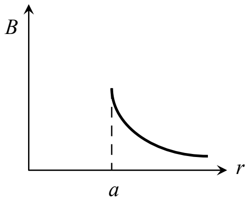
(d)


4. The magnetic field due to a strai… ductor of uniform cross section of radius a and carrying a steady current is represented by **[AIIMS 2004]**

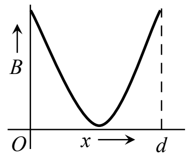
(a)


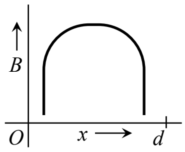
(b)


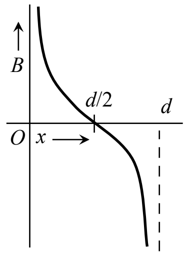
(c)


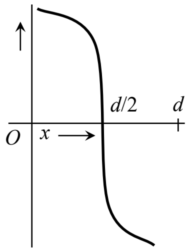
(d)


5. Two parallel beams of protons and electrons, carrying equal currents are fixed at a separation d. The protons and electrons move in opposite directions. P is a point on a line joining the beams, at a distance x from any one beam. The magnetic field at P is B. If B is plotted against x, which of the following best represents the resulting curve

(a)


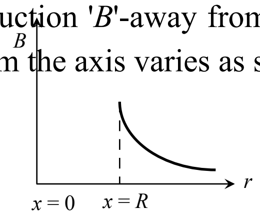
(b)


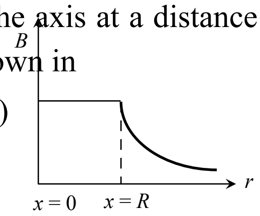
(c)


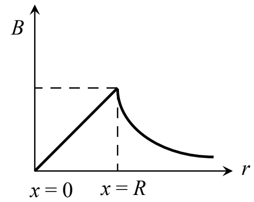
(d)


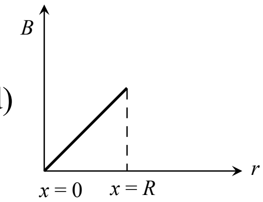
(c) (d)

6. A long thin hollow metallic cylinder of radius 'R' has a current i *ampere*. The magnetic induction 'B'-away from the axis at a distance r from the axis varies as shown in

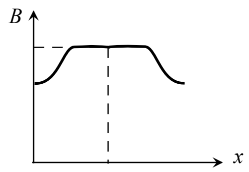
(a) 

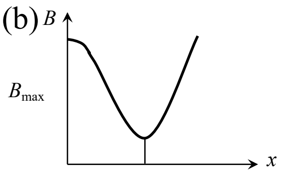
(b) 

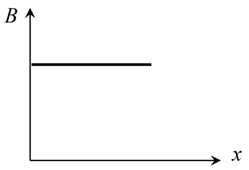
(c) 

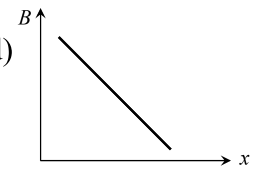
(d) 

7. The correct curve between the magnetic induction (B) along the axis of a long solenoid due to current flow i in it and distance x from one end is

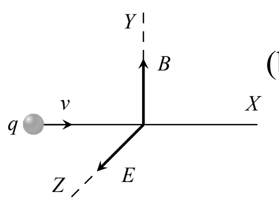
(a) 

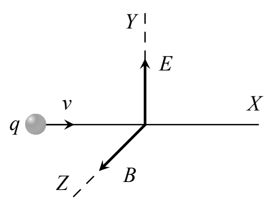
(b) 

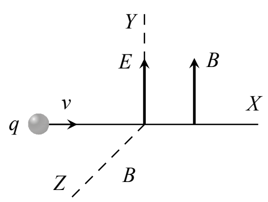
(c) 

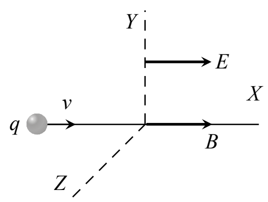
(d) 

8. A particle of charge q and mass m is moving along the x-axis with a velocity v and enters a region of electric field E and magnetic field B as shown in figure below for which figure the net force on the charge may be zero

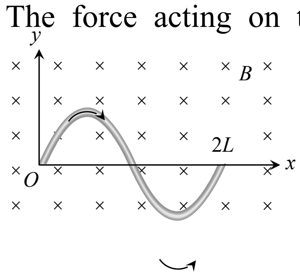
(a) 

(b) 





9. A wire carrying a current i is placed in a uniform magnetic field in the form of the curve $y = a\sin\left(\frac{\pi x}{L}\right) 0 \le x \le 2L$. The force acting on the wire is



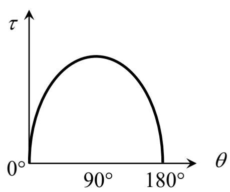
(a) $\frac{iBL}{\pi}$

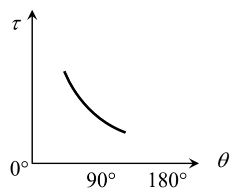
(b) $iBL\pi$

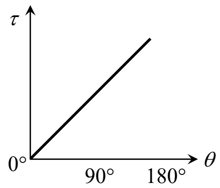
(c) $2iBL$

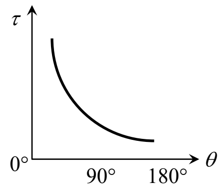
(d) Zero

10. The ($\tau - \theta$) graph for a coil is

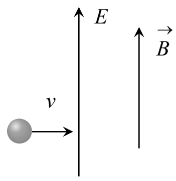
(a) 

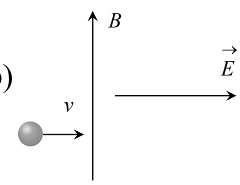
(b) 

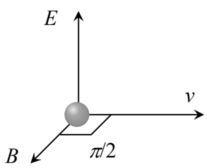
(c) 

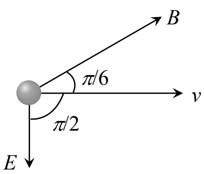
(d) 

11. A uniform magnetic field B and a uniform electric field E act in a common region. An electron is entering this region of space. The correct arrangement for it to escape undeviated is

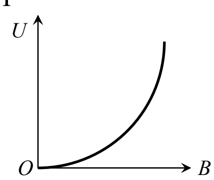
(a) 

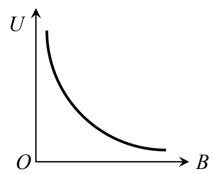
(b) 

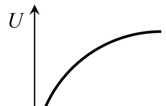
(c) 

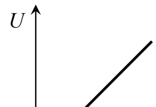
(d) 

12. If induction of magnetic field at a point is B and energy density is U then which of the following graphs is correct

(a) 

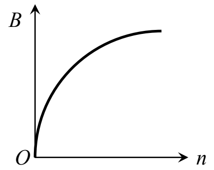
(b) 

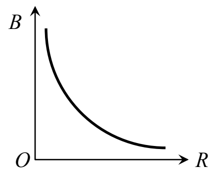


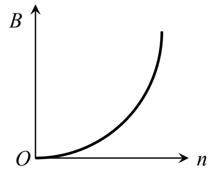


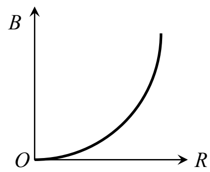
(c) (d) (c) (d)

13. A thin wire of length l is carrying a constant current. The wire is bent to form a circular coil. If radius of the coil, thus formed, is equal to R and number of turns in it is equal to n, then which of the following graphs represent (s) variation of magnetic field induction (B) at centre of the coil

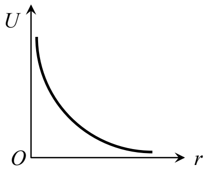
(a) 

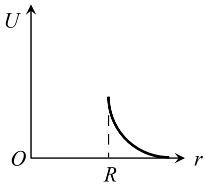
(b) 

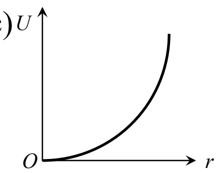
(c) 

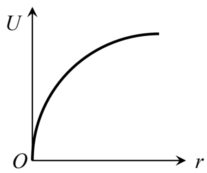
(d) 

14. A current is flowing through a thin cylindrical shell of radius R. If energy density in the medium, due to magnetic field, at a distance r from axis of the shell is equal to U then which of the following graphs is correct

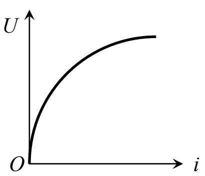
(a) 

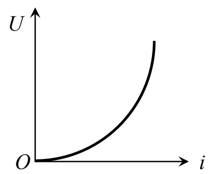
(b) 

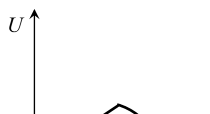
(c) 

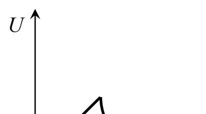
(d) 

15. If current flowing through shell of previous objective is equal to i, then energy density at a point distance $2R$ from axis of the shell varies according to the graph

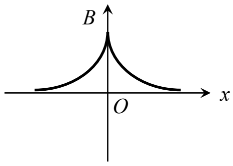
(a) 

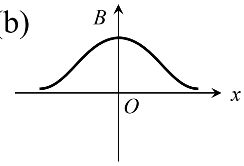
(b) 

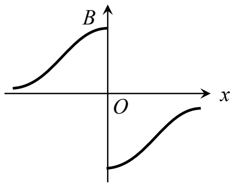


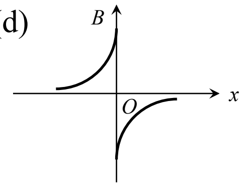


16. A circular coil is in y-z plane with centre at origin. The coil is carrying a constant current. Assuming direction of magnetic field at $x = -25\ cm$ to be positive direction of magnetic field, which of the following graphs shows variation of magnetic field along x-axis

(a) 

(b) 

(c) 

(d) 

AR Assertion & Reason

For AIIMS Aspirants

Read the assertion and reason carefully to mark the correct option out of the options given below:

(a) If both assertion and reason are true and the reason is the correct explanation of the assertion.

(b) If both assertion and reason are true but reason is not the correct explanation of the assertion.

(c) If assertion is true but reason is false.

(d) If the assertion and reason both are false.

(e) If assertion is false but reason is true.

1. Assertion : Cyclotron does not accelerate electron.

Reason : Mass of the electron is very small.

[AIIMS 2000]

2. Assertion : Cyclotron is a device which is used to accelerate the positive ion.
Reason : Cyclotron frequency depends upon the velocity. [AIIMS 1997]

3. Assertion : Magnetic field interacts with a moving charge and not with a stationary charge.
Reason : A moving charge produces a magnetic field.

4. Assertion : If an electron is not deflected while passing through a certain region of space, then only possibility is that there is no magnetic region.
Reason : Force is directly proportional to the magnetic field applied.

5. Assertion : Free electron always keep on moving in a conductor even then no magnetic force act on them in magnetic field unless a current is passed through it.
Reason : The average velocity of free electron is zero.

6. Assertion : The ion cannot move with a speed beyond a certain limit in a cyclotron.
Reason : As velocity increases time taken by ion increases.

7. Assertion : The coil is bound over the metallic frame in moving coil galvanometer.
Reason : The metallic frame help in making steady deflection without any oscillation.

8. Assertion : A circular loop carrying current lies in XY plane with its center at origin having a magnetic flux in negative Z-axis.
Reason : Magnetic flux direction is independent of the direction of current in the conductor.

9. Assertion : The energy of charged particle moving in a uniform magnetic field does not change.
Reason : Work done by magnetic field on the charge is zero.

10. Assertion : If an electron, while coming vertically from outerspace, enter the earth's magnetic field, it is deflected towards west.
Reason : Electron has negative charge.

11. Assertion : A direct current flows through a metallic rod, produced magnetic field only outside the rod.
Reason : There is no flow of charge carriers inside the rod.

12. Assertion : An electron and proton enters a magnetic field with equal velocities, then, the force experienced by the proton will be more than electron.
Reason : The mass of proton is 1837 times more than electron.

13. Assertion : Torque on the coil is the maximum, when coil is suspended in a radial magnetic field.
Reason : The torque tends to rotate the coil on its own axis.

14. Assertion : A loosely round helix made of stiff wire is suspended vertically with the lower end just touching a dish of mercury. When a current is passed through the wire, the helical wire executes oscillatory motion with the lower end jumping out of and inside of mercury.
Reason : When electric current is passed through helix, a magnetic field is produced both inside and outside the helix.

15. Assertion : The magnetic filed at the ends of a very long current carrying solenoid is half of that at the center.
Reason : If the solenoid is sufficiently long, the field within it is uniform.

16. Assertion : If a charged particle is moving on a circular path in a perpendicular magnetic field, the momentum of the particle is not changing,.
Reason : Velocity of the particle in not changing in the magnetic field.

17. Assertion : If a proton and an α-particle enter a uniform magnetic field perpendicularly, with the same speed, then the time period of revolution of the α-particle is double than that of proton.

Reason : In a magnetic field, the time period of revolution of a charged particle is directly proportional to mass.

18. Assertion : If two long wires, hanging freely are connected to a battery in series, they come closer to each other.

Reason : Force of attraction acts between the two wires carrying current.

19. Assertion : A current I flows along the length of an infinitely long straight and thin walled pipe. Then the magnetic field at any point inside the pipe is zero.

Reason : $\oint \vec{B}.d\vec{l} = \mu_o I$