PHYSICS

BOOKS - CP SINGH PHYSICS (HINGLISH)

MAGNETIC FORCE, MOMENT AND TORQUE

Example

1. (a) A particle of mass $1mg$ and having charges $1\mu C$ is moving in a magnetic field $\vec{B} = 2\hat{i} + 3\hat{j} + kT$, with velocity $\vec{v} = 2\hat{i} + \hat{j} - \hat{k}m/\text{sec}$. Find magnetic force in vector form and magnitude of acceleration.

(b) A magnetic field of $8\hat{k}T$ exerts a force $8\hat{i} + 6\hat{j}N$ on a particle having a charge $2C$ and going in $x - y$ plane. Find the velocity of the particle.

(c) A particle is moving in a magnetic field $3\hat{i} + 4\hat{j}T$ and acceleration of particle is $\lambda\hat{i} + 3\hat{j}m/\sec^2$. Find the value of λ.

(d) When a proton has a velocity $bec(v) = \left(2\hat{i} + 3\hat{j}\right) \times 10^6 m/\sec$ it experiences a force $\overrightarrow{F} = \left(-1.28 \times 10^{-13}\overrightarrow{k}\right)N$. When its velocity is along the z-axis, it experiences a force along the x-axis. What is the magnetic field ?

(e) A circular loop of radius $20cm$ carries a current of $10A$. An electron cross the plane of the loop with a speed of $2.0 \times 10^6 m/\sec$. The direction of motion makes an angle centre. Find the magnitude of the magnetic force on the electron at the instant it crosses the plane.

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2. (a) A particle having a charge of $10\mu C$ and a mass $20mg$ is projected with a speed $2km/\sec$ in a region having a uniform magnetic field of $1kT$. Find the radius of the circle formed by the particle and also time period.

(b) A proton, deuteron and α-particle enter a region of constant magnetic field perpendicularly. If r_p, r_d and r_α denote respectively the radii of the trajectories of these particles, then find ratio $r_p : r_d : r_\alpha$ if they enter with same (i) speed, (ii) linear momentum, (iii) kinetic energies.

(c) A charged particle is accelerated through a potential difference V_0 and acquires a speed of v. It is then injected perpendicular into a magnetic field B. Find the radius of the circle described by it.

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3. A beam of charged particle, having kinetic energy $10^3 eV$, contains masses $8 \times 10^{-27} kg$ and $1.6 \times 10^{-26} kg$ emerge from the end of an accelerator tube. There is a plate at distance $10^2 m$ from the end of the tube and placed perpendicular to the beam. Calculate the magnitude of the smallest magnetic field which can prevent the beam from striking the plate.

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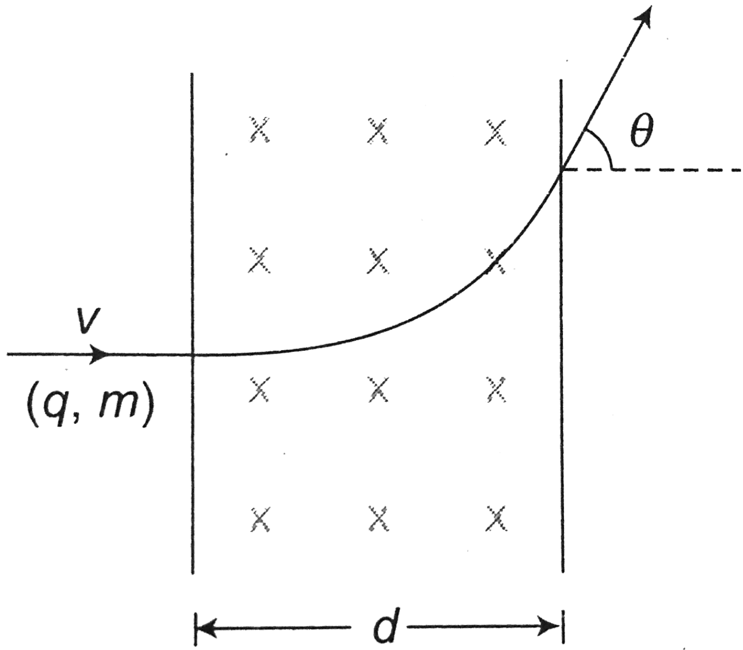
4. A charged particle (q, m) enters perpendicular in a uniform magnetic field B and comes out field as shown. The angle of deviation θ time taken by particle to cross magnetic field will be



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5. (a) A charged particle having mass m and charge q is accelerated by a potential difference V, it flies through a uniform transverse magnetic field B. The field occupies a region of space d. Find the time interval for which it remains inside the magnetic field.

(b) An α-particle is acceleration by a potential difference of $10^4 V$. Find the change in its direction of motion if it enters normally in a region of thickness $0.1m$ having transverse magnetic induction of $0.1T$.

$(m_\alpha = 6.4 \times 10^{-27} kg)$.

(c) A $10g$ bullet having a charge of $4\mu C$ is fired at speed of $270m/\sec$ in a horizontal direction. A vertical magnetic field of $500\mu T$ exists in the space. Find the deflection of the bullet due to the magnetic field as it travels through $100m$. Make appropriate approximations.

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6. A particle of mass m and charge q is projected into a region having a perpendicular magnetic, field B. Find the angle of deviation of the particle as it comes out of the magnetic field if th„ width of the region is (b)

(a) $\frac{2mv}{Bq}(b)$(mv)/(Bq)(c)(mv)/(2 Bq)`

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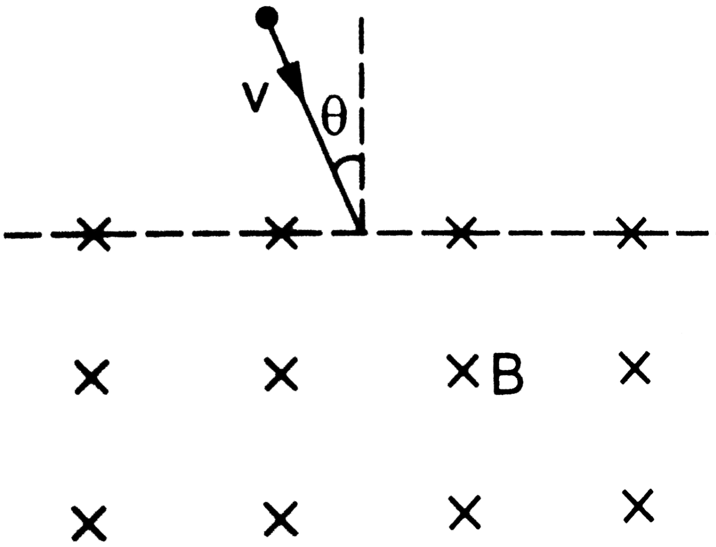
7. A particle of mass m and positive charge q, moving with a uniform velocity v, enters a magnetic field B as shown in Find The radius of the circular are it describes in the magnetic field. (b) find the angle subtended by the arc at the centre. (c) How long does the particule stay inside the magnetic field? (d) Solve the three parts of the above problem if the charge q on the particle is negative.



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8. The region between $x = o$ and $x = L$ is filled with uniform, steady magnetic field $B_0\hat{k}$. A particle of mass m , positive charge q and velocity $v_0\hat{i}$ travels along $x - a\xi s$ and enters the region of the magnetic field. Neglect gravity throughout the question .

(a) Find the value of L if the particle emerges from the region of magnetic field with its final velocity at angle 30° to its initial velocity.

(b) Find the velocity of the particle and the time spent by it in the magnetic field, if the magnetic field now extends upto $2.1L$.

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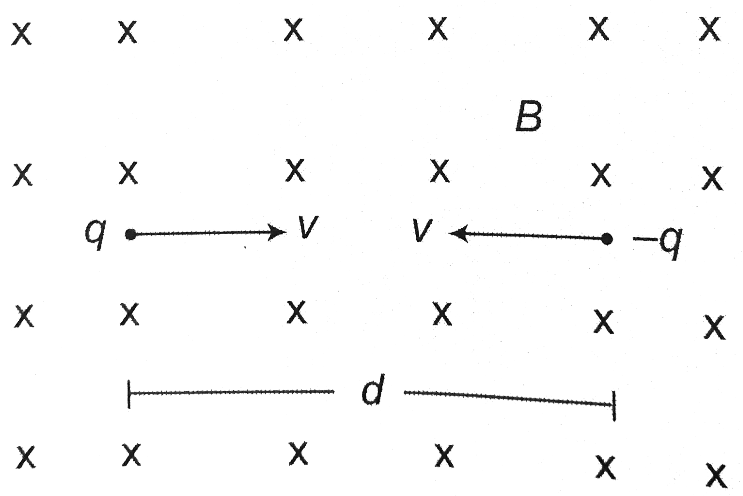
9. Two particles, each having a mass m are placed at a separation d in a uniform magnetic field B as shown in the figure. They have opposite charges of equal magnitude q. At time $t = 0$, the particles are projected towards each other, each with a speed v. Suppose the Coulomb force between the charges is switched off. (a) Find the maximum value v_m of the projection speed so that the two particles do not collide. (b) What would be the minimum and maximum separation between the particles if $v = v_m/2$? (c) At what instant will a collision occur between the particles if $v = 2v_m$? (d) Suppose $v = 2v_m$ and the collision between the particles is completely inelastic. Describe the motion after the collision.



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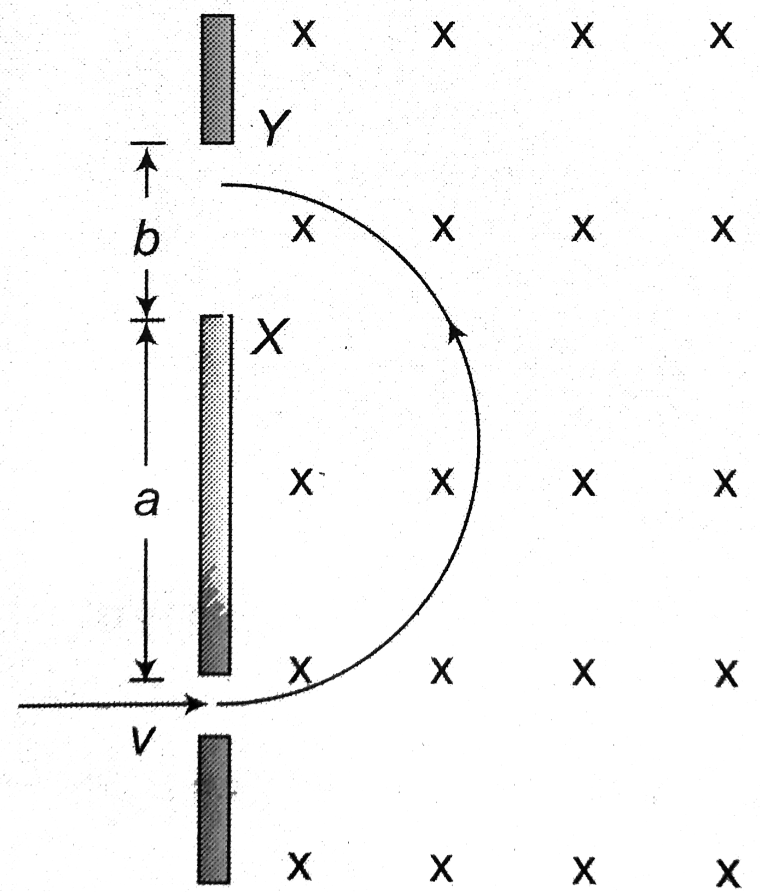
10. A beam of equally charged particles after being accelerated through a voltage V enters into a magnetic field $'B'$ as shown. It is found that all the particles hit the plate between X and Y. Find the ration between the masses of the heaviest and lightest particles of the beam.



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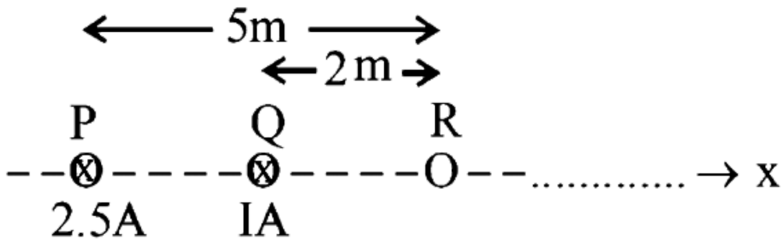
11. Two long parallel wires carrying current $2.5 amperes$ and $I ampere$ in the same direction (directed into the plane of the paper) are held at P and Q respectively such that they are perpendicular to the plane of paper. The points P and Q are located at a distance of $5 metres$ and $2 metres$ respectively from a collinear point R (see figure)

(i) An electron moving with a velocity of $4 \times 10^5 m/s$ along the positive $x - direction$ experiences a force of magnitude $3.2 \times 10^{-20} N$ at the point R. Find the value of I.

(ii) Find all the positions at which a third long parallel wire carrying a current of magnitude $2.5 amperes$ may be placed so that the magnetic induction at R is zero.



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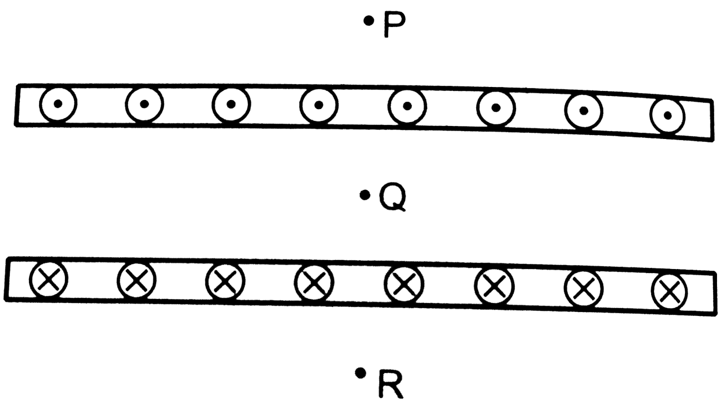
12. A tightly-wound, long solenoid has n turns per unit length, a radius r and carries a current i. A particle having charge q and mass m is projected from a point on the axis in a direction perpendicular to the axis. What can be the maximum speed for which the particle does not strike the solenoid?

13. Two large metal sheets carry surface currents as shown in figure . The current through a strip of width dl is Kdl where K is a constant . Find the magnetic field at the points P,Q and R. `



14. A beam of protons with a velocity $4 \times 10^5 m/\sec$ enters a uniform magnetic field of $0.4T$ at an angle of 37° to the magnetic field. Find the radius of the helium path taken by proton beam. Also find the pitch of helix.

$\sin 37^\circ = 3/5 \cos 37^\circ = 4/5. m_p \cong 1.6 \times 10^{-27} kg.$

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15. A particle of mass m and charge q is lying at the origin in a uniform magnetic field B directed along x-axis. At time t = 0, it is given a velocity v_0, at an angleθ with the y-axis in the xy-plane. Find the coordinates of the particle after one revolution.

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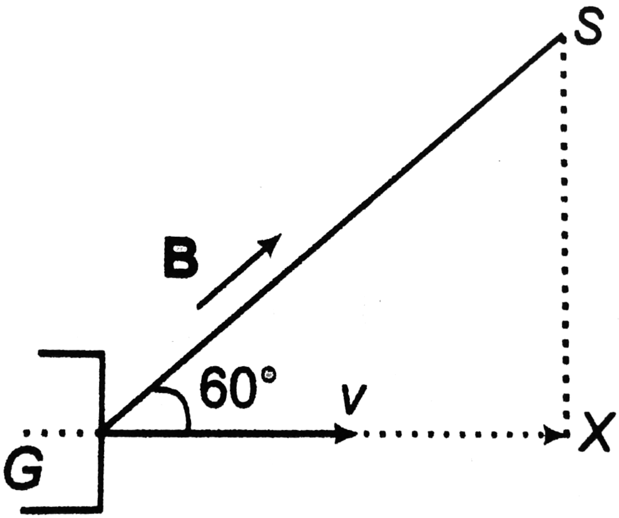
16. An electron gun G emits electons of energy $2keV$ travelling in the positive x-direction. The electons are required to hit the spot S where $GS = 0.1m$, and the line GS makes an angle of 60° with the x-axis as shown in figure. A uniform magnetic field B parallel to GS exists in the region outside the electron gun.



find the minimum value of B needed to make the electrons hit S.

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17. A wire of length a carries a current I along the y-axis.A magnetic field exists given by

$B = B_0\left(3\hat{i} + 2\hat{j} + \hat{k}\right)T$

Calculate magnetic force in vector from and its magnitude

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18. A wire, carrying a current i, is kept in the $x - y$ plane along the curve $y = A\sin\left(\frac{2\pi}{\lambda}x\right)$. A magnetic field B exista in the z-direction. Find the magnitude of the magnetic force on the portion of the wire between $x = 0$ and $x = \lambda$.

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19. The magnetic field existing in a region is gicen by $\overrightarrow{B} = B_0\left(1 + \frac{x}{l}\right)\overrightarrow{k}$. A square loop of edge l and carrying a current I, is placed with its edges parallel to the x-y axes. Find the magnitude of the net magnetic force experienced by the loop.

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20. A hypthetical magnetic field existing in a region is given by $\overrightarrow{B} = B_0 \overrightarrow{e}_r$, where $\overrightarrow{=}r$ denotes the uit vector along the redial direction. A circular loop of radus a, carrying a current I, is placed with its plane parallel to the x-y plane and the centre at (0,0, d) .Find the magnitude of the magnetic force acting on the loop.

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21. A straight wire of length l can slide on two parallel plastic rails kept in a horizontal plane with a separation d. The coefficient of friction between the wire and the rails is μ. If the wire carries a current I, what minimum magnetic field should exist in the space in order to slide the wire on the rails.

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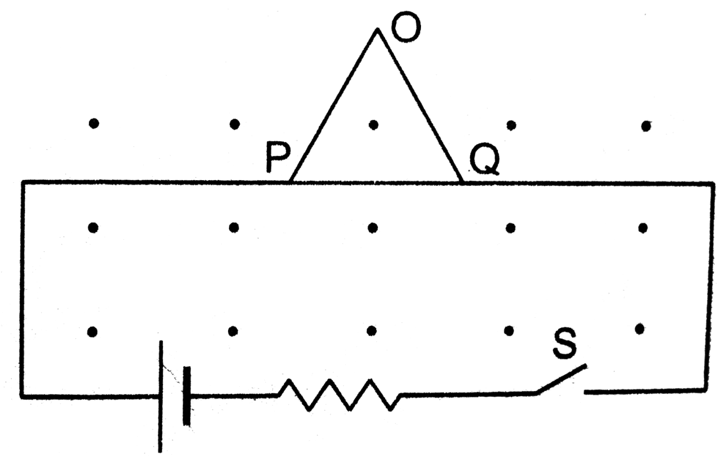
22. Shows a rod PQ of length 20.0 cm and mass 200g suspended through a fixed point O by two threads of lengths 20.0 cm each. A magnetic field of strenght 0.500 T exists in the vicinity of the wire PQ as shown in the figure. The exists in the vicinity of the wire PQ as shown in the figure. The wires conecting PQ with the battery are loose and exert no force on PQ.(a) find the tension in the threads when the switch S is open. (b) A current of 2.0 A is established when the switch S is closed. Find the tension in the threads now.



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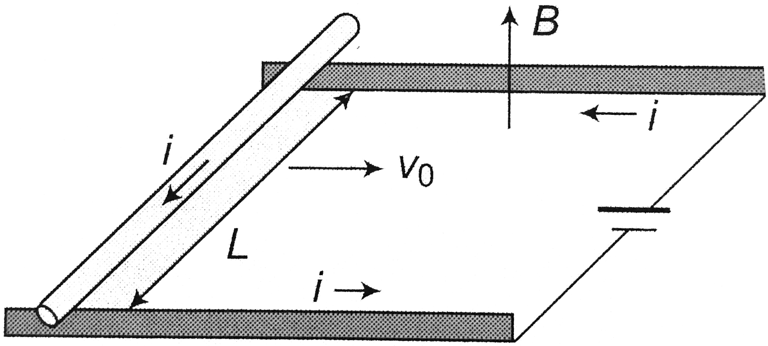
23. A constant current i flows through a metal rod of length L and mass m that slides on frictionless rails as shown in

Fig. If the initial speed of the rod is v_0 towards right and a magnetic field B acts vertically up, find (a) the speed of the rod as a function of time, (b) the total distance moved by the rod before coming to a stop.



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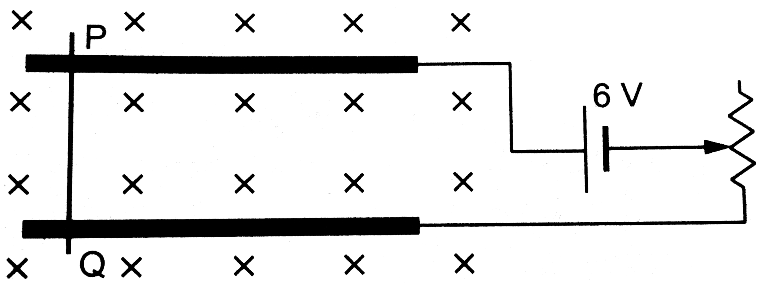
24. A matel wire PQ of mass 10g lies at rest on two horizontal metal rails separated by 4.90 cm . A vertically downward magnetic field of magnitude 0.800 T exists in the space. The resistance of the circuit is slowly decreased and it is found that when the resistance goes below 20.0Ω, the wire PQ starts sliding on the rails. Find the coefficient of friction.



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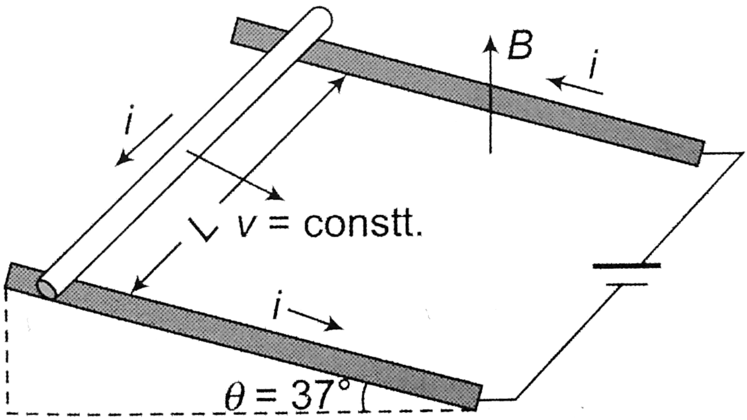
25. Two conducting rails are connected to a source of e.m.f. and form an incline as shown in the figure. A bar of mass $50g$ slides without friction down the incline through a vertical magnetic field B. If the length of the bar is $50cm$ and a current of $2.5A$ is provided by the battery, for what value of

B will the bar slide at a constant velocity ? $\left(g = 10m / \sec^2\right)$



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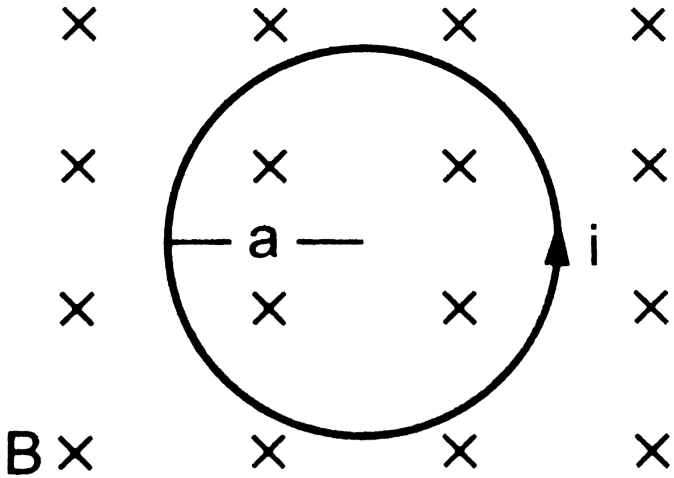
26. Shows a circular wire-loop of radius a m carrying a current I, placed in a perpendicualr matgnetic field B. (a) Consider a small part dl of the wire. Find the force on this part of the wire exerted by the magnetic field. Find the force of compression in the wire.



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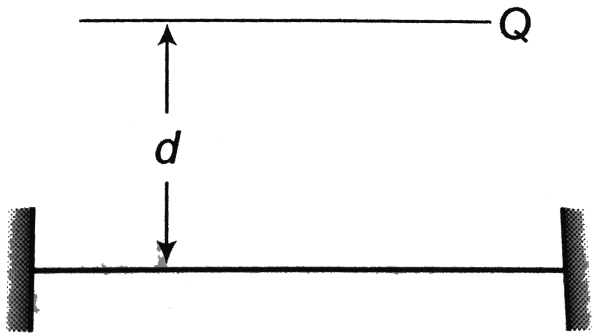
27. A long horizontal wire P carries of $50A$. It is rigidly fixed. Another fine wire Q is placed directly above and parallel to P. The wieght of wire Q is $0.075N/m$ and carries a current of $25A$. Find the position of wire Q from P so that the wire

Q remains suspended due to magnetic repulsion.



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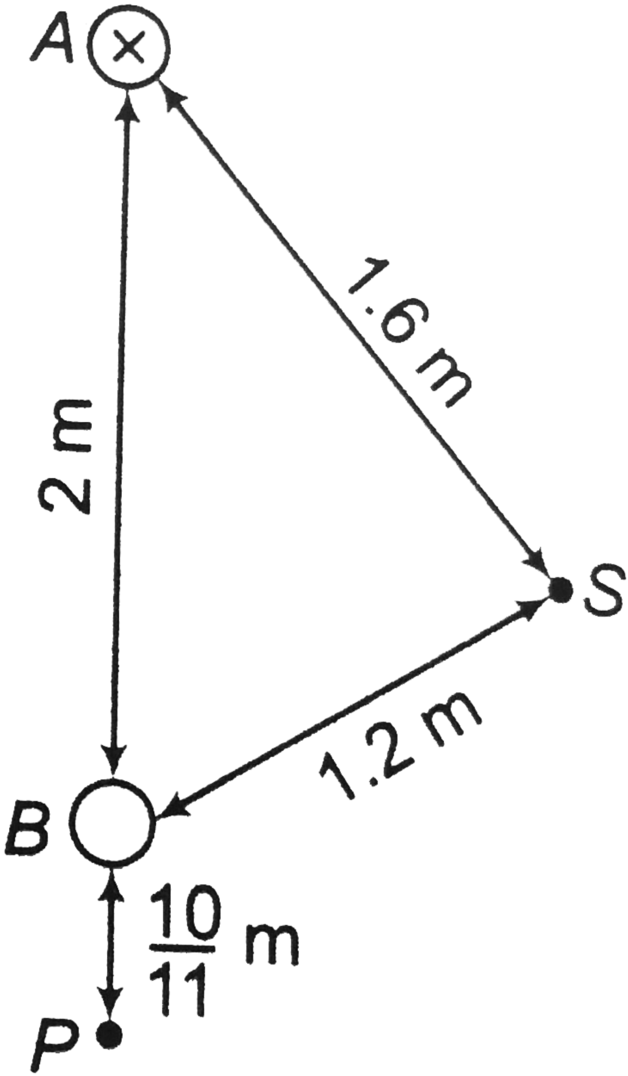
28. Two long straight parallel wieres are $2m$ apart, perpendicular to the plane of the paper. The wire A carries a current of $9.6A$, directed into the plane of the paper. The wire B carries a current such that the magnetic field of induction at the point P, at a distance of $\frac{10}{11}$ m from the wire B, is zero. find

a. the magnitude and directiion of the current in B.

b. the magnitude of the magnetic field of induction of the pont S.

c. the force per unit length on the wire B.



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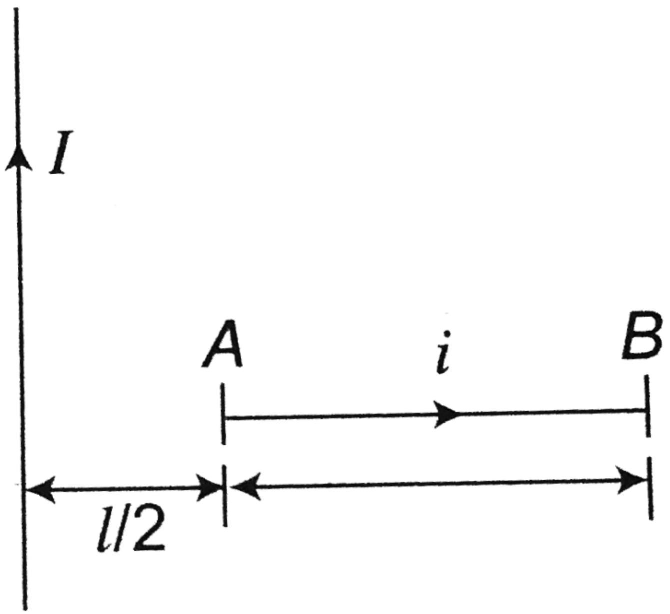
29. A conductor AB of length l carrying current i is placed perpendicular to a long straight conductor carrying a current I as shown. Force on AB will be



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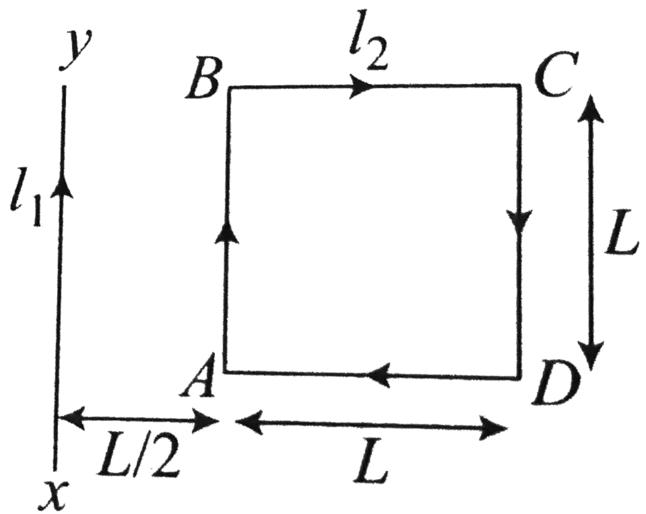
30. A sqaure loop $ABCD$, carrying a current I_2 is placed near and coplanar with a long straight conductor XY, carrying a current I_1 as shwon in Figure. The net force on the loop will be



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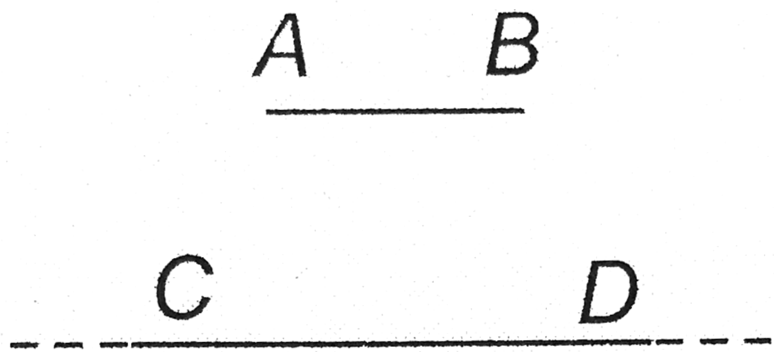
31. A horizontal wire AB which is free to move in a vertical plane and carries a steady current of $i_2 A$, is in equilibrium at a height of h over another parallel long wire CD, which is fixed in a horizontal plane and carries a steady current of $i_1 A$ as shown. Show that when AB is slightly depressed and released it executes simple harmonic motion. Find the period of oscillations.



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32. Three infinitely long thin wires, each carrying current i in the same direction, are in the $x-y$ plane of a gravity free space . The central wire is along the $y-a\xi s$ while the other two are along $x = \pm d$.

(i) Find the locus of the points for which the magnetic field B is zero.

(ii) If the central wire is displaced along the $Z - direction$ by a small amount and released, show that it will excecute simple harmonic motion . If the linear density of the wires is λ, find the frequency of oscillation.

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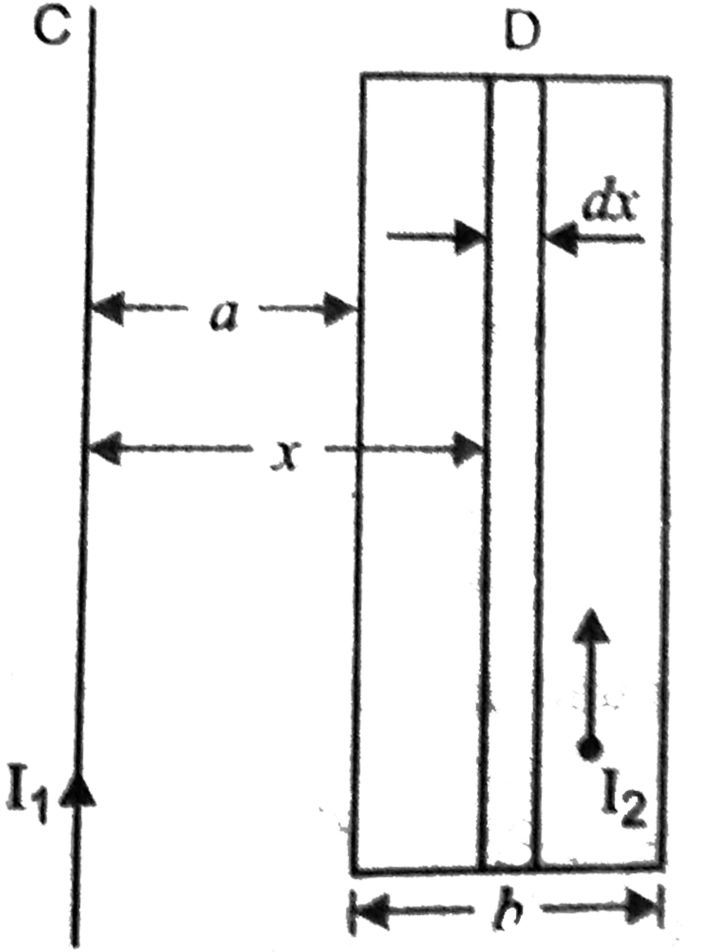
33. Two long thin parallel conductors C and D of the shape as shown in figure. Carry currents I_1 and I_2. The separation between the conductors is a, the width of the right hand conductor is equal to b. Both the conductors are lying in one plane. Find the magnetic interaction force between them reduced to a unit length.



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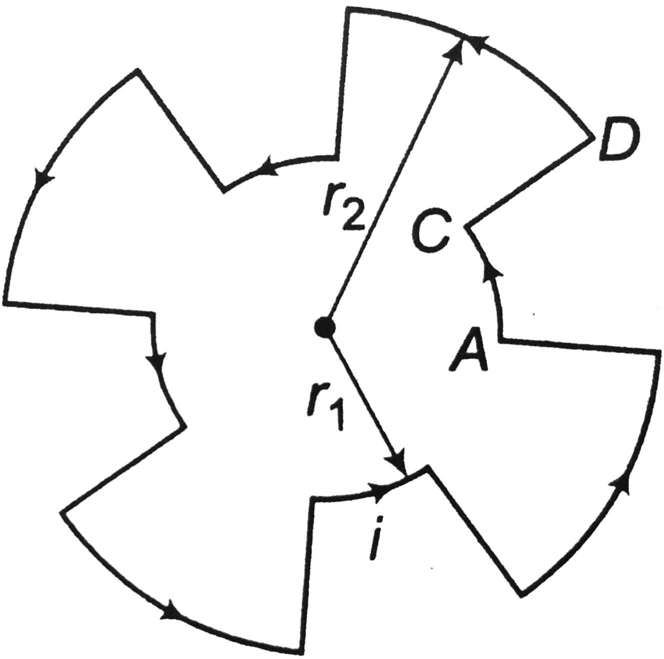
34. A current of $10A$ flows around a closed path in a circuit which is in the horizontal plane as shown in the figure. The circuit consists oif eight alternating arcs of radii $r_1 = 0.08m$ and $r_2 = 0.12m$. Each subtends the same angle at the centre.



a. Find the magnetic field produced by this circuit at the centre.

b. An infinitely long straight wire carryin as current of $10A$ is passing through the centre of the above circuit vertically with the direction of the current being into the pane of the circuit. what is the force acting on the wire at the centre due to the current in the circuit? What is the force acting on the arc AC and the straight segment CD due to the current at the centre?

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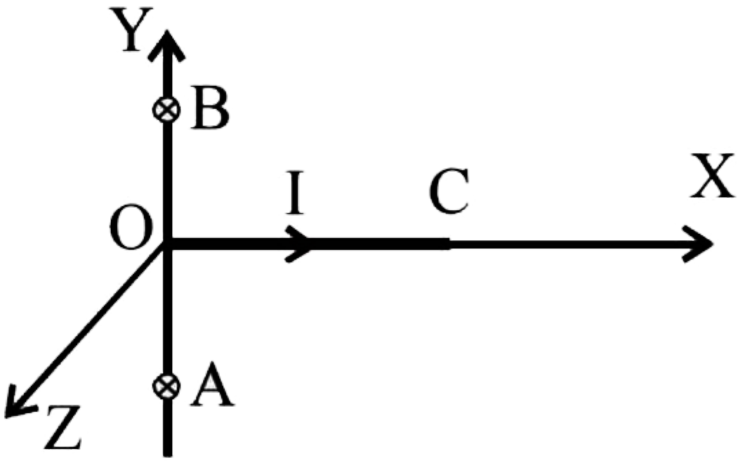
35. A straight segment OC(of length L meter) of a circuit carrying a current $Iamp$ is placed along the $x - a\xi s$ (fig.). Two infinetely long straight wires A and B, each extending from $z = -\infty \rightarrow +\infty$, are fixed at $y = -ameter$ and $y = +ameter$ respectively, as shown in the figure.

If the wires A and B each carry a current $Iamp$ into the plane of the paper, obtain the expression for the force acting on the segment OC. What will be the force on OC if the current in the wire B is reversed?



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36. Two protons move parallel to each other with an equal velocity $v = 300kms^{-1}$. Find the ratio of forces of magnetic and electric interaction of the protons.

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37. A proton goes undflected in a crossed and magnetic field (the fields are perpendicular to each other) at a speed of $2.0X10^5 ms^{-1}$. The velocity is perpendicular to both the fields. When the electric field is switched off, the proton moves along a circle of radius 4.0 cm. Find the magnitudes of the electric and the magnetic fields. take the mass of the proton $= 1.6X10^{-27}$ kg.

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38. A non-relativistic proton beam passes without deviation through a region of space where there are uniform transverse mutually perpendicular electric and magnetic fields with $E = 120 kVm^{-1}$ and $B = 50 mT$. Then the beam strikes a grounded target. Find the force which the beam acts on the target if the beam current is equal to $i = 0.8 mA$.

Mass of protons $= 1.67 \times 10^{-27} kg$.

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39. When a proton is released from rest in a room, it starts with an initial acceleration a_0 towards west. When it is projected towards north with a speed v_0 it moves with an initial accelaration $3a_0$ towards west. The electric and the maximum possible magnetic field in the room

(i) $\frac{ma_0}{e}$, towards west

(ii) $\frac{2ma_0}{ev_0}$, downward

(iii) $\frac{ma_0}{e}$, towards east

(iv) $\frac{2ma_0}{ev_0}$, upward

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40. A particle having mass m and charge q is released from the origin in a region in which electric field and megnetic field are given by $\vec{B} = -B_0\hat{j}$ and $\vec{E} = \vec{E}_0\hat{k}$. Find the speed of the particle as a function of its z-coordinate.

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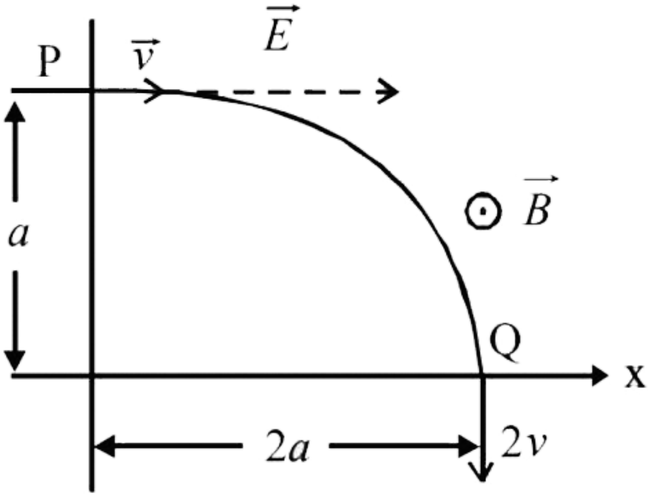
41. A particle of charge $+q$ and mass m moving under the influence of a uniform electric field $E\hat{i}$ and uniform magnetic field $B\hat{k}$ follows a trajectory from $P \rightarrow Q$ as shown in fig. The velocities at P and Q are $v\hat{i}$ and $-2v\hat{j}$.

which of the following statement(s) is/are correct ?



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42. Find the magnetic moment of a thin round loop with current if the radius of the loop is equal to $R = 100mm$ and the magnetic induction at its centre is equal to $B = 6.0\mu T$.

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43. An electron moves with a constant speed v along a circle of radius r.(a) find the equivalent current through a point on its path.(b) Find the magnetic moment of the circulating electron.(c) Find the ratio of the magnetic moment to the angular momentum of the electron.

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44. consider a nonconducting ring of radius r and mass m which has a totoal chargej q distributed uniformly on it the ring is rotated about its axis with an angular speed ω. (a) Find the equivalent electric current in the ring (b) find the magnetic moment μ of the . (c) show that $\mu = \frac{q}{2m}L$ where l is the angular momentum of the ring about its axis of rotation.

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45. A non-conducting thin disc of radius R and mass m having charge uniformly over one side with surface density σ rotates about its axis with an angular velocity ω. Find :

(a) the magnetic induction at the centre of the disc,

(b) the magnetic moment of the disc.

(c) the ratio of magnetic moment and angular momentum of disc.

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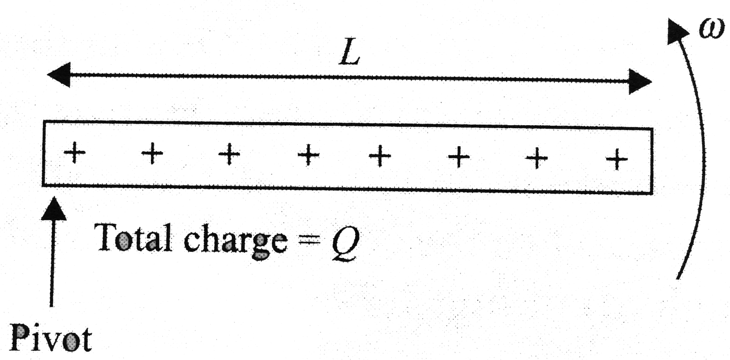
46. A rod has a total charge Q uniformly distributed along its length L. If the rod rotates with angular velocity ω about its end, compute its magnetic moment.



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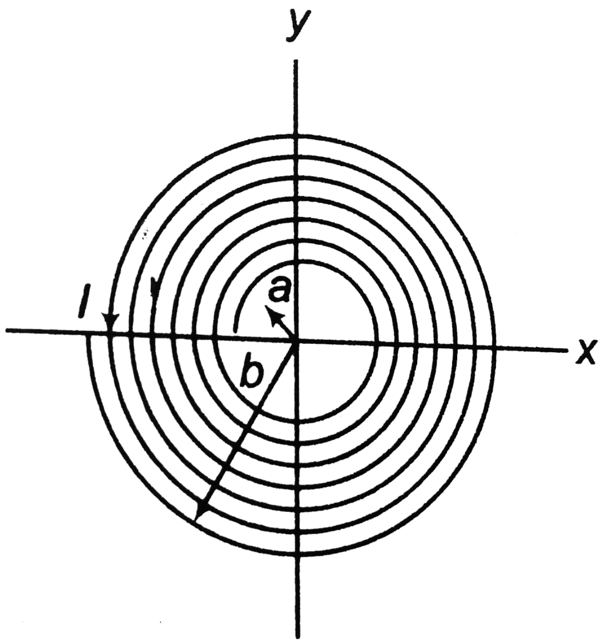
47. A long insulated copper wire is closely wound as a spiral of N turns. The spiral has inner radius a and outer radius b. The spiral lies in the xy-plane and a steady current I flows through the wire. The$z$-component of the magetic field at the centre of the spiral is



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48. A circular loop carrting a current a current I has wire of total length L. A uniform umagnetic field B exists parallel to the plane of the loop. (a) find the trouque on the loop.(b) If the sme length of the wire is used to form a squar loop, what would be the torque? Which is larger?

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49. A 50 turn circular coil of radius 2.0 cm carrying a current of 5.0 A is rotated in a magnetic field of strength 0.20 T. (a) What is the maximum torque that acts on the coil? (b) in a particular position of the coil, the torque acting on it is half of this maximum. What is the angle between the magnetic field and the plane of the coil?

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50. A circular loop of radius r carrying a current i is held at the centre of another circular loop of radius R(gtgtr) carrying a current I. The plane of the smaller loop makes an angle of 30° with that of the larger loop. It the smaller loop is held fixed in this position by applying a single force at a point on its periphery, what would be the minimum magnitude of this force?

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51. A circular loop of radius r carrying a current i is held at the centre of another circular loop of radius R(gtgtr) carrying a current I. The plane of the smaller loop makes an angle of 30° with that of the larger loop. It the smaller loop is held fixed in this position by applying a single force at a point on its periphery, what would be the minimum magnitude of this force?

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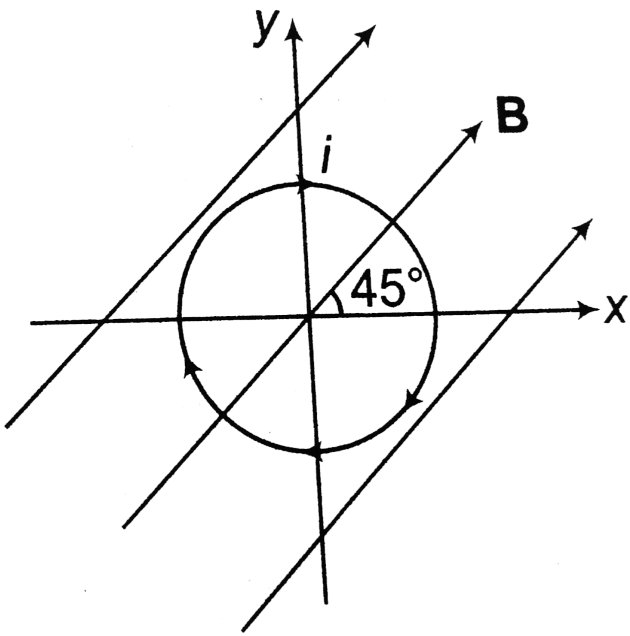
52. A circular loop of radius $R = 20$ cm is placed in a uniform magnetic field $B = 2T$ in xy-plane as shown in figure. The loop carries a current $i = 1.0A$ in the direction shown in figure. Find the magnitude of torque acting on the loop.



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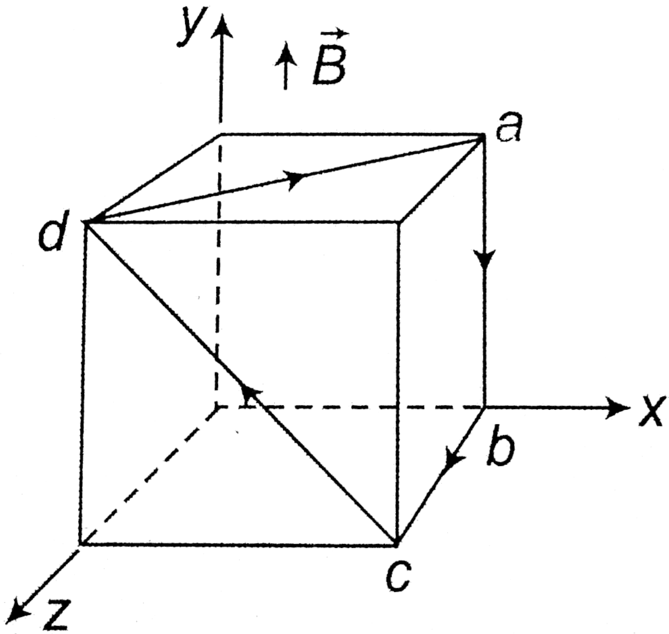
53. In the given figure, the cube is length l on each side. Four straight segments of wire ab, bc, cd and da form a closed loop that carries a current $I = i_0$ in the direction shown. A uniform magnetic field of magnitude $B = B_0$ is in the positive y direction. Determine the torque on the loop



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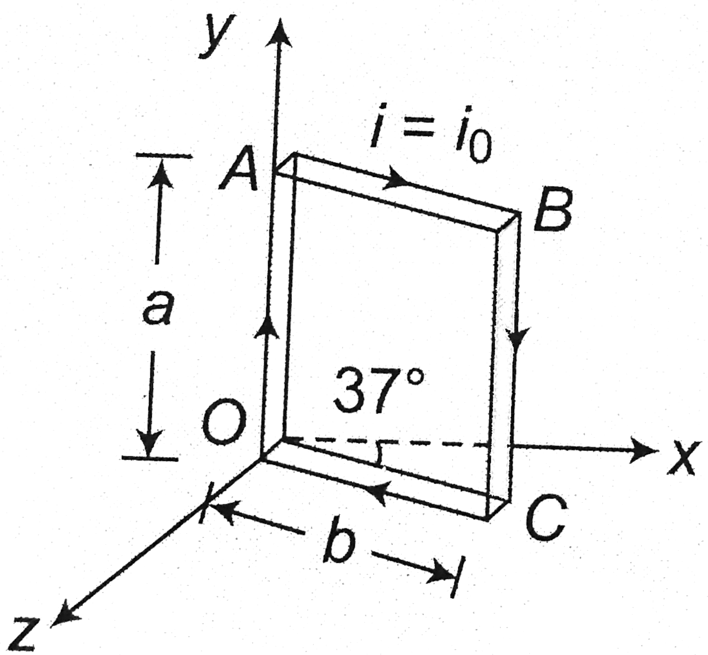
54. A rectangular loop consists of N closed wrapped turns and has dimensions $a \times b$. The loop is hinged along the y-axis. What is the magnitude of the torque exerted on the loop by a uniform magnetic field $B = B_0$ directed along the x-axis when current $i = i_0$ in the direction shown. What is the expected direction of rotation of the loop ?



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55. A square coil of edge I having n turns carries a curent i. it is kept on a smooth horizontal plate. A uniform magnetic field B exists in a direction parallel to an edge the total mass of the coil is M. What should be the minimum value of B for which the coil will start tipping over?

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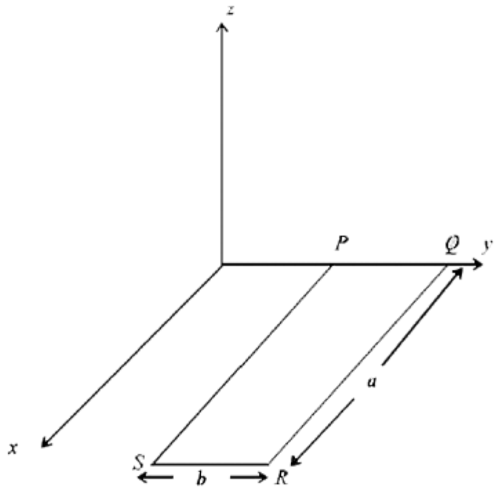
56. A rectangular loop PQRS made from a uniform wire has length a, width b and mass m. It is free to rotate about the arm PQ, which remains hinged along a horizontal line taken as the y-axis (see figure). Take the vertically upward direction as the z-axis. A uniform magnetic field $\vec{B} = \left(3\hat{i} + 4\hat{k}\right)B_0$ exists in the region. The loop is held in the x-y plane and a current I is passed through it. The loop is now released and is found to stay in the horizontal position in equilibrium



(a) What is the direction of the current I in PQ?

(b) Find the magnetic force on the arm RS.

(c) Find the expression for I in terms of B_0, a, b and m

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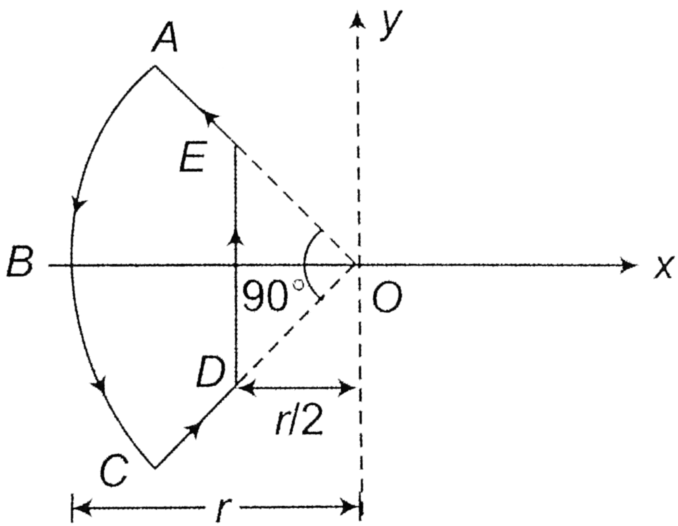
57. A wire loop $ABCDE$ carrying a current I is placed in the $x - y$ plane as shown in the figure. A particle of mass m and charge q is projected from origin with velocity

$$\overrightarrow{V} = \frac{V_0}{\sqrt{2}}\left(\hat{i} + \hat{j}\right)m/\text{sec.}$$

(a) Find the instaneous acceleration

(b) If an external magnetic field $\overrightarrow{B} = B_0\hat{i}$ is applied, find the force and torque acting on the loop due to this field.



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Exercises

1. A positively charged particle projected towards east is deflected towards north by a magnetic field. The field may be

A. toward west

B. towards south

C. upward

D. downward

Answer: D

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2. A vertical wire carries a current in upward direction. An electron beam sent horizontally towards the wire will be deflected

A. towards right

B. towards left

C. upwards

D. downwards

Answer: C

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3. Which of the following particles will describe wll experience maximum magnetic force(magnitude) when projected with the same velocity perpendicular to a magnetic field?

A. electron

B. proton

C. He^{+}

D. Li^{++}

Answer: D

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4. Which of the following particles will describe the smallest circle when projected with the same velocity perpendicular to a magnetic field?

A. electron

B. proton

C. He^{+}

D. Li^{++}

Answer: A

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5. Which of the follwing particles will have minimum frequency of revolution when projected with the same velocity perpendicular to a magnetic field?

A. electron

B. proton

C. He^{+}

D. Li^{++}

Answer: D

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6. A stream of protons and α-particle of equal momenta enter a unifom magnetic field perpendicularly. The radii of their orbits are in the ratio

A. (1) 1

B. 2

C. 0.5

D. 4

Answer: B

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7. A proton, a deutron and α-particle, whose kinetic energies are same, enter perpendicularly a uniform magnetic field. Compare the radii of their circualr paths.

A. $1:1$

B. $2:1$

C. $1:2$

D. $4:1$

Answer: A

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8. A proton, a deuteron and an α- particle having the same kinetic energy are moving in circular trajectors 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. $r_p = r_d = r_\alpha$

Answer: A

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9. A charged particle enters a uniform magnetic field perpendicular to it. The magnetic field

A. increases the $K.E.$ of the particle

B. decreases the $K.E.$ of the particle

C. changes the direction of motion of the particle

D. does both (a) and (c)

Answer: C

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10. A beam of electrons is accelerated through a potential difference V. It is then passed normally through a uniform magnetic field where it moves in a circle of radius r. It would have moved in a circle of radius $2r$ if it were initially accelarated through a potential difference

A. $\sqrt{2}V$

B. $2V$

C. $2\sqrt{2}V$

D. $4V$

Answer: D

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11. Two particle X and Y having equal charge, after being accelerated through the same potential difference enter a region of uniform magnetic field and describe circular paths of radii R_1 and R_2 respectively. The ratio of the mass of X to that of Y is

A. $\left(\frac{R_1}{R_2}\right)^{\frac{1}{2}}$

B. $\frac{R_1}{R_2}$

C. $\left(\frac{R_1}{R_2}\right)^2$

D. $\frac{R_2}{R_1}$

Answer: C

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12. Two ions have equal masses but one is singly- ionized and the other is doubly- ionized. They are pojected from the same place in a uniform magnetic field with the same velocity perpendicular to the field.

A. (i), (ii)

B. (ii), (iv)

C. (ii), (iii)

D. (i), (iv)

Answer: B

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13. A particle is projected in a plane perpendicular to a uniform magnetic field. The area bounded by the path described by the particle is proportional to

A. the velocity

B. the momentum

C. the kinetic energy

D. none of these

Answer: C

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14. Which of the following statement is correct ?

A. A charged particle can be accelerated by a magnetic field

B. A charged particle cannot be accelerated by a magnetic field

C. The speed of charged particle cane be increased by a unifrom magnetic field

D. The speed of charged particle cane be increased by a non-unifrom magnetic field

Answer: A

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15. A charged particle begins to move in a magnetic field, initially parallel to the field. The direction of the field now begins to change, with its magnitude remaining constant

A. The magnitude of the force acting on the particle will remain constant

B. The magnitude of the force acting on the particle will change

C. The particle will always move parallel to the field

D. The speed of the particle will change

Answer: B

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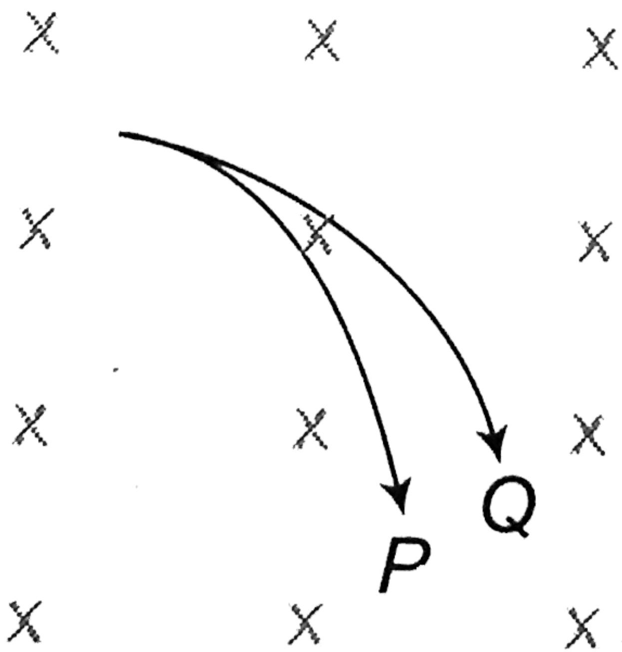
16. Two charged particles P and Q enter a uniform magnetic field normally with the same speed. Their paths in the field are as shown in the figure. It can be concluded that



(i) the charge of P is greater than of Q

(ii) specific charge of P is $>$ that of Q

(iii) both P and Q are positively charged

(iv) both P and Q are negatively charged

A. (i), (ii)

B. (ii), (iv)

C. (ii), (iii)

D. (i), (iv)

Answer: B

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17. A beam consisting of protons and electrons moving at the same speed goes through a thin region in which there is a magnetic field perpendicular to the beam. Protons and the electrons

A. will go undeviated

B. deviated by same angle and won't separate

C. deviated by different angles and separate

D. deviated by same angle but will separate

Answer: C

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18. An electron and a proton enter a magnetic field at right angles to the field with the same kinetic energy

A. The trajectory of the electron will be less curved

B. The trajectory of the proton will be less curved

C. Both the trajectory electron will be equally curved

D. Both will move along straight line paths

Answer: B

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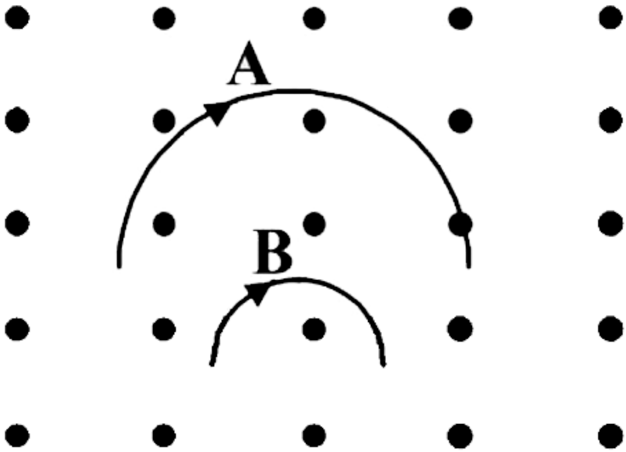
19. Two particles A and B of masses m_A and m_B respectively and having the same charge are moving in a plane . The speeds of the particles are v_A and v_B respectively and the trajectories are as shown in the figure.

Then



A. $m_A v_A < m_B v_B$

B. $m_A v_A > m_B v_B$

C. $m_A v_B < m_A v_B$

D. $m_A = m_B, v_A = v_B$

Answer: B

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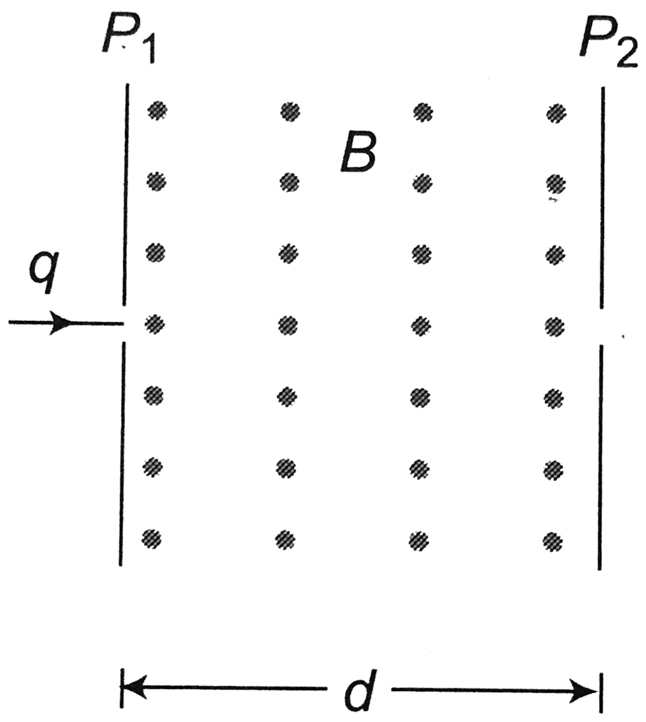
20. A charged particle having kinetic energy E enters normally a region of uniform magnetic field between two plates P_1 and P_2 as shown in the figure. If the particle just misses hitting the plate P_2, then the magnetic field B in the region between the plates is



A. $\frac{2mE}{qd}$

B. $\frac{mE}{qd}$

C. $\frac{\sqrt{mE}}{qd}$

D. $\frac{\sqrt{2mE}}{qd}$

Answer: D

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

A. $\frac{qbB}{m}$

B. $\frac{q(b-a)B}{m}$

C. $\frac{qaB}{m}$

D. $\frac{q(b+a)B}{m}$

Answer: B

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22. H^{+}, He^{+} and O^{++} all having the same kinetic energy pass through a region in which there is a uniform magnetic field perpendicular to their velocity . The masses of H^{+}, He^{+} and O^{2+} are $1a\mu$, $4a\mu$ and $16a\mu$ respectively . Then

A. H^{+} ions will be deflected most

B. O^{++} ions will be deflected least

C. He^{+} and O^{++} ions will be undergo same deflecton

D. all ions will undergo the same deflection

Answer: B

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23. An electron and a proton are moving on straight parallel paths with same velocity. They enter a semi infinite region of uniform magnetic field perpendicular to the velocity. Which of the following statement(s) is /are true?

A. (i) only

B. (ii), (iii)

C. (ii), (iv)

D. (iii) only

Answer: C

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24. Maximum kinetic energy of the positive ion in the cyclotron is

A. $\frac{q^2 B r_0}{2m}$

B. $\frac{q B^2 r_0}{2m}$

C. $\frac{q^2 B^2 r_0^2}{2m}$

D. $\frac{q B r_0}{2m^2}$

Answer: C

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25. A particle mass m charge Q and kinetic energy T eneters transverse unifrom magnetic fiedl of induction $\vec{B}$ After s the kinetic energy or the particle will be

A. T

B. $4T$

C. $3T$

D. $2T$

Answer: A

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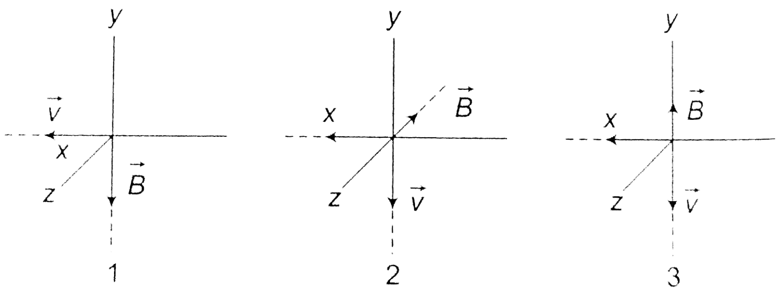
26. The figure shows three situations when an electron moves with velocity $\vec{v}$ travels through a uniform magnetic field $\vec{B}$. In each case, what is the direction of magnetic force on the electron



A. $+ve$ z-axis, $-ve$ x-axis, $+ve$ y-axis

B. $-ve$ z-axis, $-ve$ x-axis and zero

C. $+ve$ z-axis, $+ve$ x-axis and zero

D. $-ve$ z-axis, $+ve$ x-axis and zero

Answer: B

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27. A proton of mass $1.67 \times 10^{-27} kg$ and charge $1.6 \times 10^{-19} c$ is projected with a speed of $2 \times 10^6 m/s$ at an angle of 60° to the x-axis. If a uniform magnetic field of 0.104 Tesla is applied along Y-axis, the path of proton is

A. A circle of radius $= 0.2m$ & time period $\pi \times 10^{-7}$ sec

B. A circle of radius $= 0.1m$ & time period $2\pi \times 10^{-7}$ sec

C. A helix of radius $= 0.1m$ & time period $2\pi \times 10^{-7}$ sec

D. A helix of radius $= 0.2m$ & time period $4\pi \times 10^{-7}$ sec

Answer: C

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28. A particle of mass M and charge Q moving with velocity $\vec{v}$ describe a circular path of radius R when subjected to a uniform transverse magnetic field of induction B. The work done by the field when the particle completes one full circle is

A. $(BQv)(2\pi R)$

B. $\left(\frac{Mv^2}{R}\right)2\pi R$

C. zero

D. $(BQ)(2\pi R)$

Answer: C

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29. Two ions having masses in the ratio $1:1$ and charges $1:2$ are projected into uniform magnetic field perpendicular to the field with speeds in th ratio $2:3$. The ratio of the radius of circular paths along which the two particles move is

A. $4:3$

B. $2:3$

C. $3:1$

D. $1:4$

Answer: A

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30. A particle of charge $-16 \times 10^{-18} co\underline{o}mb$ moving with velocity $10ms^{-1}$ along the $x - a\xi s$, and an electric field of magnitude $\left(10^4\right)/(m)$ is along the negative $z - ais$. If the charged particle continues moving along the x- axis , the magnitude of B is

A. $10^{-3}Wb/m^2$

B. $10^3 Wb/m^2$

C. $10^5 Wb/m^2$

D. $10^{16} Wb/m^2$

Answer: B

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31. At a specific instant emission of radioactive compound is deflected in a magnetic field . The compound can emit

(i) electron (ii)protons(iii)He^{2+}(iv) neutrons

The emission at instant can be

A. (i), (ii), (iii)

B. all

C. (iv) only

D. (ii), (iii)

Answer: A

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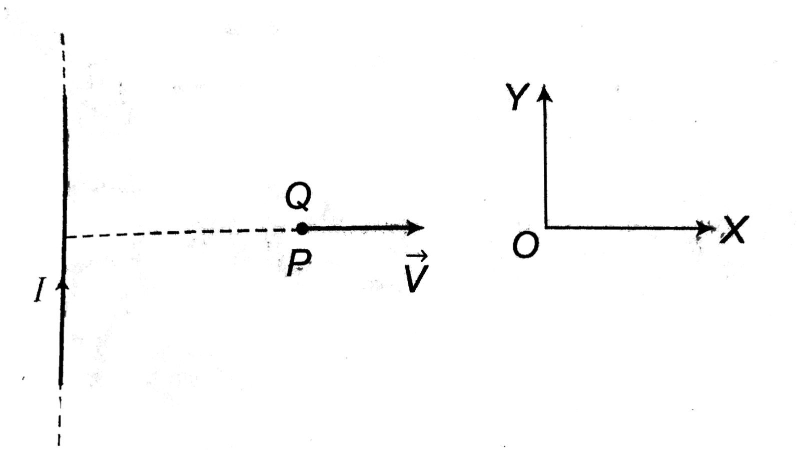
32. A very long straight wire carries a current I. At the instant when a charge $+Q$ at point P has velocity $\overrightarrow{V}$, as shown, the force on the charge is



A. opposite to OX

B. along OX

C. opposite OY

D. along OY

Answer: D

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33. Under the influence of a unifrom magnetic field a charged particle is moving on a circle of radius R with Constant speed v. The time period of the motion

A. depends on v and not on R

B. depends on both R and v

C. is independence of both R and v

D. depends on R and not on v

Answer: C

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34. When a charged particle moving with velocity $\vec{V}$ is subjected to a magnetic field of induction $\vec{B}$ the force on it is non-zero. This implies that:

A. Angles between $\vec{v}$ and $\vec{B}$ can have any value other than zero and 180°

B. Angle between $\vec{v}$ and $\vec{B}$ is either zero or 180°

C. Angle between $\vec{v}$ and $\vec{B}$ is necessarily 90°

D. Angle between $\vec{v}$ and $\vec{B}$ can have any value other than 90°

Answer: A

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35. Which of the following is unit of magnetic field

A. Tesla

B. $N/A.m$

C. $Weber/m^2$

D. all

Answer: D

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36. The magnetic force acting on a charged particle of charge $-2\mu C$ in a magnetic field of $2T$ acting y direction, when the particle velocity is $\left(2i+3\hat{j}\right)\times 10^6 ms^{-1}$, is

A. $8N$ in $-z$ direction

B. $4N$ in z direction

C. $8N$ in y direction

D. $8N$ in z direction

Answer: A

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37. If a particle of charge 10^{-12} coulomb moving along the $\hat{x}$-direction with a velocity $10^5 m/s$ experiences a force of 10^{-10} newton in $\hat{y}$-direction due to magnetic field. Then the minimum magnetic field is

A. 6.25×10^3 tesla in $\hat{z}$ -direction

B. 10^{-15} tesla in $\hat{z}$ -direction

C. 6.25×10^{-3} tesla in $\hat{z}$ -direction

D. 10^{-3} tesla in $\hat{z}$ -direction

Answer: D

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38. A charged particle entering a magnetic field from outside in a direction perpendicular to the field

A. can never complete one rotation inside the field

B. may or may not complete one rotation in the field depending on it angle of entery into the field

C. will always complete exactly half of a rotation before leaving the field

D. may allow a helium path depending o its angle of entery into the field

Answer: A

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39. A charged particle is whirled in a horizontal circle on a frictionless table by attaching it to a string fixed at one pint. If a magnetic field is wsitched on in the vertical direction, the tension in the string

A. will increase

B. will decrease

C. will remain the same

D. may increase or decrease

Answer: D

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40. An electric current I enters and leaves a uniform circular wire of radius a through diametrically opposite points. A charged paricle q moving along the axis of the circular wire passes through its centre at speed v. The magnetic force acting on the particle when it passes through the centre has a magnitude

A. $\frac{qv\mu_0 i}{2a}$

B. $\frac{qv\mu_0 i}{2\pi a}$

C. $\frac{qv\mu_0 i}{2a}$

D. zero

Answer: D

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41. The oscillating frequency of a cyclotron is $10MHz$. If the radius of its Dees is $0.5m$, the kinetic energy of a proton which is accelerated by the cyclotron is

A. $10.2MeV$

B. $2.55MeV$

C. $20.4MeV$

D. $5.1MeV$

Answer: D

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42. In a cyclotron, the angular frequency of a charged particle is independent

A. Mass

B. Speed

C. Charge

D. Magnetic field

Answer: B

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43. Cyclotron is used to accelerate

A. Electrons

B. Neutrons

C. Positive ions

D. Negative ions

Answer: C

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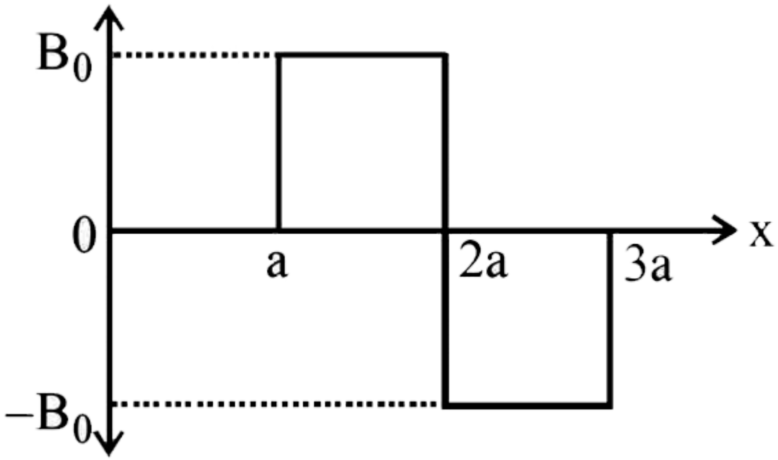
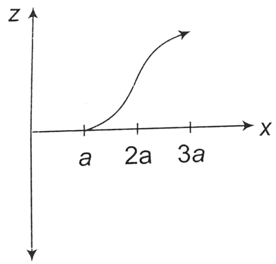
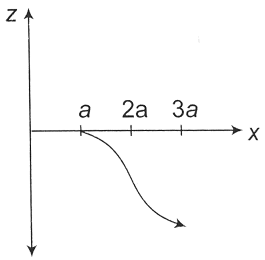
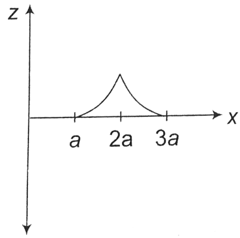
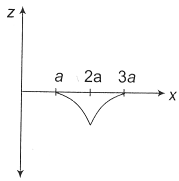
44. A magnetic field $\overrightarrow{B} = B_0 \hat{j}$, exists in the region $a < x < 2a$, and $\overrightarrow{B} = -B_0 \hat{j}$, in the region $2a < x < 3a$, where B_0 is a positive constant . A positive point charge moving with a velocity $\overrightarrow{v} = v_0 \hat{i}$, where v_0 is a positive constant , enters the magnetic field at $x = a$. The trajectory of the charge in this region can be like



A. 

B. 

C. 

D. 

Answer: A

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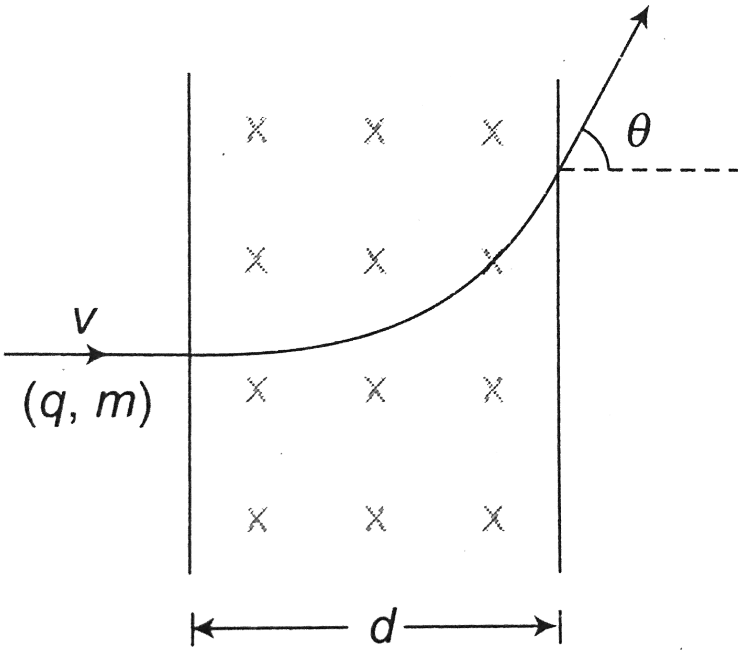
45. A charged particle (q, m) enters perpendicular in a uniform magnetic field B and comes out field as shown. The angle of deviation θ time taken by particle to cross magnetic field will be



A. $\sin^{-1}.\frac{Bqd}{mv}, \frac{m\theta}{Bq}$

B. $\sin^{-1}.\frac{Bqv}{md}, \frac{m\theta}{Bq}$

C. $\cos^{-1}.\frac{Bqd}{mv}, \frac{m\theta}{Bq}$

D. $\cos^{-1}.\frac{Bqv}{md}, \frac{m\theta}{Bq}$

Answer: A

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46. A charged particle enters a magnetic field such that the direction of initial velocity are different from the direction of the field. Which of the following characteristics of the particle change with time ?

(i) momentum

(ii) $K.E.$

(iii) acceleration

(iv) direction of motion

A. (i), (ii)

B. (ii), (iv)

C. (ii), (iii)

D. (i), (iii), (iv)

Answer: D

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47. A charged particle moves in a uniform magnetic field. The velocity of the particle at some instant makes an acute angle with the magnetic field. The path of the particle will be

A. A straight line

B. A circle

C. A helix with uniform pitch

D. A helix with non-uniform pitch

Answer: C

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48. A conductor AB carries a current i in a magnetic field B.

If $AB = r$ and the force on the conductor is F,

(i) $\overrightarrow{F}$ does not depend on shape of AB

(ii)$\overrightarrow{F} = i\left(\overrightarrow{r} \times \overrightarrow{B}\right)$

(iii) $\overrightarrow{F} = i\left(\overrightarrow{B} \times \overrightarrow{r}\right)$

(iv) $\left|\overrightarrow{F}\right| = irB$

A. (i), (ii)

B. (ii), (iv)

C. (ii), (iii)

D. (i), (iv)

Answer: A

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49. A horizontal wire $0 \cdot 1m$ long carries a current of $5A$. Find the magnitude and direction of the magnetic field, which can support the weight of the wire. Given the mass of the wire is $3 \times 10^{-3} kg/m$ and $g = 10ms^{-2}$.

A. $3 \times 10^{-3} T$

B. $6 \times 10^{-3} T$

C. $3 \times 10^{-4} T$

D. $6 \times 10^{-4} T$

Answer: B

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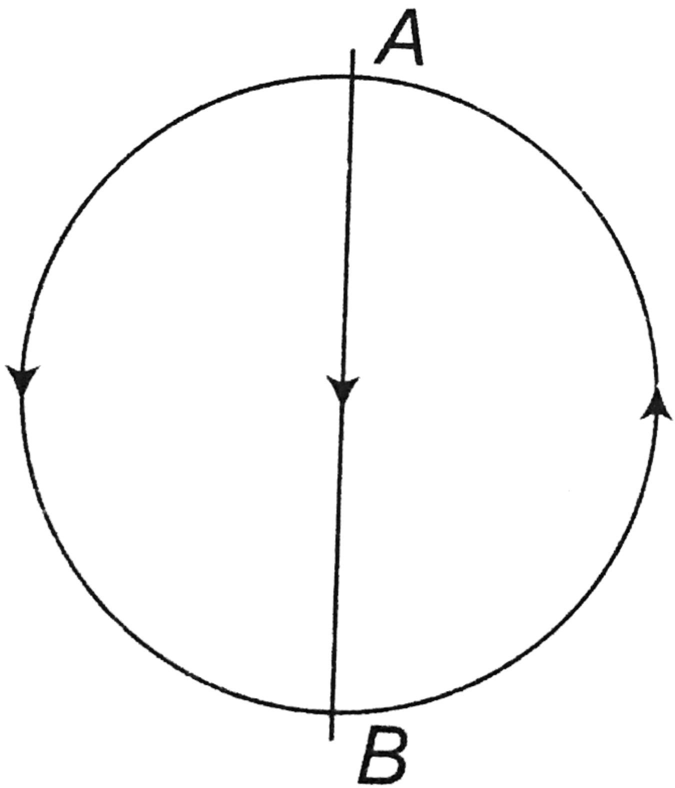
50. The figure shows a circular coil and a long straight wire AB placed close to each other, the wire being parallel to a diameter of coil. The arrows show directions of currents. The direction of magnetic force acting on AB is



A. out of the page

B. into the page

C. towards right

D. towards left

Answer: D

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51. 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

Answer: C

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52. A semicircular wire of radius r, carrying a current I, is placed in a magnetic field of magnitude B. The force acting on it

A. can never be zero

B. can have maximum magnitude $2BIr$

C. can have the maximum magnitude $BI\pi r$

D. can have the maximum magnitude BIr

Answer: B

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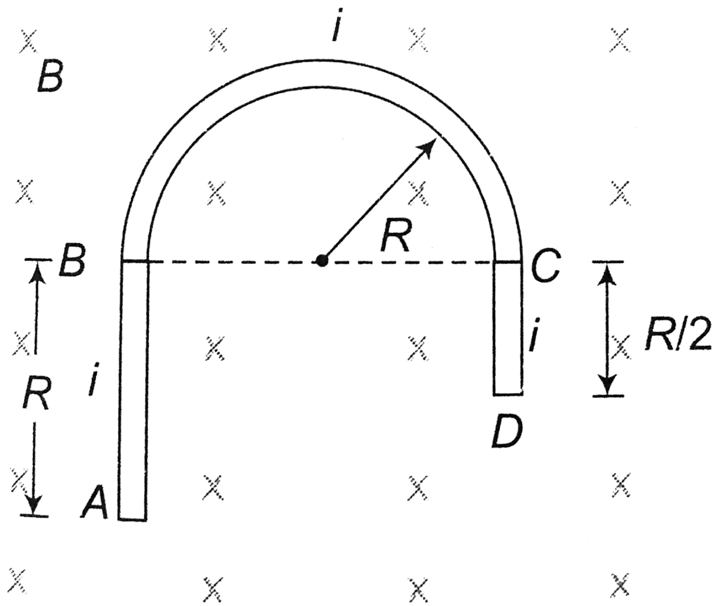
53. The current flows in the wire from A to D clockwise direction. The net force on $ABCD$



A. $\frac{\sqrt{17}}{2} BiR$

B. $\frac{\sqrt{15}}{2} BiR$

C. $\frac{\sqrt{13}}{2} BiR$

D. BiR

Answer: A

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54. Through two parallel wires x and y, currents of $10A$ and $20A$ respectively are passing in opposite directions. x is infinitely long and y has a length of $2m$. The distance between them is $10cm$. The magnetic force on y is

A. $4 \times 10^{-5} N$

B. $4 \times 10^{-6} N$

C. $8 \times 10^{-4} N$

D. $8 \times 10^{-6} N$

Answer: C

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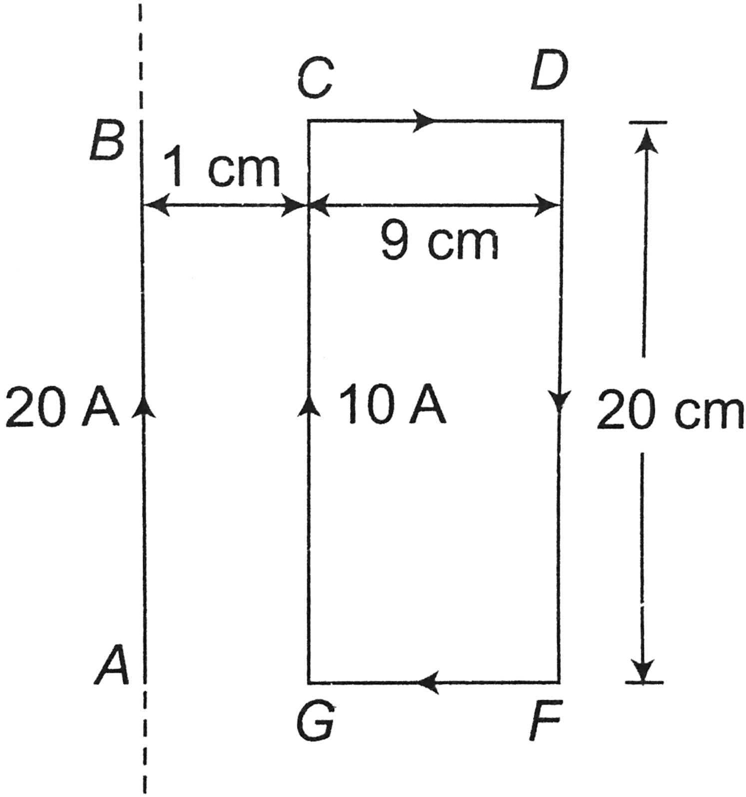
55. In the figure AB is a long straight wire carrying a current of $20A$ and $CDFG$ is a rectangular loop of size $20cm \times 9cm$ carrying a current of $10A$. The edge CG is parallel to AB, at a distance of $1cm$ from it. The force exterted on the loop by the magnetic field of the wire is



A. $3.6 \times 10^{-4} N$ towards left

B. $3.6 \times 10^{-4} N$ towards right

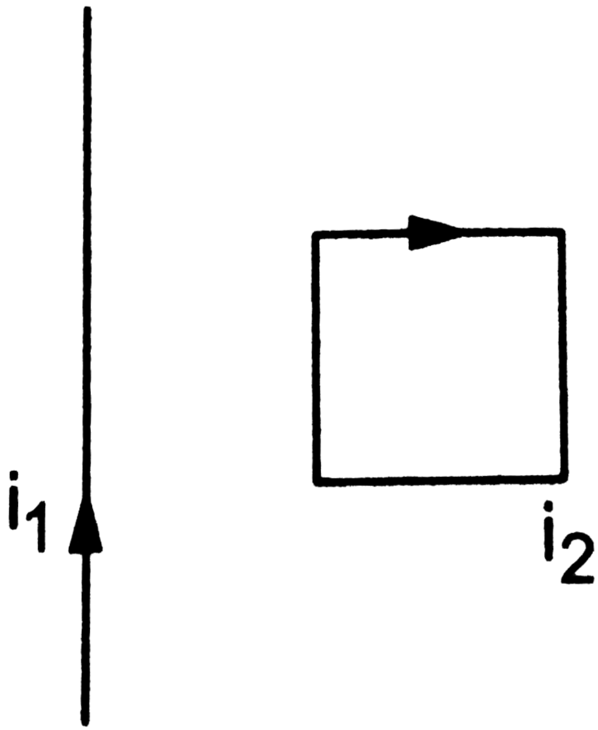
C. $37.2 \times 10^{-4} N$ towards right

D. $7.2 \times 10^{-4} N$ towards left

Answer: D

Watch Video Solution

56. Consider the situation shown in figure. The straight wire is fixed but the loop can move under magnetic force. The loop will



A. remain stationary

B. move towards the wire

C. move away from the wire

D. rotate about the wire

Answer: B

Watch Video Solution

57. Two parallel wires carry currents of $20A$ and $40A$ in same direction. Another wire carrying a current anti- parallel to $20A$ is placed midway between the two wires. The magnetic force on it will be

A. towards $20A$

B. towards $40A$

C. zero

D. $\perp$ to the plane of the currents

Answer: A

Watch Video Solution

58. The magnetic field existing in a region is gicen by $\overrightarrow{B} = B_0\left(1 + \frac{x}{l}\right)\overrightarrow{k}$. A square loop of edge l and carrying a current I, is placed with its edges parallel to the x-y axes. Find the magnitude of the net magnetic force experienced by the loop.

A. $B_0 iL$

B. $2B_0iL$

C. $4B_0iL$

D. $5B_0iL$

Answer: A

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59. A conducting circular loop of radius r carries a constant current i. It is placed in a uniform magnetic field B such that B is perpendicular to the plane of loop. What is the magnetic force acting on the loop?

A. riB

B. $2\pi riB$

C. zero

D. πriB

Answer: C

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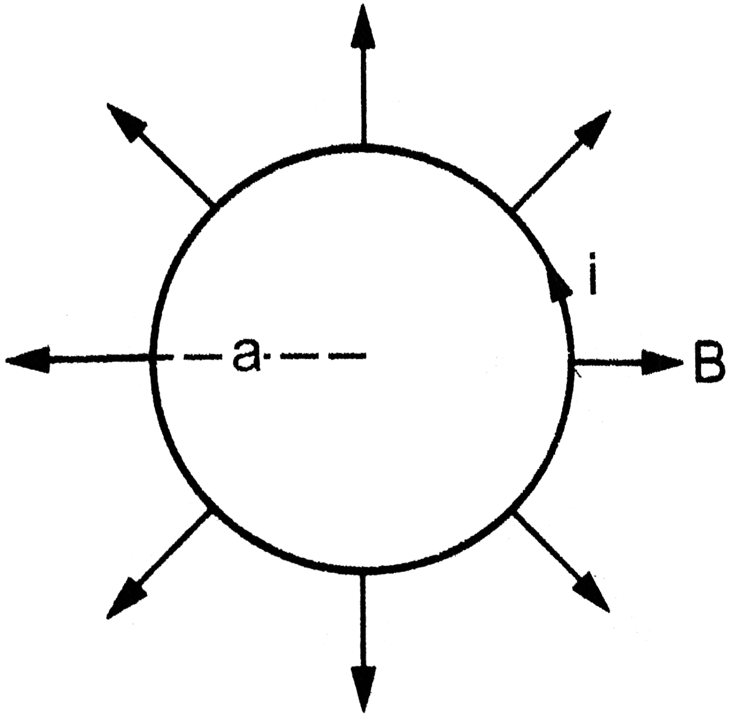
60. A circular loop of radius a, carrying a current I, is placed in a tow dimensional magnetic field. The centre of the loop coincides with the centre of the filed The strenght of the magnetic field at the pariphery of the loop is B. find the magnetic force on the wire.



A. $2\pi Bia$

B. $4\pi Bia$

C. πBia

D. Bia

Answer: A

Watch Video Solution

61. The unit of electric current "ampere" is the current which when flowing through each of two parallel wires spaced $1m$ apart in vacuum and of infinite length will give rise to a force between them equal to

A. $1N/m$

B. $2 \times 10^{-7} N/m$

C. $1 \times 10^{-2} N/m$

D. $4\pi \times 10^{-7} N/m$

Answer: B

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62. A square current carrying loop is suspended in a unifrom magnetic field acting in the palne of the loop. If the force on one arm of the loop is $\overrightarrow{F}$, the net force on the remaining three arms of the loop is

A. $\overrightarrow{F}$

B. $3\overrightarrow{F}$

C. $-\overrightarrow{F}$

D. $-3\overrightarrow{F}$

Answer: C

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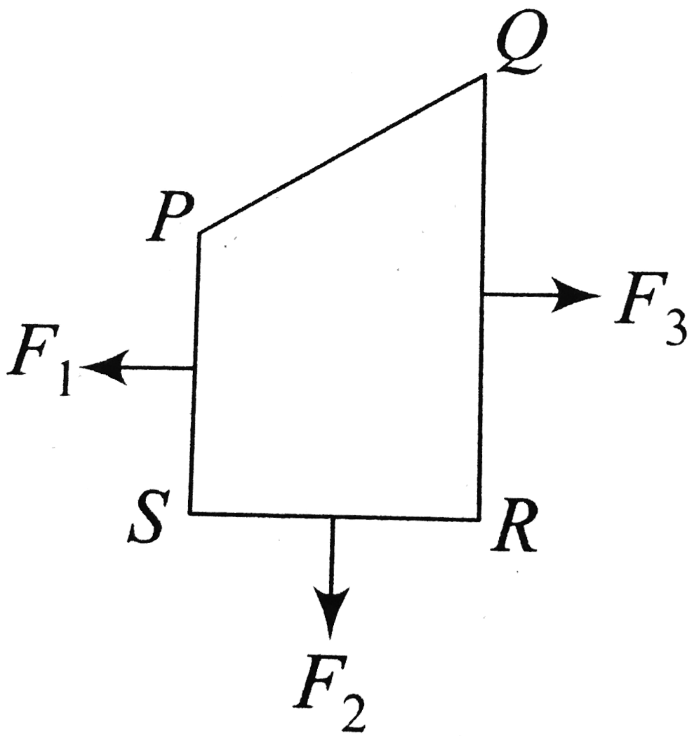
63. A closed loop $PQRS$ carrying a current is place in a unifrom magnetic forces on segments PS, SR and RQ are F_1, F_2 and F_3 respectively and are in the plane of the paper and along the directions shown, the force on the segment QP is



A. $\sqrt{(F_3 - F_1)^2 - F_2^2}$

B. $F_3 + F_1 - F_2$

C. $F_3 - F_1 + F_2$

D. $\sqrt{(F_3 - F_1)^2 + F_2^2}$

Answer: D

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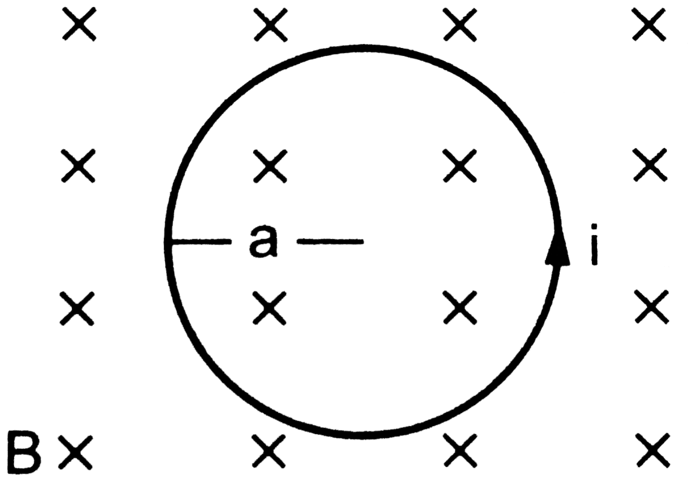
64. Shows a circular wire-loop of radius a m carrying a current I, placed in a perpendicualr matgnetic field B. (a) Consider a small part dl of the wire. Find the force on this part of the wire exerted by the magnetic field. Find the force of compression in the wire.



A. Bia

B. $2Bia$

C. $5Bia$

D. none

Answer: A

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65. A current-carrying ring is placed in a magnetic field. The direction of the field is perpendicular to the plane of the ring

(i) There is no net force on the ring

(ii) The ring will tend to expand

(iii) The ring will tend to contract

(iv) Either (ii) or (iii) depending on the directions of the current in the ring and the magnetic field

A. (i), (ii)

B. (ii), (iv)

C. (ii), (iii)

D. (i), (iv)

Answer: D

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66. A small circular flexible loop of wire of radius r carries a current I. It is placed in a uniform magnetic field B. The tension in the loop will be doubled if (Choose the incorrect option)

A. I is doubled

B. B is doubled

C. r is doubled

D. both B and I are doubled

Answer: D

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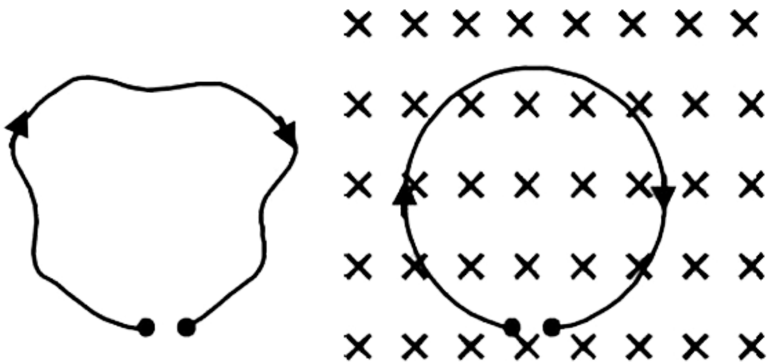
67. A thin wire of length L is connected to two adjacent fixed points and carries a current I in the clockwise direction , as shown in the figure. When the system is put in a uniform magnetic field of strength B going into the plane of the paper , the wire takes the shape of a circle . The tension in the wire is



A. IBL

B. $\frac{IBL}{\pi}$

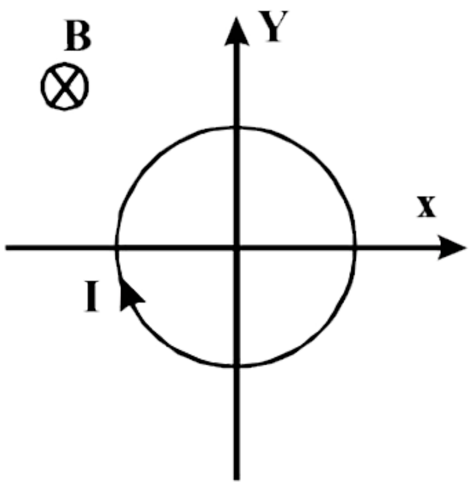
C. $\frac{IBL}{2\pi}$

D. $\frac{IBL}{4\pi}$

Answer: C

Watch Video Solution

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



A. contract

B. expand

C. move towards $+ve$ x-axis

D. move towards $-ve$ x-axis

Answer: B

Watch Video Solution

69. An irregular closed loop carrying a current has a shape such that the entire loop cannot lie in a single plane. If it is a placed in a uniform magnetic field, the force acting on the loop

A. must be zero

B. can never be zero

C. may be zero

D. will be zero only for one particular direction of the magnetic field

Answer: A

Watch Video Solution

70. A closed loop lying in the xy plane carries a current. If a uniform magnetic field B is present in the region, the force acting on the will be zero if B is in

A. the x-dierction

B. the y-dierction

C. the z-dierction

D. ant of the above direction

Answer: D

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71. Two very long, straight , parallel wires carry steady currents $I\& -I$ 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 wires , in the plane of the wires. Its instantaneous vel,ocity v is perpendicular to this plane. The magnitude of the force due to the magnetic field acting on the charge at this instant is

A. $\frac{\mu_0 Iqv}{2\pi d}$

B. $\frac{\mu_0 Iqv}{\pi d}$

C. $\frac{2\mu_0 Iqv}{\pi d}$

D. zero

Answer: D

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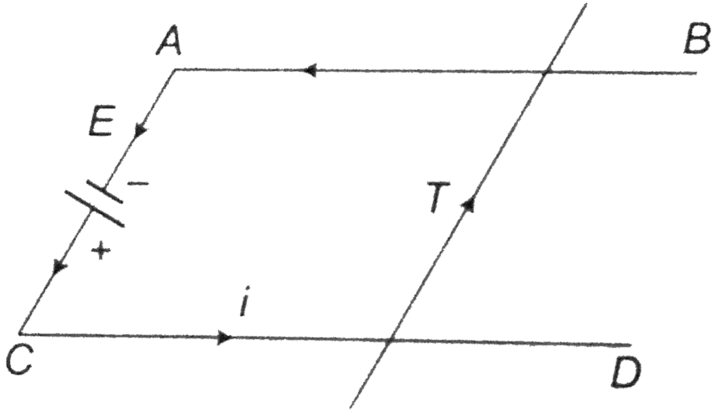
72. AB and CD are smooth, parallel, horizontal rails on which a conductor T can slide. A cell, E, drives current I through the rails and T



(i) The current in the rails will set up a magnetic field over T

(ii) T will experienced a force to the right

(iii) T will experienced a force to the left

(iv) T will not experienced any force

A. (i), (ii)

B. (ii), (iv)

C. (ii), (iii)

D. (i), (iv)

Answer: A

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73. In the previous question,

(i) the force on T is proportional to i

(ii) the force T is proportional to i^2

(iii) if direction of I is reversed in the circuit be reversing E,

the force on T will remain in the same direction

A. (i), (ii)

B. (ii), (iv)

C. (ii), (iii)

D. (i), (iv)

Answer: B

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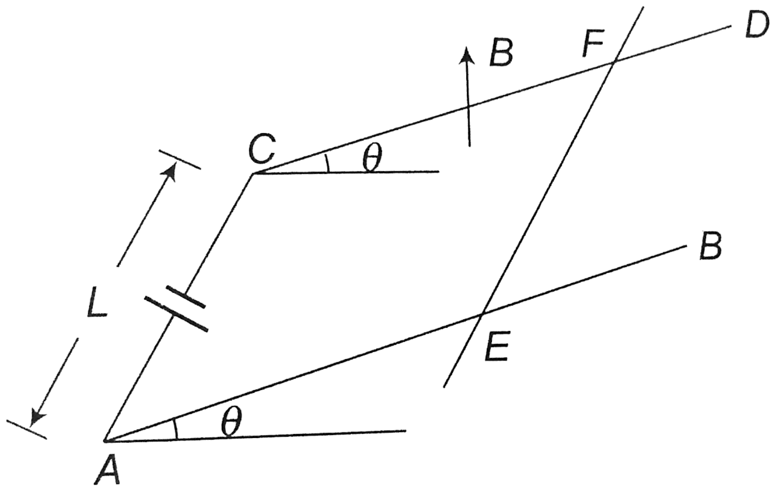
74. AB and CD are smooth, parallel rails, separated by a distance L and inclined to the horizontal at an angle θ. A uniform magnetic field of magnitude B, directed vertically upwards, exists in the region. EF is a conductor of mass m, carrying a current i. For EF to be in equilibrium



(i) i must flow from E to F

(ii) $BiL = mg\tan\theta$

(iii) $BiL = mg\sin\theta$

(iv) $BiL = mg$

A. (i), (ii)

B. (ii), (iv)

C. (ii), (iii)

D. (i), (iv)

Answer: A

Watch Video Solution

75. In the previous question, if B is normal to the plane of the rails,

A. $BiL = mg\tan\theta$

B. $BiL = mg \sin \theta$

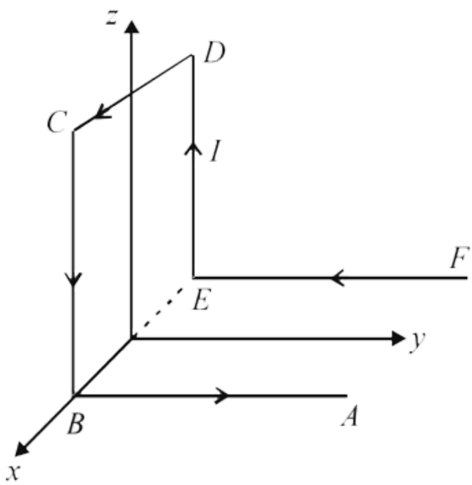
C. $BiL = mg \cos \theta$

D. Equilibrium cannot be reached

Answer: B

Watch Video Solution

76. A wire $ABCDEF$ (with each side of length L) bent as shown in figure and carrying a current I is placed in a uniform magnetic induction B parallel to the positive $y - direction$. The force experienced by the wire is .... In the .... direction .



A. BIL in $+y$-direction

B. BIL in $-z$-direction

C. $3BIL$

D. zero

Answer: B

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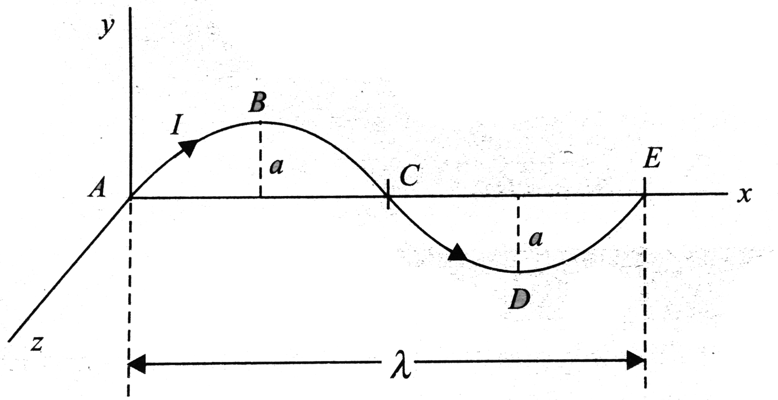
77. A conductor ABCDE, shaped as shown, carries current I. It is placed in the x-y plane with the end A and E on the x-axis. A uniform magnetic field of magnitude B exists in the region. The force acting on it will be



A. (i), (ii)

B. (ii), (iii)

C. (iii), (iv)

D. (i), (ii), (iii)

Answer: D

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78. An experimenter's diary reads as follows: "a charged particle is projected in a magnetic feld of $\left(7.0\overrightarrow{i}-3.0\overrightarrow{j}\right)X10^{-3}$ T. The acceleraation of the particle is found to be $\left(sqrare\overrightarrow{i}+7.0\overrightarrow{j}\right)X10^{-6}ms^{-2}'. The\nu mber \rightarrow the \leq ftof$ vec i` in the last expression was not readable. What can this number be?

A. 3

B. 2

C. 1

D. zero

Answer: A

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79. Two long, thin, parallel conductors are kept very close to each other, without touching. One carries a current i and the other has charge λ, per unit length. An electron moving parallel to the conductor is undeflected. Let $c =$ velocity of right

(i) $v = \frac{\lambda c^2}{i}$

(ii) $v = \frac{i}{\lambda}$

(iii) $c = \frac{i}{\lambda}$

(iv) the electron may be at any distance from the conductor

A. (i), (ii)

B. (ii), (iii)

C. (i), (iii)

D. (i), (iv)

Answer: D

Watch Video Solution

80. A charged particle P leaves the origin with speed $v = v_0$ at some inclination with the x-axis. There is a uniform magnetic field B along the x-axis. P strikes a fixed target T on the x-axis for a minimum value of $B = B_0$. P will also strike T if

A. (i), (ii)

B. (ii), (iii)

C. (i), (iii)

D. (i), (iv)

Answer: A

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81. A charged particle is fired at an angle θ to a uniform magnetic field directed along the x-axis. During its motionalong a helical path, the particle will

A. (i), (ii)

B. (ii), (iii)

C. (i), (iii)

D. (i), (iv)

Answer: D

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82. In the previous question, if the pitch of the helical path is equal to the maximum distance of the particle from the x-axis

A. $\cos\theta = \frac{1}{\pi}$

B. $\sin\theta = \frac{1}{\pi}$

C. $\tan\theta = \frac{1}{\pi}$

D. $\tan\theta = \pi$

Answer: D

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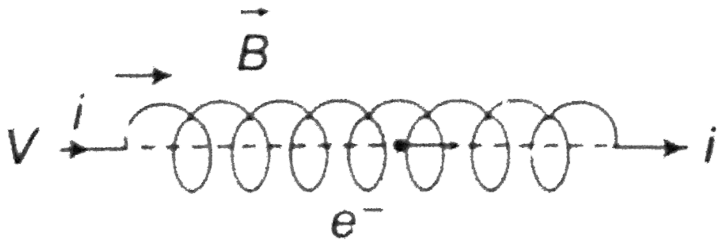

83.

Work done on an electron moving in a solenoid along its axis is equal to

A. zero

B. $-evB$

C. i/B

D. none of the above

Answer: A

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84. If a current is passed through a spring then the spring will

A. gets compressed

B. gets expanded

C. oscillates

D. remains unchanged

Answer: A

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85. Two parallel conductors carrying current in the same direction attract each other, while two parallel beams of electrons moving in the same direction repel each other. Which of the following statement provide part of all of the reason for this ? (Choose the incorrect option)

A. The conductors are electrically netural

B. The conductors produce magnetic fields on each other

C. The electrons beams do not produce magnetic field on each other

D. The magnetic forces caused by the electron beams on each other are weaker than the electrostatic forces between them

Answer: C

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86. A proton beam is going from north to south and an electron beam is going from south to north. Neglecting the earth's magnetic field, the electron beam will be deflected

A. towards the proton beam

B. away from the proton beam

C. upwards

D. downwards

Answer: A

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87. A beam of electrons and protons move parallel to each other in the same direction, then they

A. do not exert any force on each other

B. repel each other

C. attract each other

D. get rotated to be perpendicular to each other

Answer: B

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88. Lorentz force is given by

A. $q\left(\overrightarrow{E} + \overrightarrow{v} \times \overrightarrow{B}\right)$

B. $q\left(\vec{E} - \vec{v} \times \vec{B}\right)$

C. $q\left(\vec{E} + \vec{v} . \vec{B}\right)$

D. $q\left(\vec{E} \times \vec{B} + \vec{v}\right)$

Answer: A

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89. If a chraged particle at rest experiences no electromagnetic force,

(i) the electric field must be zero

(ii) the magnetic field must be zero

(iii) the electric field may or may not be zero

(iv) the magnetic field may or may not be zero

A. (i), (ii)

B. (ii), (iv)

C. (ii), (iii)

D. (i), (iv)

Answer: D

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90. If a charge particle kept at rest experiences an electromagnetic force,

(i) the electric field must not be zero

(ii) the magnetic field must not be zero

(iii) the electric field may or may not be zero

(iv) the magnetic field may or may not be zero

A. (i), (ii)

B. (ii), (iv)

C. (ii), (iii)

D. (i), (iv)

Answer: D

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91. A uniform electric field and a uniform magnetic field are acting along the same direction in a certain region. If an electron is projected along the direction of the fields with a certain velocity then

A. turn to its right

B. turn to its left

C. keep moving in the same but its speed will increase

D. keep moving in the same but its speed will decrease

Answer: D

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92. A particle moves in a region having a uniform magnetic field and a parallel, uniform electric field. At some instant, the velocity of the particle is perpendicular to the field directjion. The path of the particle will be

A. a straight line

B. a circle

C. a helix with uniform pitch

D. a helix with non-uniform pitch

Answer: D

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93. A uniform magnetic field of magnitude 0.20 T exists in space from east to west what speed should a particle of mass 0.010 g and having a charge $1.0X10^{-5}C$ be projected from south to north so that it moves with a uniform velocity?

A. $49m/\sec$

B. $49.5m/\sec$

C. $50m/\sec$

D. $48.5m / \sec$

Answer: C

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94. A particle moves in a circle of diamater 1.0 cm under the action of magnetic field of 0.40 T, An electric field of $200Vm^{-1}$ makes the path straight. Find the charges/mass ration of the particle.

A. $2.5 \times 10^5 C / kg$

B. $2.0 \times 10^5 C / kg$

C. $2.5 \times 10^6 C / kg$

D. $3.0 \times 10^5 C / kg$

Answer: A

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95. A proton goes undflected in a crossed and magnetic field (the fields are perpendicular to each other) at a speed of $2.0X10^5 ms^{-1}$. The velocity is perpendicular to both the fields. When the electric field is switched off, the proton moves along a circle of radius 4.0 cm. Find the magnitudes of the electric and the magnetic fields. take the mass of the proton $= 1.6X10^{-27}$ kg.

A. $10^4 N/C, 0.05$

B. $10^5 N/C, 0.05$

C. $10^{-4} N/C, 0.04$

D. $10^4 N/C, 0.04$

Answer: A

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96. Which of the following does not affect the motion of a moving electron ?

A. Electric field applied in the direction of motion

B. Magnetic field applied in the direction of motion

C. Electric field applied perpendicular to the direction of motion

D. Magnetic field applied perpendicular to the direction of motion

Answer: B

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97. if a charged particle projected in a gravity free room deflects,

A. (i), (ii)

B. (ii), (iv)

C. (ii), (iii)

D. (iii) , (iv)

Answer: D

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98. 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 $+y$ - direction and the negative ions towardws $-y$ - direction

A. $+ve$ ions deflects towards $+y$ and $-ve$ ions towards $-y$

B. all ions deflects towards $+y$

C. all ions deflects towards $-y$

D. $+ve$ ions deflects towards $-y$ and $-ve$ ions towards $+y$

Answer: D

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99. A charged particle moves in a gravity-free space without change in velocity. Which of the following is/are possible?

(i) $E = 0, B = 0$

(ii) $E = 0, B \neq 0$

(iii) $E \neq 0, B = 0$

(iv) $E \neq 0, B \neq 0$

A. (i), (ii)

B. (ii), (iv)

C. (ii), (iii)

D. (i), (ii), (iv)

Answer: D

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100. A charged particle moves along a circle under the action of possible constant electric and magnetic fields. Which of the following are possible?

A. $E = 0, B = 0$

B. $E = 0, B \neq 0$

C. $E \neq 0, B = 0$

D. $E \neq 0, B \neq 0$

Answer: B

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101. If a charged particle goes unaccelerated in a region containing electric and magnetic fields,

(i) $\overrightarrow{E}$ must be perpendicular to $\overrightarrow{B}$

(ii) $\overrightarrow{v}$ must be perpendicular to $\overrightarrow{E}$

(iii) $\overrightarrow{v}$ must be perpendicular to $\overrightarrow{B}$

(iv)E must be equal to vB

A. (i), (ii)

B. (ii), (iv)

C. (ii), (iii)

D. (i), (iv)

Answer: A

Watch Video Solution

102. If a charged particle goes unaccelerated in a region containing electric and magnetic fields,

(i) $\overrightarrow{E}$ must be perpendicular to $\overrightarrow{B}$

(ii) $\overrightarrow{v}$ must be perpendicular to $\overrightarrow{E}$

(iii) $\overrightarrow{v}$ must be perpendicular to $\overrightarrow{B}$

(iv)E must be equal to vB

A. (i), (ii)

B. (ii), (iv)

C. (ii), (iii)

D. (i), (iv)

Answer: A

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103. 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 nagative x-axis. This can be done by applying the magnetic field along

A. (i), (ii)

B. (ii), (iv)

C. (ii), (iii)

D. (i), (iv)

Answer: B

Watch Video Solution

104. A particle having mass m and charge q is released from the origin in a region in which ele field and magnetic field are given by $B = -B_0\hat{j}$and $E = E_0\hat{k}$.

Find the y- component of the velocity and the speed of the particle as a function of it z-coordinate.

A. $\sqrt{\frac{2qE_0z}{m}}$

B. $\sqrt{\frac{qE_0z}{m}}$

C. $\sqrt{\frac{qE_0z}{2m}}$

D. $\sqrt{\frac{4qE_0z}{m}}$

Answer: A

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105. A charged particle moves undeflected in a region of crossed electric and magnetic fields. If the electric field is switched off, the particle has an initial acceleration a. If the magnetic field is switched off, instead of electric field, the particle will have an initial acceleration

A. equal to 0

B. $> a$

C. equal to a

D. $< a$

Answer: C

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106. A charged particle begins to move from the origin in a region which has a uniform magnetic field in the x-direction and a uniform electric field in the y-direction. Its speed is v when it reaches the point (x, y, z). Then, v will depend

A. only on x

B. only on y

C. on both x and y but not z

D. on x, y and z

Answer: B

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107. When a proton is released from rest in a room, it starts with an initial acceleration a_0 towards west. When it is projected towards north with a speed v_0 it moves with an initial accelaration $3a_0$ towards west. The electric and the maximum possible magnetic field in the room

(i) $\frac{ma_0}{e}$, towards west

(ii) $\frac{2ma_0}{ev_0}$, downward

(iii) $\frac{ma_0}{e}$, towards east

(iv) $\frac{2ma_0}{ev_0}$, upward

A. (i), (ii)

B. (ii), (iv)

C. (ii), (iii)

D. (i), (iv)

Answer: A

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108. A region has uniform electric and magnetic fields along the positive x-direction. An electron is fired from the origin at an angle $\theta(< 90^\circ)$ with the x-axis. It will

(i) move along a helical path of increasing pitch

(ii) move along a helical path of decreasing pitch initially

(iii) return to the yz plane at some time

(iv) come to rest momentarily at some position

A. (i), (ii)

B. (ii), (iv)

C. (ii), (iii)

D. (i), (iv)

Answer: C

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109. A particle having a mass of $10^{-2}kg$ carries a charge of $5 \times 10^{-8}C$. The particle is given an initial horizontal velocity of $10^5 m\sec^{-1}$ in the presence of electric field $\overrightarrow{E}$ and magnetic field $\overrightarrow{B}$. To keep the particle moving in a horizontal direction, it is necessary that

A. $\overrightarrow{B}$ should be perpendicular to the direction of velocity and $\overrightarrow{E}$ should be along the direction of velocity

B. Both $\overrightarrow{B}$ and $\overrightarrow{E}$ should be along the direction of velocity

C. Both $\overrightarrow{B}$ and $\overrightarrow{E}$ are mutually perpendicular and perpendicular to the direction of velocity

D. $\overrightarrow{B}$ should be along the direction of velocity and $\overrightarrow{E}$ should be perpendicular to the direction of velocity

A. A and B

B. C and D

C. B and C

D. B and D

Answer: C

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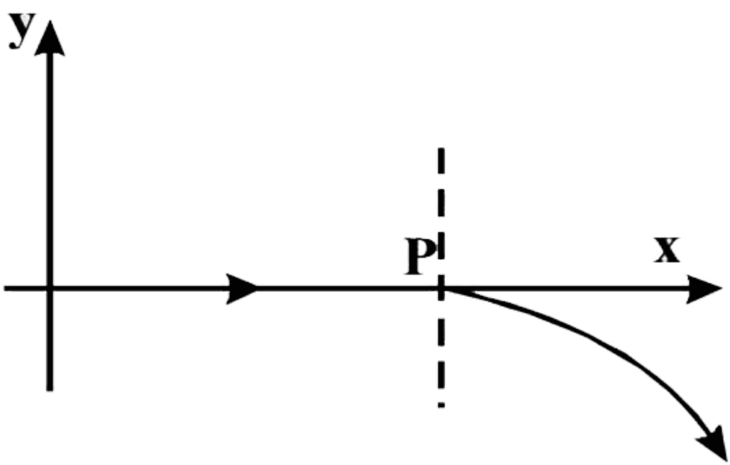
110. For a positively charged particle moving in a $x-y$ plane initially along the $x-a\xi s$, there is a sudden change in its path due to the presence of electric and//or magnetic fields beyond p . The curved path is shown in the $x-y$plane and is found to be non - circular. Which one of the following combinations is possible ?



A. $\overrightarrow{E} = 0, \overrightarrow{B} = b\hat{i} + c\hat{k}$

B. $\overrightarrow{E} = b\hat{i}, \overrightarrow{B} = c\hat{k} + a\hat{i}$

C. $\overrightarrow{E} = 0, \overrightarrow{B} = c\hat{j} + b\hat{k}$

D. $\overrightarrow{E} = a\hat{i}, \overrightarrow{B} = c\hat{k} + b\hat{j}$

Answer: B

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111. Consider the motion of a positive point charge in a region where there are simultaneous uniform electic and magnetic field $E = E_0\hat{j}$ and $B = B_0\hat{j}$. At time $t = 0$, this charge has velocity v inn the xy-plane making an angle θ with the x-axis. Which of the following option(s) is (are) correct for time $t > 0$?

If $\theta = 0^0$ the charge moves in a circular path in the xy-plane.

$b. If\theta = 0^0$ the charge undergoes helical motion with constant pitch along the y-axis.

c. If $\theta = 10^0$ the charge undergoes helicalmotion with its pitch increasing with time along the y-axis.

d If $\theta = 90^\circ$ the charge undergoes linear but accelerated motion along the y-axis.

A. (i), (ii)

B. (i), (iv)

C. (ii), (iii)

D. (iii), (iv)

Answer: D

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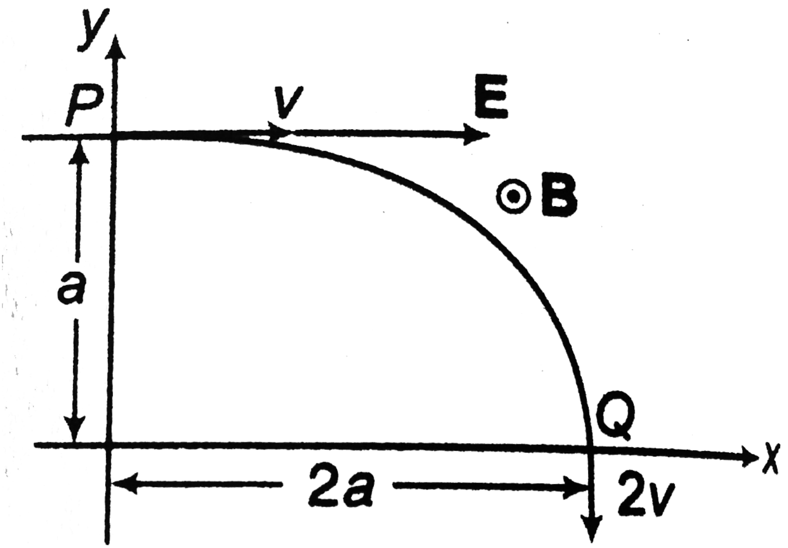
112. A particle of charge $+q$ and mass m moving under the influence of as uniform electric field $E\hat{i}$ and uniform magnetic field $B\hat{k}$ follows trajectory form P to Q as shown in figure. The velocities at P and Q re $v\hat{i}$ and $-2\hat{j}$. Which of the following statement(s) is/are correct?



a. $E = \frac{3}{4}\left[\frac{mv^2}{qa}\right]$

b. Rate of work done by the electrif field at P is $\frac{3}{4}\left[\frac{mv^3}{a}\right]$

c. Rate of work done by the electric field at P is zero.

d. Rate of work done by both the field at Q is zero.

A. (i), (ii)

B. (ii), (iv)

C. (i), (ii), (iv)

D. (i), (iv)

Answer: C

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113. A circular coil of radius $4cm$ and of 20 turns carries a current of 3 amperes. It is placed in a magnetic field of intensity of $0.5weber/m^2$. The magnetic dipole moment of the coil is

A. $0.15\text{ampere}-m^2$

B. $0.3\text{ampere} - m^2$

C. $0.45\text{ampere} - m^2$

D. $0.6\text{ampere} - m^2$

Answer: B

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114. An electron moving in a circular orbit of radius r makes n rotation per secound. The magnetic field produced at the centre has magnitude

A. zero

B. $\frac{\mu_0 ne}{4\pi r}$

C. $\frac{\mu_0 ne}{2r}$

D. $\dfrac{\mu_0 n^2 e}{2r}$

Answer: C

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115. In the previous question, the orbital electron has magnetic moment

A. zero

B. $\pi r^2 ne$

C. $\pi r^2 n^2 e$

D. $\dfrac{\mu_0}{2\pi} r^2 ne$

Answer: B

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116. A point P lies on the axis of a flat coil carrying a current. The magnetic moment of the coil is μ. The distance of P from the coil is d, which is large compared to the radius of the coil. The magnetic field at P has magnitude

A. $\frac{\mu_0}{2\pi}\left(\frac{\mu}{d^3}\right)$

B. $\frac{\mu_0}{4\pi}\left(\frac{\mu}{d^3}\right)$

C. $\frac{\mu_0}{2\pi}\left(\frac{\mu}{d^2}\right)$

D. $\frac{\mu_0}{4\pi}\left(\frac{\mu}{d^2}\right)$

Answer: A

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117. Due to the flow of current in a circular loop of radius R, the magnetic induction produced at the centre of the loop is B. The magnetic moment of the loop is (μ_0=permeability constant)

A. $BR^3 / 2\pi\mu_0$

B. $2\pi BR^3 / \mu_0$

C. $BR^2 / 2\pi\mu_0$

D. $2\pi BR^2 / \mu_0$

Answer: B

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118. A flat coil of n turns, area A and carrying a current I is placed in a uniform magnetic field of magnitude B. The plane of the coil makes an angle θ with the direction of the field. The torque acting on the coil is

A. $BInA\sin\theta$

B. $\frac{nAI}{B}\sin\theta$

C. $BInA\cos\theta$

D. $BIn^2A\cos\theta$

Answer: C

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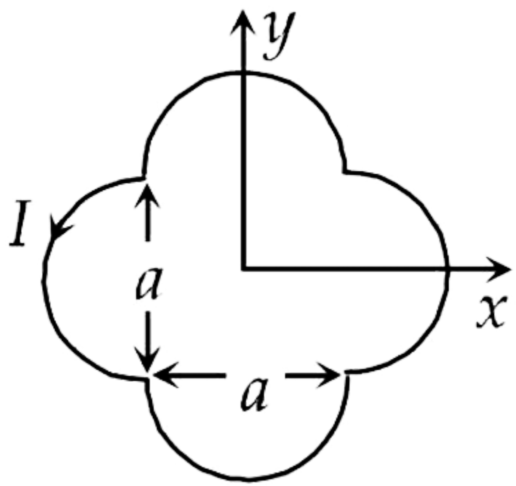
119. A loop carrying current I lies in the $x-y$ plane as shown in the figure . The unit vector $\hat{k}$ is coming out of the plane of the paper . The magnetic moment of the current loop is



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. $(2\pi+1)a^2 I\hat{k}$

Answer: D

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120. 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

A. M

B. $\frac{4}{\pi^2}M$

C. $\frac{4}{\pi}M$

D. $\frac{\pi}{4}M$

Answer: D

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121. A steady current i flows in a small square lopp 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 $\overrightarrow{\mu}_1$ and $\overrightarrow{\mu}_2$ respectively denote the magnetic moments due to the current loop before and after folding. Then

A. $\overrightarrow{\mu}_2 = 0$

B. $\overrightarrow{\mu}_1$ and $\overrightarrow{\mu}_2$ are in the same direction

C. $\dfrac{\left|\overrightarrow{\mu}_1\right|}{\left|\overrightarrow{\mu}_2\right|} = \sqrt{2}$

D. $\dfrac{\left|\overrightarrow{\mu}_1\right|}{\left|\overrightarrow{\mu}_2\right|} = \left(\dfrac{1}{\sqrt{2}}\right)$

Answer: C

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122. A rectangular coil of 100 turns has length 5 cm and width 4 cm. it is placed with its plane parallel to a uniform magnetic field and a current of 2 A is sent through the coil. Find the magnitude of the magnetic field B, if the torque acting on the coil is $0.2Nm^{-1}$.

A. $0.5T$

B. $0.6T$

C. $0.4T$

D. zero

Answer: A

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123. A 50 turn circular coil of radius 2.0 cm carrying a current of 5.0 A is rotated in a magnetic field of strength 0.20 T. (a) What is the maximum torque that acts on the coil? (b) in a particular position of the coil, the torque acting on it is half of this maximum. What is the angle between the magnetic field and the plane of the coil?

A. 60°

B. 30°

C. 90°

D. 100°

Answer: A

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124. A rectangular loop of sides $20cm$ and $10cm$ carries a current of $5.0A$. A uniform magnetic field of magnitude $2T$ exists parallel to the longer side of the loop. The torque acting on the loop is

A. $0.2Nm$

B. $0.3Nm$

C. $2Nm$

D. $3Nm$

Answer: A

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125. A closely wound solenoid of 2000 turns and area of cross-section $1.5 \times 10^{-4} m^2$ carries a current of $2.0A$. It is suspended through its centre and perpendicular to its length, allowing it to turn in a horizontal plane in a uniform magnetic field 5×10^{-2} tesla making an angle of 30° with the axis of the solenoid. The torque on the solenoid with the

A. $3 \times 10^{-3} N. m$

B. $1.5 \times 10^{-3} N. m$

C. $1.5 \times 10^{-2} N. m$

D. $3 \times 10^{-2} N. m$

Answer: C

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126. A coil in the shape of an equilateral triangle of side l is suspended between the pole pieces of permanent magnet. Such that $\overrightarrow{B}$ is in plane of the coil. If due to a current I in the triangle, a torque τ acts on it, the side l of the triangel is:

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

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

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

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

Answer: C

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127. A coil of 100 turns and area $2 \times 10^{-2} m^2$, pivoted about a vertical diameter in a uniform magnetic field carries a current of $5A$. When the coil is held with its plane in North-South direction, it experiences a torque of $0.3N/m$. When the plane is in East-West direction the torque is $0.4Nm$. The value of magnetic induction is (Neglect earth's magnetic field)

A. $0.2T$

B. $0.3T$

C. $0.4T$

D. $0.05T$

Answer: D

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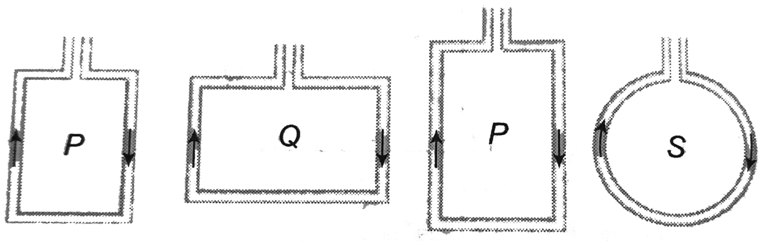
128. Four wires each of length 2.0 meters area bent into four loops P, Q, R and S and then suspended into uniform magnetic field. Same current is passed in each loop. Which statement is correct?



A. P

B. Q

C. R

D. S

Answer: D

129. A particle of the charged 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

A. ω and q

B. ω, q and m

C. q and m

D. ω and m

Answer: C

130. 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

A. $q/2m$

B. q/m

C. $2q/m$

D. $q/\pi m$

Answer: A

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131. A long straight conductor carrying a current lies along the axis of a ring. The conductor will exert a force on the ring if the ring

A. carries a current

B. has uniformly distributed charge

C. has non-uniformly distributed charge

D. none of the above

Answer: D

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132. In the previous question, let the ring have non-uniformly distributed charge, and let it be spinning about its axis. Let

F be the net force on the ring and τ be the torque on the ring due to the straight conductor

A. $F \neq 0, \tau \neq 0$

B. $F = 0, \tau \neq 0$

C. $F \neq 0, \tau = 0$

D. $F = 0, \tau = 0$

Answer: D

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133. A flat coil carrying a current has a magnetic moment μ. It is placed in a magnetic field B such that μ is anti-parallel to B. The coil is

A. not in equilibrium

B. in stable equilibrium

C. in unstable equilibrium

D. in natural equilibrium

Answer: C

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134. A current carrying loop is free to turn in a uniform magnetic field.The loop will then come into equilibrium when its plane is inclined at

A. 0° to the direction of the field

B. 45° to the directed of the field

C. 90° to the directed of the field

D. 135° to the directed of the field

Answer: C

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135. A flat coil carrying a current has a magnetic moment μ. It is initially in equilibrium, with its plane perpendicular to a magnetic field of magnetic B, If it now rotated through an angle θ, the work done is

A. $\mu B\theta$

B. $\mu B \cos\theta$

C. $\mu B(1 - \cos\theta)$

D. $\mu B \sin \theta$

Answer: C

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136. A small coil of N turns has an effective area A and carries a current I. It is suspended in a horizontal magnetic field $\overrightarrow{B}$ such that its plane is perpendicular to $\overrightarrow{B}$. The work done in rotating it by 180° about the vertical axis is

A. $NAIB$

B. $2NAIB$

C. $2\pi NAIB$

D. $4\pi NAIB$

Answer: B

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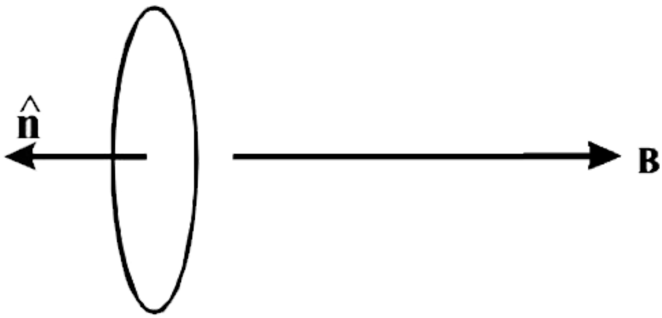
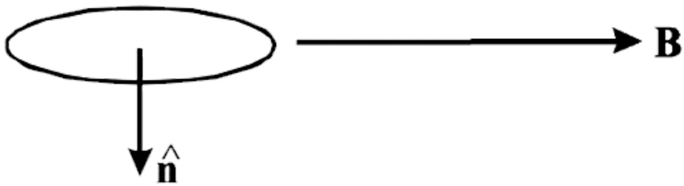
137. A current carrying loop is placed in a uniform magnetic field in four different orientations , I,ii,iii & iv arrange them in the decreasing order of potential Energy`

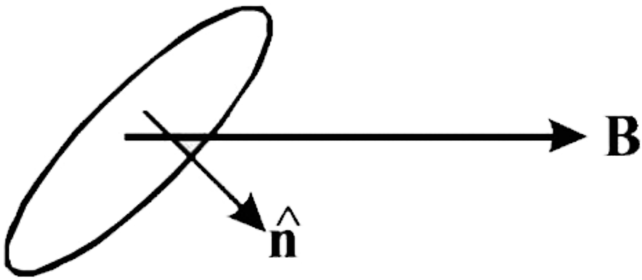
I.

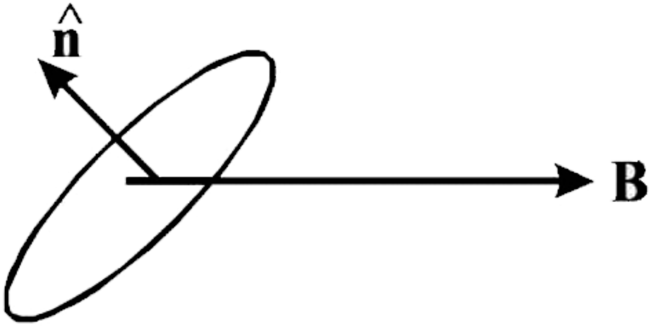


II.



III



IV 

A. $I > III > II > IV$

B. $I > II > III > IV$

C. $I > IV > II > III$

D. $III > IV > I > II$

Answer: C

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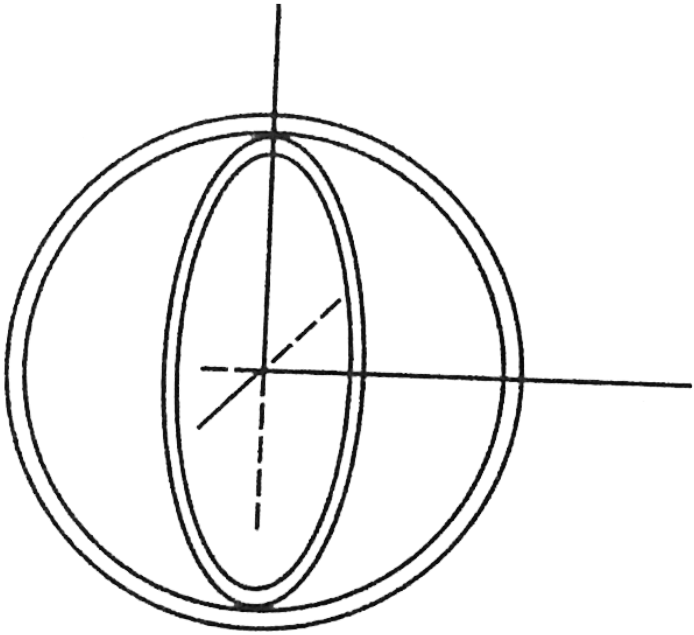
138. Two insulated rings, one of a slighlty smaller diameter than the other are suspended along their common diameter as shown. Initially the planes of the rings are mutually perpendicular. When a steady current is set up each of them



A. The two rings rotate into a common plane

B. The inner rings 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

Answer: A

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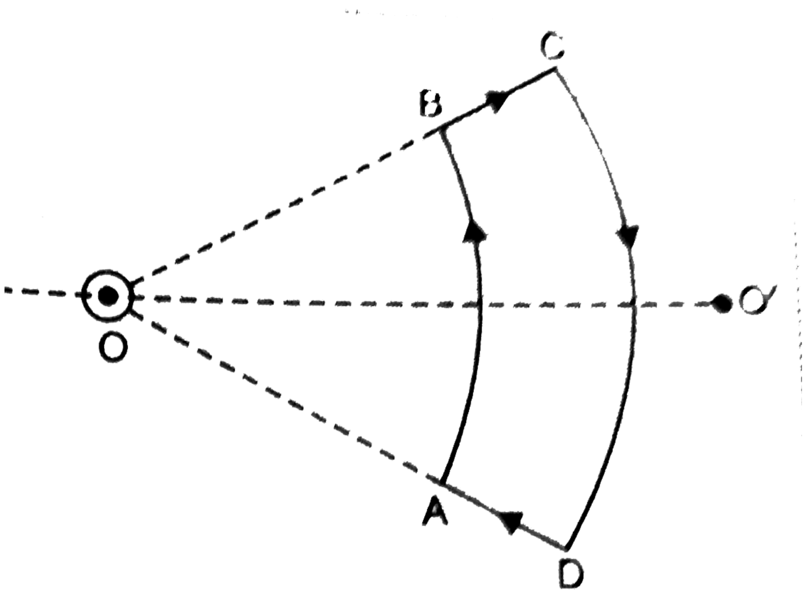
139. An infinite current carrying wire passes through point O and is perpendicular to the plane containing a current carrying loop ABCD as shown in figure. Choose the correct option(s).



A. (i), (ii)

B. (i), (iii)

C. (ii), (iii)

D. (ii), (iv)

Answer: B

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140. A square coil of edge l having n turns carries a curent i. it is kept on a smooth horizontal plate. A uniform magnetic field B exists in a direction parallel to an edge the total mass of the coil is M. What should be the minimum value of B for which the coil will start tipping over?

A. $\frac{Mg}{2nil}$

B. $\frac{Mg}{nil}$

C. $\frac{2Mg}{nil}$

D. $\left(\frac{Mg}{nil}\right)^2$

Answer: A

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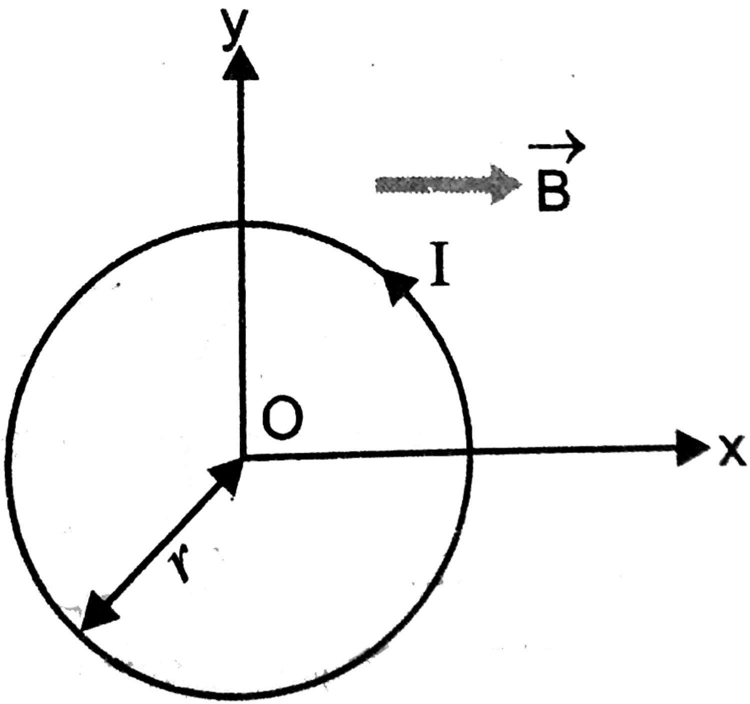
141. A circular loop of mass m and radius r in X-Y plane of a horizontal table as shown in figure. A uniform magnetic field B is applied parallel to X-axis. The current I in the loop, so that its one edge just lifts from the table is



A. $\frac{mg}{\pi r^2 B}$

B. $\frac{mg}{2\pi r^2 B}$

C. $\frac{mg}{\pi r B}$

D. $\frac{\pi r B}{mg}$

Answer: C

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