PHYSICS

AAKASH INSTITUTE ENGLISH

MOVING CHARGES AND MAGNETISM

Example

1. A chagre particle having charge 2 C is thrown with velocity $2\hat{i} + 3\hat{j}$ inside a region

$E = 2\hat{j}$ and magnetic field $5\hat{k}$ Find the initial Lorentz force action on the particle

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2. A charged particle of charge 1 mC and mass 2g is moving with a speed of 5m/s in a uniform magnetic field of 0.5 tesla. Find the maximum acceleration of the charged particle

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3. A charged particle of specific charge (i.e charge per unit mass) 0.2 C/kg has velocity $2\hat{i} - 3\hat{j}$ (m/s) at some instant in a uniform magnetic field $5\hat{i} + 2\hat{j}$ (tesla). Find the acceleration of the particle at this instant

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4. A charged particle moving in a magnetic field $\overrightarrow{B} = \hat{i} - \hat{j}$ tesla, has an acceleration of

$2\hat{i} + \alpha\hat{j}(m/s^2)$ at some instant. Find the value of α

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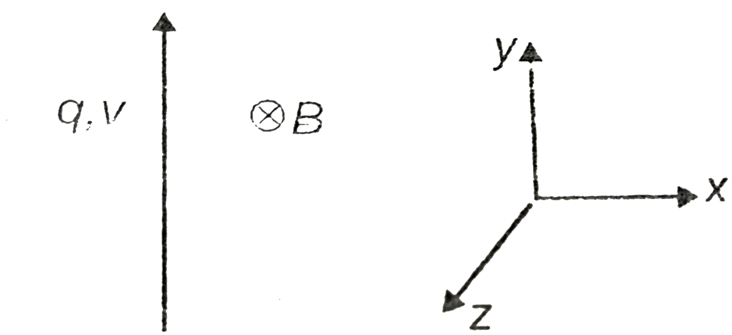
5. Find the instantaneous direction of force in following case (magnetic field and velocity are indicated)



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6. The horizontal component of earth's magnetic field at a certain place is $3 \times 10^{-5} T$ and the direction of the field is from the geographic south to the geographic north. A very long straight conductor is carrying a steady current of 1 A. What is the force per unit length on it when it is placed on a horizontal table and the direction of current is from east to west ?

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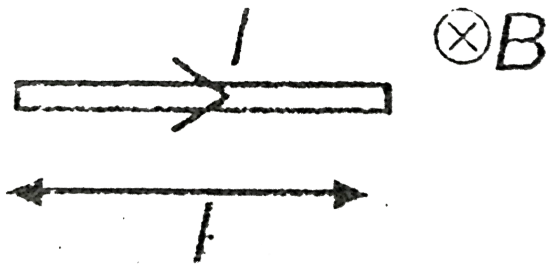
7. A straight wire of mass 400 g and length 2m carries a current of 2A. It is suspended in mid air by a uniform horizontal field B. What is the magnitude of the magnetic field ?



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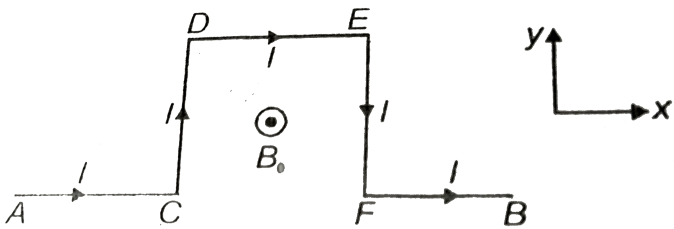
8. A uniform magnetic field $\overrightarrow{B} = B_0\hat{k}$ exists in a region. A current carrying wire is placed in x-y plane as show. Find the force acting on the wire AB, if each section of the wire is of length 'a'.



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9. A proton and an α-particle, accelerated through same potential difference, enter a region of uniform magnetic field with their velocities perpendicular to the field. Compare the radii of circular paths followed by them.

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10. If a charged particle is thrown with double the speed in a region of transverse magnetic field, how do its radius and time period of revolution change?

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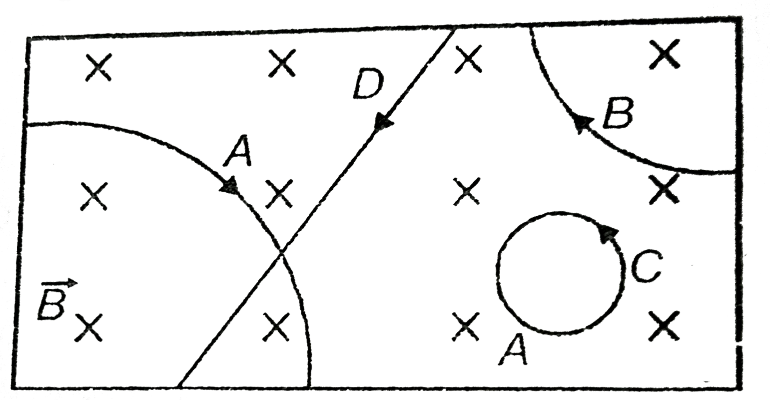
11. Four particles enter a region of uniform magnetic field. Their trajectories are shown in figure. What are the signs of the charge of all four particles ?



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12. Two protons are projected with different velocities in a region having uniform magnetic field that is perpendicular to their velocities. The region is large enough that the protons can execute complete circular trajectories. How do the radii of their circular paths compare? Which particles takes longer to complete one revolution?

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13. A beam of proton with a velocity of $4 \times 10^5 ms^{-1}$ enters a uniform magnetic field of 0.3 T at an angle of 60° to the magnetic field/The radius of helical path taken by proton beam is

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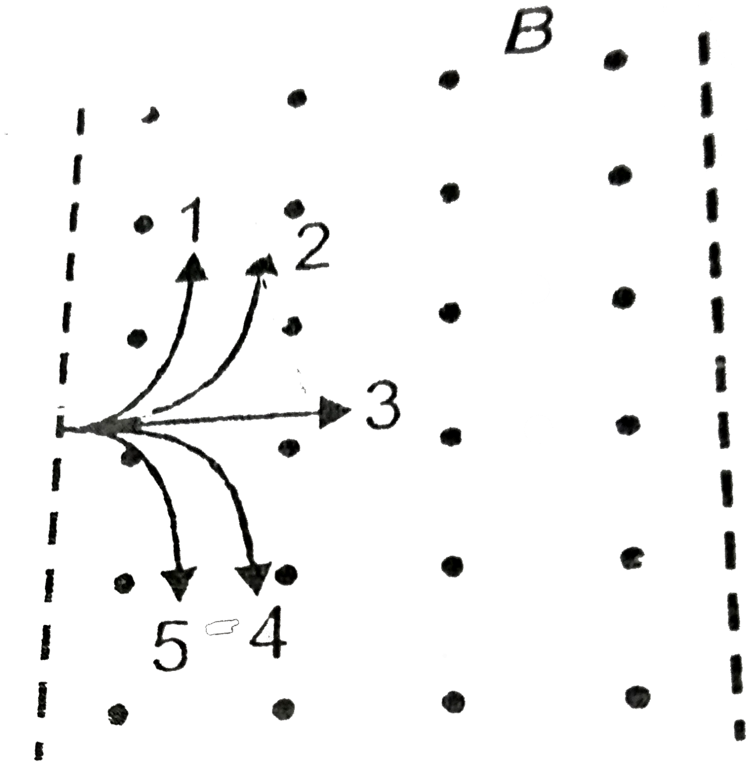
14. A proton, an electron, a neutron, an α-particle and an unknown particle enter a region of magnetic field with equal momental. Figure shows paths (market 1 to 5) followed by these particles. Identify which path corresponds to which particle



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15. The magnetic field applied in a cyclotron is 3.5 T. What will be the frequency of electric field that must be applied between the does in order to accelerate protons ?

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16. Magnetic field applied on a cyclotron is $0 \cdot 7T$ and radius of its dees is $1 \cdot 8m$. What will be the energy of the emergent protons in MeV? Mass of proton $= 1 \cdot 67 \times 10^{-27} kg$.

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17. A current carrying conductor of length l is bent into two loops one by one. First loop has one turn of wire and the second loop has two turns of wire. Compare the magnetic fields at the centre of the loops

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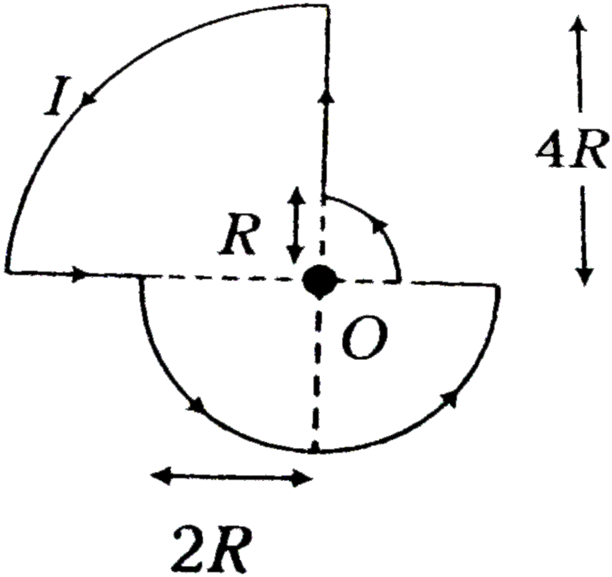
18. Find the magnetic field at the centre O of the loop shown in the figure



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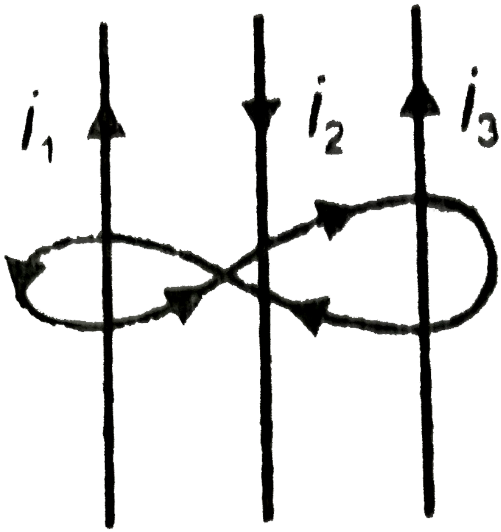
19. Write equation for Ampere's circuital law for the Amperian loop shown (traversed in the direction shown by arrow marks put on it)



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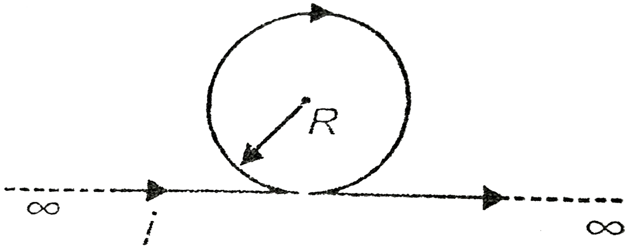
20. Find the magnetic field at the centre of the circular loop shown in figure.



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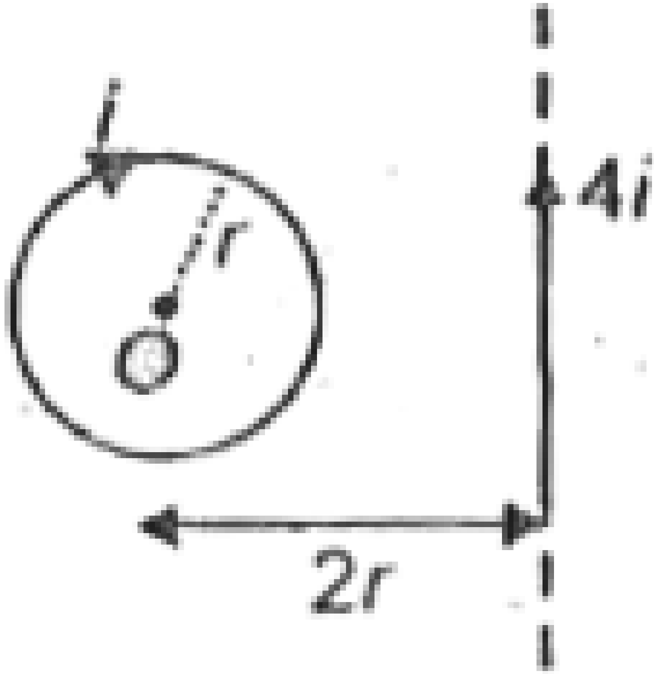
21. What is the net magnetic field at point O for the current distribution shown here?



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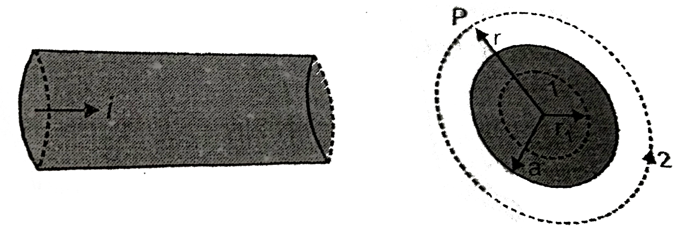
22. Figure shows a long straight wire of a circular cross-section (radius a) carrying steady current I. The current I is uniformly distributed across this cross-section. Calculate the magnetic field in the region $r < a$ and $r > a$



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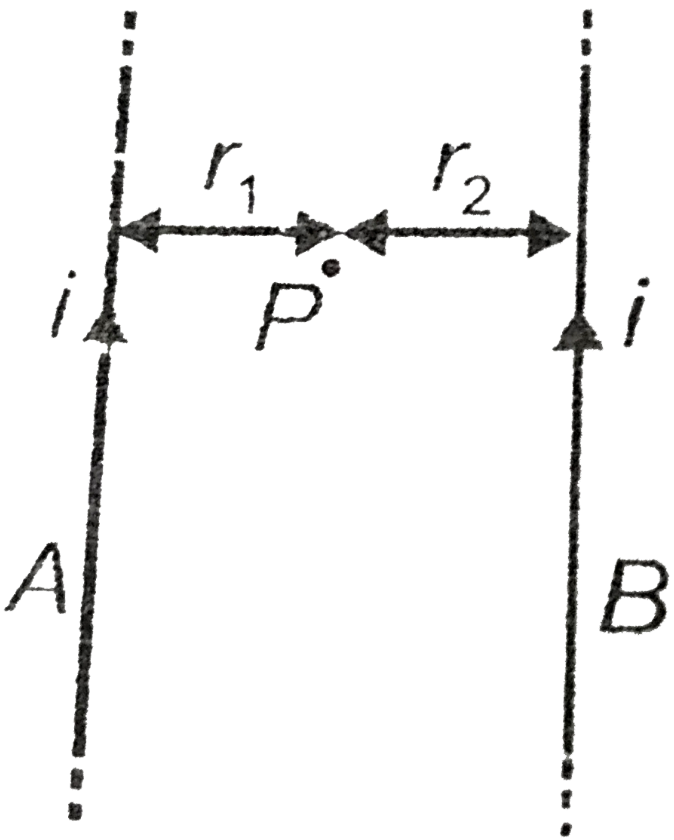
23. Find the direction of magnetic field at a point P due to two infinite current carrying

wires shown in the figure. Given $r_1 > r_2$



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24. A solenoid 50 cm long has 4 layers of windings of 350 turns each. If the current carried is 6A, find the magnetic field at the centre of the solenoid.

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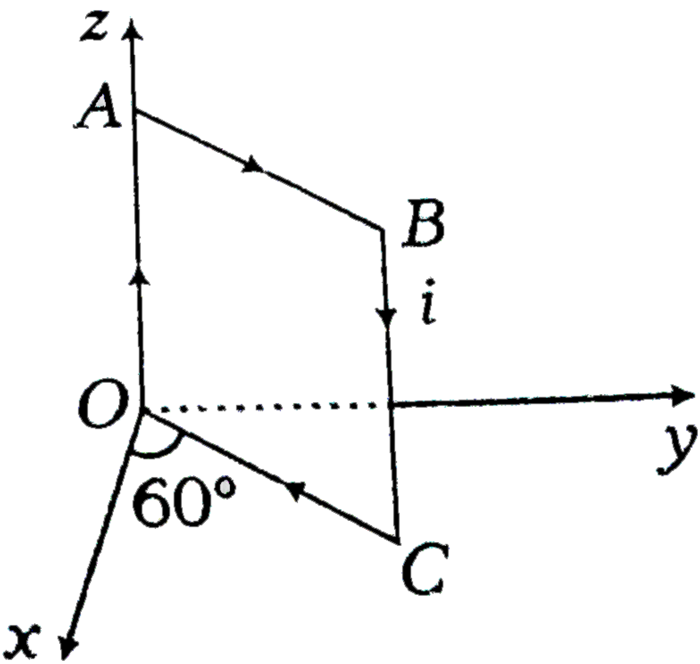
25. A square loop OABCO of side l carries a current i. It is placed as shown figure.Find the magnetic moment of the loop



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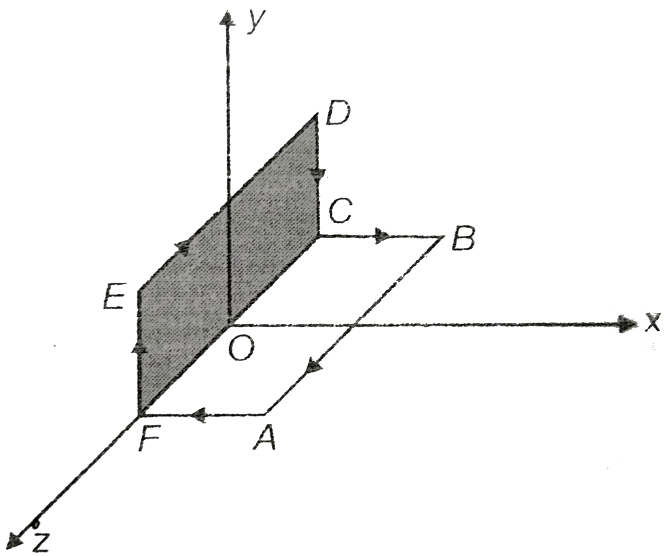
26. Current is flowing in a wire frame kept as shown in the figure where EDCF is in y-z plane and AFCB is in x-z plane. Current in the wire frame is i and length of each side is a. Find the magnetic moment



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27. A current carrying circular loop of radius R is placed in a uniform magnetic field B_0 Tesla in x-y plane as shown in figure. The loop carries a current $i = 1A$ in the direction shown. Find the torqure acting on the loop

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28. A disc of mass m, radius r and carrying charge q, is rotating with angular speed ω about an axis passing through its centre and perpendicular to its plane. Calculate its magnetic moment

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29. A galvanometer has a resistance of 30 ohm and a current of 2 mA is needed to give a full scale deflection. What is the resistance needed and how is it to be connected to convert this galvanometer

(a) Into an ammeter of 0.3 A range ?

(b) Into a volmeter of 0.2 V range ?

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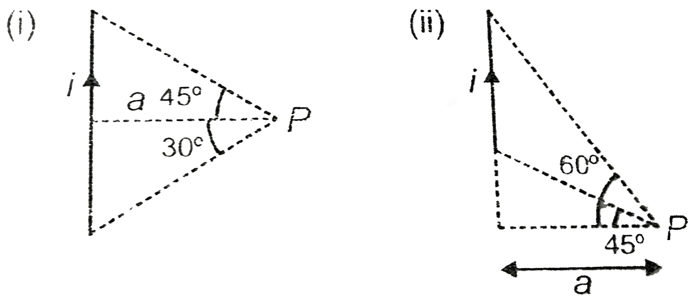
30. What are value of ϕ_1, ϕ_2 and r to find out magnetic field at P in the following cases ?



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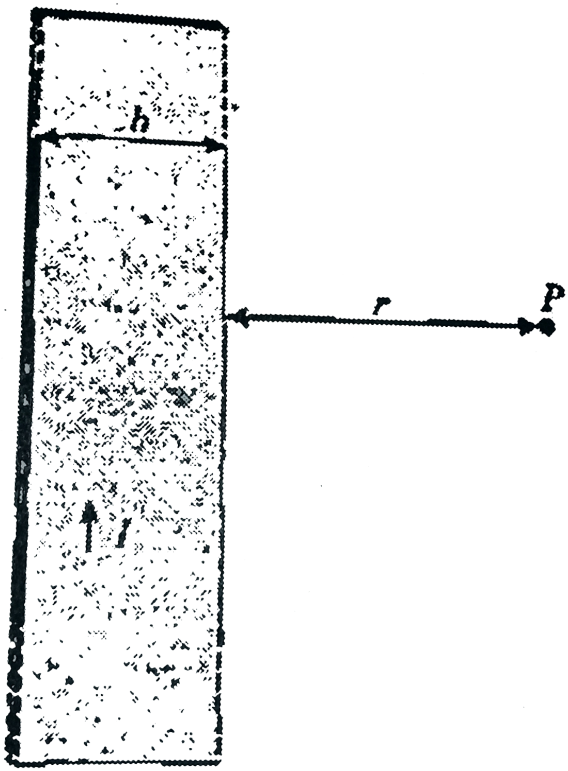
31. Figure shows a long and thin strip of width b which carries a current I. Find magnetic induction due to the current in strip at point P located at a distance r from the strip in the plane of strip as shown in figure-4.35.



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32. Two straight infinitely long and thin parallel wires are spaced 0.2m apart and carry a current of 10A each. Find the magnetic field at a point distance 0.1m from both wires in the two cases when the currents are in the (a) same and (b) opposite directions.

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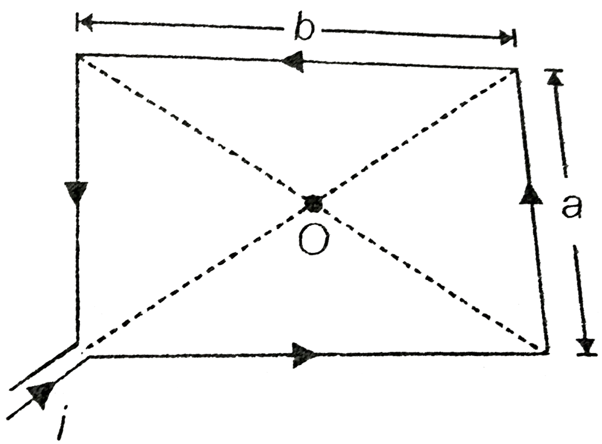
33. A current loop is bent in the form of a rectangule of sides a and b as shown. The current flowing through the loop is i and its direction is shown in the figure. Calculate the magnetic field at the centre of the rectangle



Strategy : Due to each side of the rectangle, field at O is perpendicular to the plane of paper adn outwards (you can check it using Right Hand Thumb Rule). So the fields can be added up to find net magnetic field.

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34. Find the magnetic field at the ccentre of a current carrying conductor bent in the form of an arc subtending angle θ at its centre. Radius of the arc is R

Strategy: Let the arc lie in x-y plane with its centre at the origin. Consider a small current element $i\overrightarrow{dl}$ as shown. The field due to this element at the centre can be obtained by Biot-Savart law

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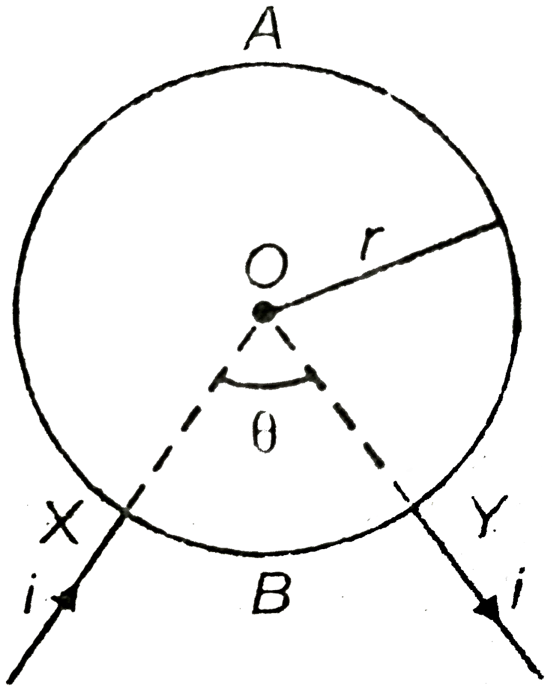
35. A current enters a uniform conducting loop of radius r at X and leaves at Y

(i) What is magnetic field at O due to arc portions XBY and XAY of the loop ?

(ii) What is net magnetic field at O ?



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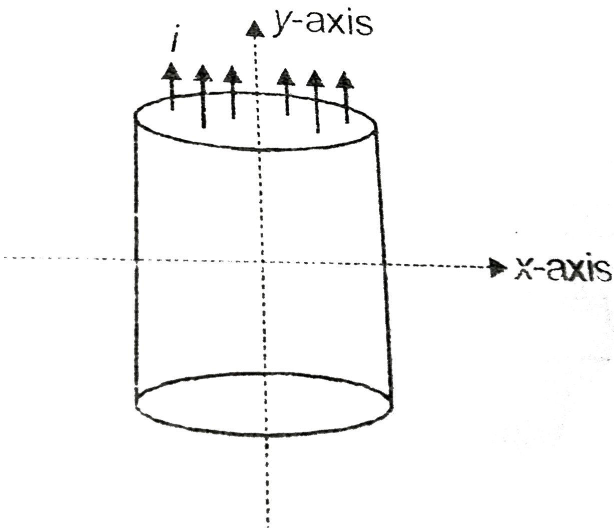
36. The figure shows a long straight current carrying conductor. Can you plot the variation of magnetic field on x-axis ?



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37. Can you use Ampere's law of find the magnetic field at the centre of a ring of radius R and carrying current I?

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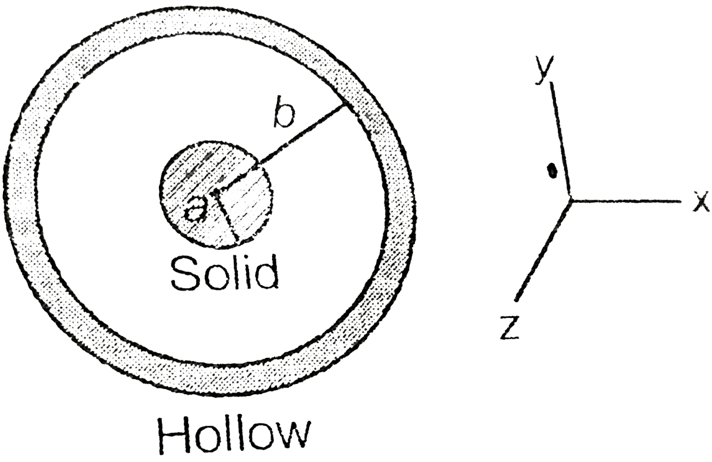
38. Consider a system of two long coaxial cylinders: solid (of radius a carrying i current in positive z direction) and hollow (or radius b carrying current i in negative z direction). Find the magnetic field at a point distant r from of the cylinders for

(i) $r \leq a$

(ii) $a < r < b$

(iii) $r > b$



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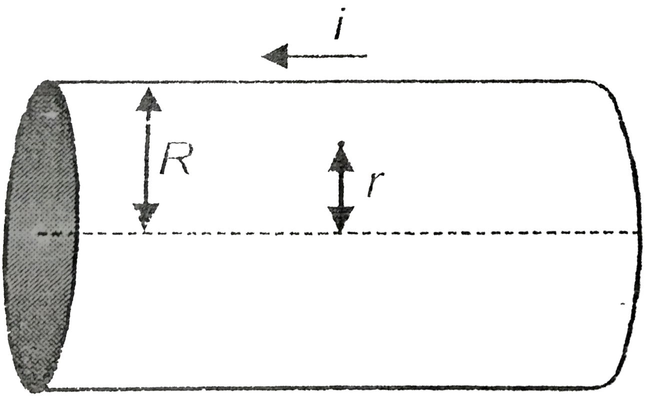
39. A long cylindrical conductor of radius R carries a current i as shown in the figure. The current density J varies across the cross-section as $J = kr^2$, where, k is a constant.

Find an expression for the magnetic field B at a distance $r(< R)$ from the axis



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40. A proton and an α-particle, accelerated through same potential difference, enter a region of uniform magnetic field with their velocities perpendicular to the field. Compare the radii of circular paths followed by them.

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41. If a charged particle is thrown with double the speed in a region of transverse magnetic field, how do its radius and time period of revolution change?

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42. There exists a uniform magnetic field $\overrightarrow{B} = +B_0\hat{k}$ for $x > 0$ and $\overrightarrow{B} = 0$ for all $x < 0$. A charged particle placed at $(0, -a, 0)$ is given an initial velocity $\overrightarrow{v} = v_0\hat{\imath}$. What is the magnitude and nature of charge on the particle such that it crosses through the origin ?

Strategy: When the charge is projected perpendicular to a uniform magnetic field, it follows a circular path. In this case, the force acting on it will be directed either towards +y-axis. or y-axis. It is given that it crosses point O.

Thus, the force at $(0, -a, 0)$ must be towards y-axis

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43. A particle of charge q and mass m released from origin with velocity $\vec{v} = v_0 \hat{i}$ into a region of uniform electric and magnetic fields parallel to y-axis. i.e., $\vec{E} = E_0 \hat{j}$ and $\vec{B} = B_0 \hat{j}$. Find out the position of the particle as a functions of time

Strategy : Here $\vec{E} \mid \mid \vec{B}$

The electric field accelerates the particle in y-direction i.e., component of velocity goes on increasing with acceleration

$$a_y = \frac{F_y}{m} = \frac{F_e}{m} = \frac{qE_0}{m}$$

The magnetic field rotates the particle in a circle in x-z plane (perpendicular to magnetic field) The resultant path of the particle is a helix with increasing pitch.

Velocity of the particle at time t would be

$$\overrightarrow{v}(t) = v_x \hat{i} + v_y \hat{j} + v_z \hat{k}$$

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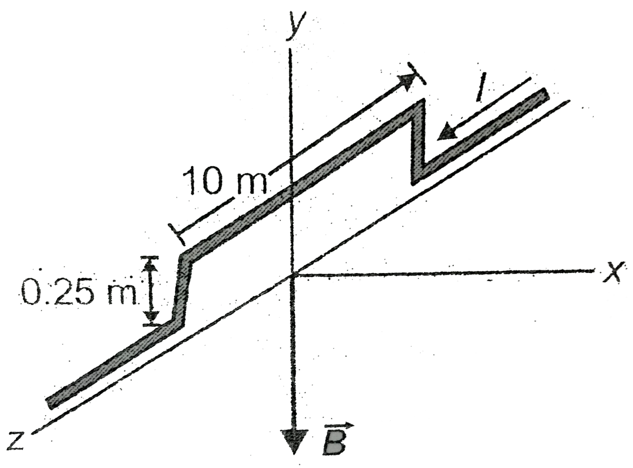
44. A long wire is bent to form a rectangular section and is placed in a region with a uniform magnetic field, as shown in figure. The magnetic field is directed downward and has a magnitude of 2.5 T. The wire carries a 25-A current. Find the net torque on the wire about the z-axis



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45. The figure shows top view of a conducting rob AB, bent to form a semicircle of radius R, carrying current I, placed on a smooth horizontal table. It is subjected to a uniform magnetic field B perpendicular to its plane as shown. The rod is held at rest in its position by two light strings attached to its ends. Calculate the magnetic force acting on the conductor AB and the tension in the strings.

Strategy: To find the force conductor, consider a small arc of length $dl = Rd\theta$. This arc can be consider as a straight conductor of length dl.

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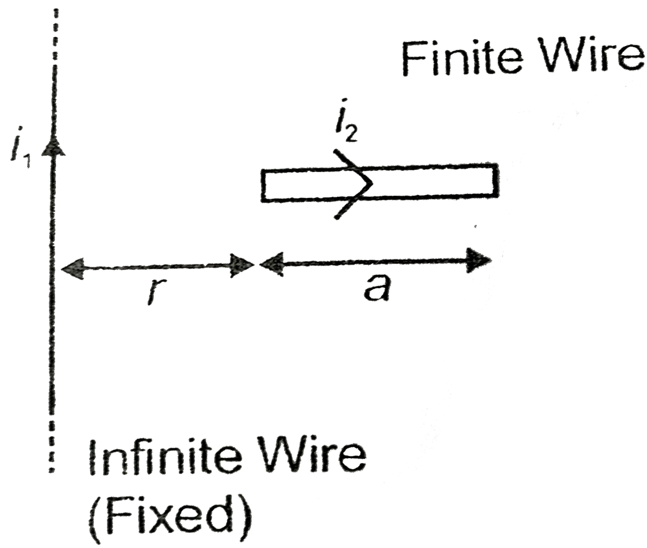
46. What is the magnetic force acting on the finite wire due to the fixed infinite wire shown here?



Strategy: We cannot use formula $\vec{F} = i\vec{l} \times \vec{B}$ to find the force as the magnetic field created by the fixed infinite wire is non-uniform. We have to consider an element on the finite wire, find force on it and integrate to obtain the net force.

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47. An electron revolves anti-clockwise around a proton in a hydrogen atom. The speed of electron is v and radius of its circular orbit is r. find

(i) The magnetic field produced at the centre

(ii) Magnetic dipole moment of circulating electron

(iii) The ratio of magnetic moment of angular momentum of electron

Strategy: A charge in motion constitutes current. Therefore, an electron moving on circle is equivalent to a current carrying loop

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48. A disc of mass m, radius r and carrying charge q, is rotating with angular speed ω about an axis passing through its centre and perpendicular to its plane. Calculate its magnetic moment

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49. A current loop of magnetic dipole moment $\overrightarrow{M}$ is placed in uniform magnetic field B. Initially the angle between $\overrightarrow{M}$ and $\overrightarrow{B}$ is θ_1. Find the work done by magnetic field as the angle is increased from θ_1 to θ_2

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50. A coil of radius R carries a current i_1. Another concentric coil of radius $r(r < < R)$ carries a current i_2. Planes of two coils are mutually perpendicular and both the coils are free to rotate about common diameter. Find maximum kinetic energy attained by the two coils, when both are released from rest. The masses of two coils are M and m respectively.

Strategy : The magnetic field due to coil of radius R is $\frac{\mu_0 i_1}{2R}$. This field exerts a torque on shorter coil. An equal and opposite torque is exerted by the shorter coil on larger coil. There is no external torque acting on the system. The angular momentum remains conserved. Also the total mechanical energy remains conserved. At any instant, let ω_1 and ω_2 represent the angular velocity

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Illustration

1. If an electron is not deflected in passing through a certain region of space can we be sure that there is no magnetic field in that region?

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2. If a moving electron if deflected sideways in passing through a certain region of space, can we be sure that a magnetic field exists in that region?

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3. A beam of protons is deflected sideways. Could this deflection be caused

(1) By an electric field ?

(2) By a magnetic field ?

(3) If either could be responsible how would you be able to tell which was present ?

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4. If a charged particle at rest experiences no electromagnetic force, then

The electric field must be zero

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5. If a charged particle at rest experiences no electromagnetic force

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6. If a charged particle kept at rest experiences an electromagnetic force,

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7. If a charged particle at rest experiences no electromagnetic force

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8. If a charged particle projected in a gravity-free room deflects, then

Both fields cannot be zero

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9. A charged particle enters into a gravity free space occupied by anelectric field E and magnetic field B and it comes out without any change in velocity. Then, the possible cases may be

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

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11. A charged particle goes undeflected in a region containing electric and magnetic field. It is possible that

(i) $\vec{E}\left|\left|\vec{B}.\ \vec{v}\right|\right|\vec{E}$

(ii) $\vec{E}$ is not parallel to $\vec{B}$

(iii) $\vec{v}\ |\ |\ \vec{B}$ but $\vec{E}$ is not parallel to $\vec{B}$

(iv) $\vec{E}\ |\ |\ \vec{B}$ but $\vec{v}$ is not parallel to $\vec{E}$

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

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13. The primary functions of

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14. Which of the following particles can't be accelerated in a cyclotron?

(1) Proton p^{+} (2) Antiproton p^{-}

(3) Alpha particle α^{++} (4) Positron e^{+}

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Try Yourself

1. An α-particle of mass $6.65 \times 10^{-27} kg$ is travelling at right angles to a magnetic field with a speed of $6 \times 10^{5} ms^{-1}$. The strength of the magnetic field is $0.2T$. Calculate the force on the α-particle and its acceleration.

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2. Find instantaneous direction of force in following cases (magnetic field and velocity are indicated)

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3. The horizontal component of the earth's magnetic field at a certain place is $3.0x \times 10^{-5} T$ and the direction of the field is from the geographic south to the geographic north. A very long straight conductor is carrying a steady current of 1A. What is the force per unit length on it when it is placed on a horizontal table and the direction of the current is (a) east to west, (b) south to north?

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4. In the previous example find the mass of the wire if the magnetic field is equal to the earth magnetic field $(4 \times 10^{-5} T)$, current in the wire is 5 A and length of the wire is 1m. The wire remains suspended in mid air in equilibrium. (take $g = 10 m / s^2$)

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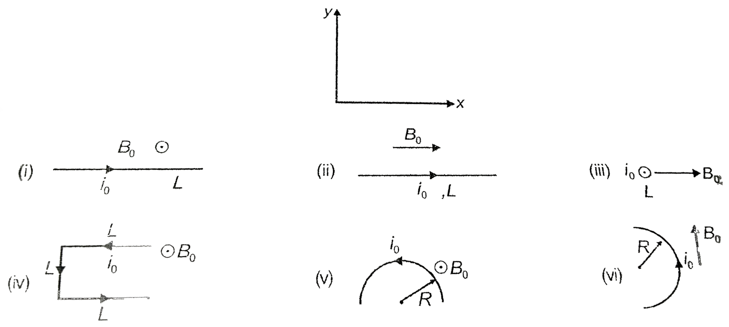
5. Find the magnitude and direction of force on following current carrying wires. Direction of magnetic field is indicated in each case.



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6. Magnetic force acting on the charged particle projected perpendicular to magnetic field is proportional to v^n. Where v is the speed. Find n

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7. Magnetic force acting on the charged particle projected perpendicular to magnetic field is proportional to r^n, where r is radius of circular path. Find n

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8. A small ball of radius r rolls down without sliding in a big hemispherical bowl. of radius R. What would be the ratio of the translational and rotational kinetic energies at the bottom of the bowl?

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9. An alpha particle and proton enter a region of magnetic field which is perpendicular to their direction of motion. Find ratio of radius of circle described by them if they

(i) have same velocity

(ii) have same momentum

(iii) have same energy

(iv) are accelerated by same potential difference

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10. Two protons enter a region of transverse magnetic field. What will be ratio of time period of revolution if the ratio of energy is $2\sqrt{2}:\sqrt{3}$?

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11. The magnetic field applied in a cyclotron is 3.5 T. What will be the frequency of electric field that must be applied between the does in order to accelerate protons ?

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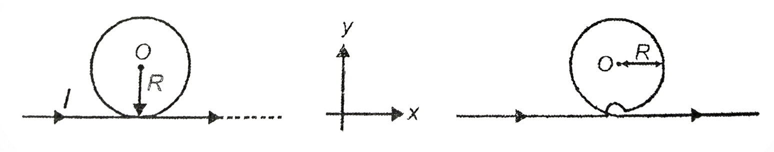
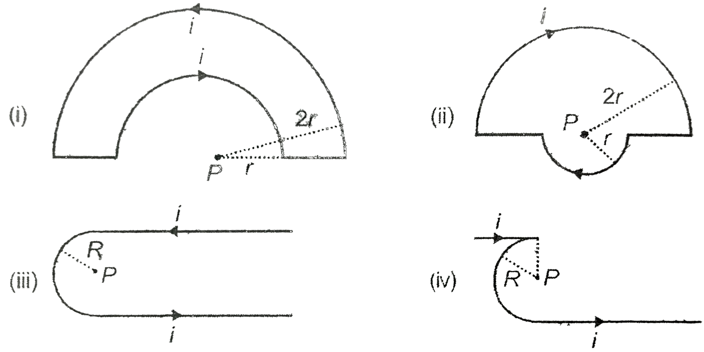
12. A nucleus of mass 220 amu in the free state decays to emit an α-particle . Kinetic energy of the α-particle emitted is 5.4 MeV. The recoil energy of the daughter nucleus is

13. What is net magnetic field at point O?



14. Find the magnetic field at point P in following cases



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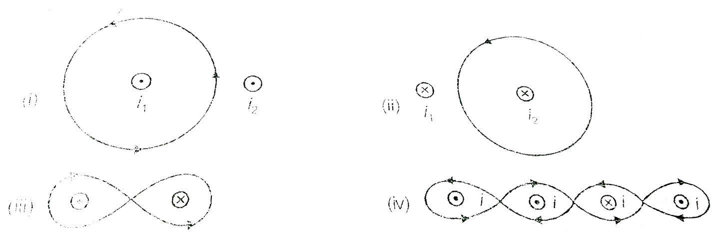
15. Find $\oint \vec{B} \cdot \vec{dl}$ over following loops (direction in which integration has to be performed is indicated by arrows)



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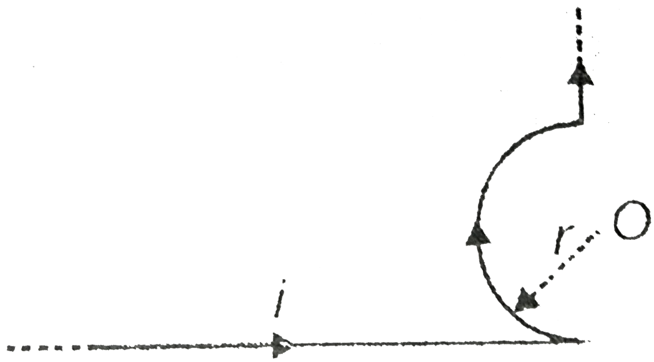
16. Find the magnetic field at point O shown in the figure



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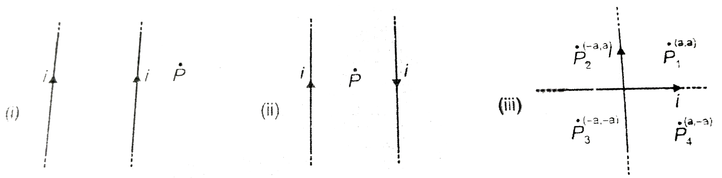
17. Find the direction of magnetic field at a point P due to two infinite current carrying wires shown in the figure below



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18. The magnetic field at a point near the centre but outside a current carrying solenoid is zero. Explain why?

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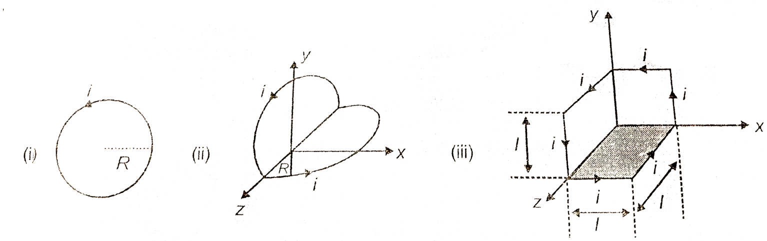
19. Find magnetic moment in following cases



(Eash segment is of length l)

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20. A galvanometer can withstand safely a maximum current of 5 mA. If is converted into voltmeter readding upto 20 V by connecting in series an external resistance of 3960Ω. The resistance of galvanometer is

A. 48Ω

B. 44Ω

C. 36Ω

D. 40Ω

Answer: (iv)

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21. A galvanometer having a resistance of 8 ohm is shunted by a wire of resistance 2 ohm . If the total current is 1 amp , the part of it passing through the shunt will be

A. 0.5 A

B. 0.2 A

C. 0.8 A

D. 0.25 A

Answer: (iii)

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22. In case (a) and (b) where will the magnetic field be maximum, measured on the perpendicular bisectro of the line of shortest distance between the two wires

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23. If for an Amperian loop $\oint \vec{B} . \vec{dl} = 0$ does that mean $\vec{B} = 0$ at every point on the Amperian loop ?

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24. A small ball of radius r rolls down without sliding in a big hemispherical bowl. of radius R. What would be the ratio of the translational and rotational kinetic energies at the bottom of the bowl?

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25. Can you find on the wire without finding force on its individual sections by finding $\vec{l}$?

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26. Will there be any tension in a current carrying loop placed in uniform magnetic field ? If yes, will it be equal to BiR ?

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27. Let $\vec{M}$ and $\vec{L}$ represent magnetic moment and angular momentum vectors for the electron in the above example. What is the

sign of the dot product, $\overrightarrow{M}.\overrightarrow{L}.$ (positive, negative or zero) ?

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Assignment Section A Objective Type Questions One Option Is Correct

1. A long wire carries a steady curent . It is bent into a circle of one turn and the magnetic field at the centre of the coil is B. It is then bent into a circular loop of n turns. The magnetic field at the centre of the coil will be

A. 2nB

B. n^2B

C. nB

D. $2n^2B$

Answer: B

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2. The magnetic field due to a current carrying circular loop of radius 3 cm at a point on the axis at a distance of 4 cm from the centre is $54\mu T$. what will be its value at the centre of the loop?

A. $125\mu T$

B. $150\mu T$

C. $250\mu T$

D. $75\mu T$

Answer: C

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3. A circular coil of radius R carries an electric current. The magnetic field due to the coil at a point on the axis of the coil located at a distance r from the centre of the coil, such that $r > > R$, varies as

A. $1/r$

B. $1/r^{3/2}$

C. $1/r^2$

D. $1/r^3$

Answer: D

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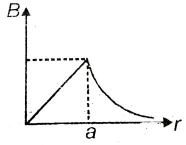
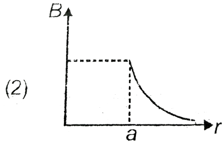
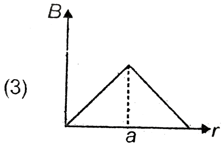
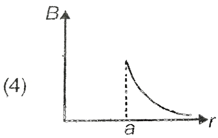
4. The magnetic field due to a straight conductor of uniform cross section of radius a and carrying a steady current is represented by

A. (1) 

B. 

C. 

D. 

Answer: A

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5. A current flows in a conductor from east to west. The direction of the magnetic field at a points above the conductor is

A. Towards west

B. Towards east

C. Towards south

D. Towards north

Answer: D

Watch Video Solution

6. The earth's magnetic field at a given point is $0.5 \times 10^{-5} Wb - m^{-2}$. This field is to be annulled by magnetic indcution at the centre of a circular conducting loop of radius $5.0 cm$. The current required to be flown in the loop is nearly

A. 0.2 A

B. 0.4 A

C. 4A

D. 40A

Answer: B

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7. A long straight wire carrying current of $30A$ is placed in an external uniform magnetic field of induction $4 \times 10^{-4}T$. The magnetic field is acting parallel to the direction of current. The magnitude of the resultant magnetic induction in tesla at a point $2.0cm$ away from the wire is

A. 10^{-4}

B. 3×10^{-4}

C. 5×10^{-4}

D. 6×10^{-4}

Answer: C

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8. Two similar coils are kept mutually perpendicular such that their centres coincide. At the centre, find the ratio of the magnetic field due to one coil and the resultant magnetic field by both coils, if the same current is flown

A. $1 : \sqrt{2}$

B. $1 : 2$

C. $2 : 1$

D. $\sqrt{3} : 1$

Answer: A

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9. The vector form of Biost-Savart law for a current carrying element is

A. $d\overrightarrow{B} = \frac{\mu_0}{4\pi}\frac{idl\sin\phi}{r^2}$

B. $d\overrightarrow{B} = \frac{\mu_0}{4\pi}\frac{i\overrightarrow{dl} \times \hat{r}}{r^2}$

C. $d\overrightarrow{B} = \frac{\mu_0}{4\pi}\frac{i\overrightarrow{dl} \times \hat{r}}{r^3}$

D. $d\overrightarrow{B} = \frac{\mu_0}{4\pi}\frac{i\overrightarrow{dl} \times \overrightarrow{r}}{r^2}$

Answer: B

Watch Video Solution

10. Two long straight wires are set parallel to each other Each carries a current i in the same direction and the separation between them is 2r. The intensity of the magnetic field midway between them is

A. $\mu_0 i / r$

B. $4\mu_0 i / r$

C. zero

D. $\mu_0 i / 4r$

Answer: C

Watch Video Solution

11. A long solonoid carrying a current produces a magnetic field along its axis. If the current is doubled and the number of turns per cm is halved, the new value of the magnetic field is

A. B

B. 2B

C. 4B

D. B/2

Answer: A

Watch Video Solution

12. A long solenoid has 200 turns per cm and carries a current of 2.5 amps. The magnetic field at its centre is $\left(\mu_0 = 4\pi \times 10^{-7}\text{weber}/amp - m\right)$

A. $3.14 \times 10^{-2} Wb/m^2$

B. $6.28 \times 10^{-6} Wb/m^2$

C. $9.42 \times 10^{-6} Wb/m^2$

D. $12.56 \times 10^2 Wb/m^2$

Answer: B

Watch Video Solution

13. If a long hollow copper pipe carriers a direct current, the magnetic field associated with the current will be:

A. Inside the pipe only

B. Outside the pipe only

C. Both inside and outside the pipe

D. Neither inside nor outside the pipe

Answer: B

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14. In a current carrying long solenoid, the field produced does not depend upon

A. Number of turns per unit length

B. Current flowing

C. Radius of the solenoid

D. All of these

Answer: C

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15. A long solenoid has 800 turns per metre length of solenoid. A current of $10/4\pi A$ flows through it. The magnetic induction at the end of the solenoid on its axis is

A. 16×10^{-4} tesla

B. 8×10^{-4} tesla

C. 32×10^{-4} tesla

D. 4×10^{-4} tesla

Answer: B

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16. A solenoid 1.5 metre and 4.0 cm in diameter possesses 10 turns/cm. A current of 5.0 A is flowing throught it. Calculate the magnetic induction (i) inside are (ii) At one end on the axis of solenoid respectively

A. $2\pi \times 10^{-3} T, \pi \times 10^{-3} T$

B. $\pi \times 10^{-3} T, 2\pi \times 10^{-3} T$

C. $2\pi \times 10^{-3} T, 2\pi \times 10\&(-3) T$

D. $\pi \times 10^{-3} T, \pi \times 10^{-3} T$

Answer: A

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17. A current of $\frac{1}{4\pi}$ A is flowing through a toroid. It has 1000 number of turn per meter then value of magnetic field (in wb/m^2) along its axis is

A. 10^{-2}

B. 10^{-3}

C. 10^{-4}

D. 10^{-7}

Answer: C

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Watch Video Solution

18. Mean radius of a toroid is 10 cm and number of turns is 500. If current flowing through it is 0.1 A then value of magnetic induction (in tesla) for toroid is

A. 10^{-2}

B. 10^{-6}

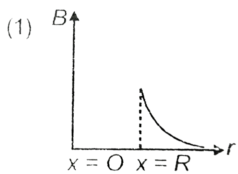
C. 10^{-3}

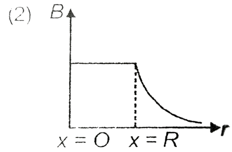
D. 10^{-4}

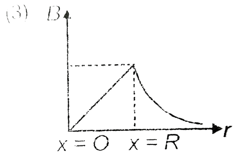
Answer: D

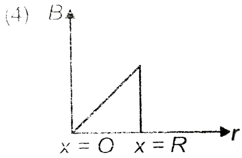
Watch Video Solution

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

A. 

B. 

C. 

D. 

Answer: A

Watch Video Solution

20. A proton an an $\alpha-$ particle, moving with the same velocity, enter a uniform magnetic field, acting normal to the plane of their motion. The ratio of the radii of the circular paths described by the proton and α-particle is

A. $1 : 2$

B. $1 : 4$

C. $1 : 16$

D. $4 : 1$

Answer: A

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21. A particle of mass M and charge Q moving with velocity 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. $BQv2\pi R$

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

C. Zero

D. $BQ2\pi R$

Answer: C

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22. An electron is travelling along the x-direction. It encounters a magnetic field in the y-direction. Its subsequent motion wil be

A. Straight line along the x-direction

B. A circule in the xz-plane

C. A circule in the yz-plane

D. A circle in the xy-plane

Answer: B

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23. Two ions having masses in the ratio charges 1:2 are projected into unifrom magnetic field and perpendicular to the field a cyclotron with speeds in the ratio 2:3 ratio of the radii of circularpsth along which the two particle move is

A. $4:3$

B. $2:3$

C. $3:1$

D. $1:4$

Answer: A

Watch Video Solution

24. A charged particle is at rest in the region where magnetic field and electric field are parallel. The particle will move in a

A. Straight line

B. Circle

C. Ellipse

D. None of these

Answer: A

Watch Video Solution

25. An electron and a proton have equal kinetic energies. They enter in a magnetic field perpendicularly, Then

A. Both will follow a circular path with same radius

B. Both will follow a helical path

C. Both will follow a parabolic path

D. All the statements are false

Answer: D

Watch Video Solution

26. A charge q moves region in a electric field E and the magnetic field B both exist, then the force on its is

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

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

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

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

Answer: D

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27. Which of the following particle will have minimum frequency of revolution when projected with the same velocity perpendicular to a magnetic field?

A. Li^{+}

B. Electron

C. Proton

D. He^{+}

Answer: A

Watch Video Solution

28. Mixed He^+ and O^{2+} ions (mass of He^+ =4 amu and that of $O^{2+} = 16$ amu) beam passes a region of constant perpendicular magnetic field. If kinetic energy of all the ions is same then

A. He^+ ions will be deflected more than those of O^{2+}

B. He^+ ions will be deflected less than those of O^{2+}

C. All the ions will be deflected equally

D. No ions will be deflected

Answer: C

Watch Video Solution

29. When a charged particle enters ina uniform magnetic field then its kinetic energy

A. Remains constant

B. Increases

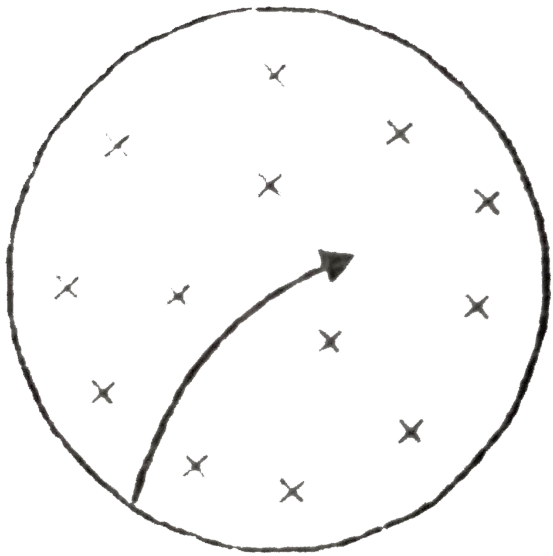
C. Decreases

D. Becomes zero

Answer: A

Watch Video Solution

30. There is a magnetic field acting in a plane perpendicular to this sheet of paper, downward into the paper as shown in the figure. Paticles in acuum move in the plane of the paper from left to right. The path indicated by the arrow could be travelled by



A. Proton

B. Neutron

C. Electron

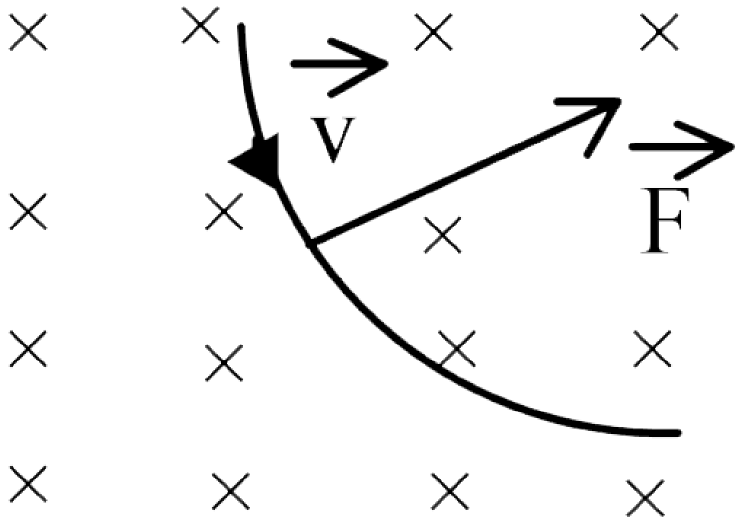
D. None of these

Answer: C

Watch Video Solution

31. A beam of protons is moving horizontally towards you. As it approaches, it passes through a magnetic field directed downward.

The beam deflects-



A. To your left side

B. To your right side

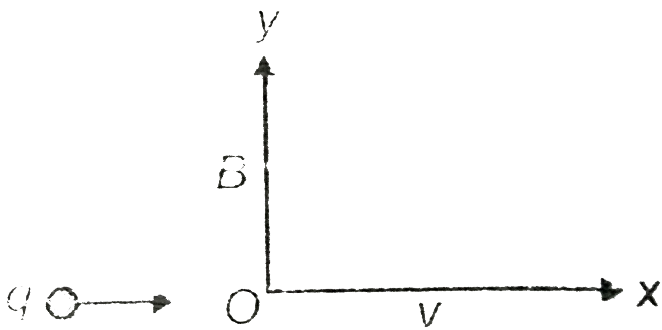
C. Does not deflect

D. Nothing can be said

Answer: B

Watch Video Solution

32. If a positively charged particle is moving as shown in the figure, then it will get deflected due to magnetic field towards



A. $+x$direction

B. $+y$-direction

C. $-x$direction

D. $+z$-direction

Answer: D

Watch Video Solution

33. A charged particle, having charge q_1 accelerated through a potential difference V enters a perpendicular magnetic field in which it experiences a force F. It V is increased to 5V, the particle will experience a force

A. F

B. 5F

C. $\frac{F}{5}$

D. $\sqrt{5}F$

Answer: D

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34. Doubly ionized oxygen atoms (O^{2-}) and singly-ionized lithium atoms (Li^{+}) are travelling with the same speed, perpendicular to a uniform magnetic field. The relative atomic masses of oxygen and lithium are 16 and 7 respectively. The ratio $\frac{\text{radius of } O^{2-} \text{orbit}}{\text{radius of } Li^{+} \text{ orbit}}$ is

A. $16:7$

B. $8:7$

C. $7:8$

D. $7:16$

Answer: B

Watch Video Solution

35. Two long conductors, separated by a distance d carry currents l_1 and l_2 in the same direction. They exert a force F on each other. Now the current in one of them is increased to two times and its direction is reversed. The distance is also increased to 3d. The new value of the force between them is

A. $-\frac{2\overrightarrow{F}}{3}$

B. $\frac{\overrightarrow{F}}{3}$

C. $-2\overrightarrow{F}$

D. $-\frac{\overrightarrow{F}}{3}$

Answer: A

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36. When two wires have current in same direction then force is

A. Attractive

B. Repulsive

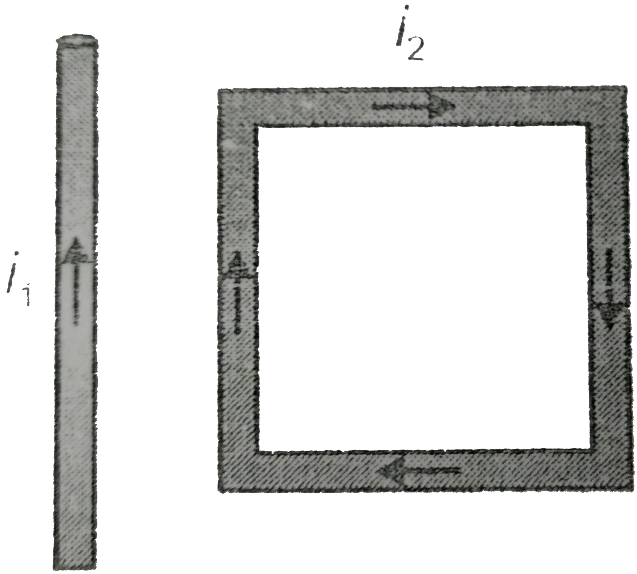
C. Both attractive and repulsive

D. Can't be determined

Answer: A

Watch Video Solution

37. A rectangular loop carrying a current i_2 situated near a long straight wire carrying a steady current i_1. The wire is parallel to one of the sides of the loop and is in the plane of the loop as shown in the figure. Then the current loop will



A. Move away from the wire

B. Move towards the wire

C. Remain stationary

D. Rotate about an axis parallel to the wire

Answer: B

Watch Video Solution

38. Two parallel conductor A and B of equal length carry current I and 10 I, respectrively, is the same direction, then

A. A and B will repel each other with same force

B. A and B will attract each other with same force

C. A will attract B, but B will repel A

D. A and B will attract each other with different forces

Answer: B

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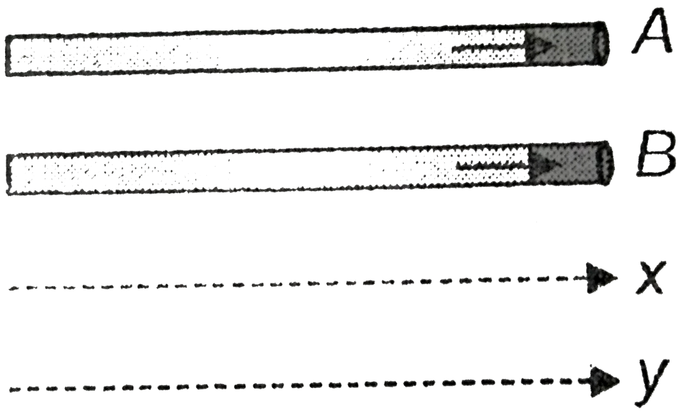
39. A and B are two conductors carrying a current i in the same direction x and y are two electron beams moving in the same direction.

There will be



A. Repulsion between A and B, attraction between x and y

B. Atraction between A and B, repulsion between x and y

C. Repulsion between A and B and also x and y

D. Attraction between A and B also x and y

Answer: B

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40. Two long parallel copper wires carry current of 5A each in opposite directions. If the wires are separated by a distance distance of 0.5m, then the force per unit length between the two wires is

A. $10^{-5} N/m$, attractive

B. $10^{-5} N/m$ repulsive

C. $2 \times 10^{-5} N/m$, attractive

D. $2 \times 10^{-5} N/m$, repulsive

Answer: B

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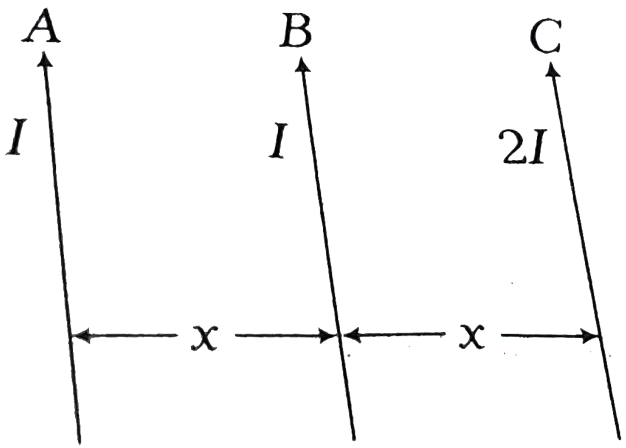
41. A, B and C are parallel conductors of equal length carrying currents I, I and 2I, respectively. Distance between B and C is also x. F_1 is the force exerted by B on A. F_2 is the force exerted by C on A. Choose the correct answer.



A. $\overrightarrow{F}_1 = 2\overrightarrow{F}_2$

B. $\overrightarrow{F}_2 = 2\overrightarrow{F}_1$

C. $\overrightarrow{F}_1 = \overrightarrow{F}_2$

D. $\overrightarrow{F}_1 = -\overrightarrow{F}_2$

Answer: D

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42. A conducting circular loop of radiius r carries a constant current i. It is placed in a uniform magnetic field $\vec{B}_0$ such that $\vec{B}_0$ is perpendicular to the plane of the loop . The magnetic force acting on the loop is

A. irB_0

B. $2\pi irB_0$

C. zero

D. πirB_0

Answer: C

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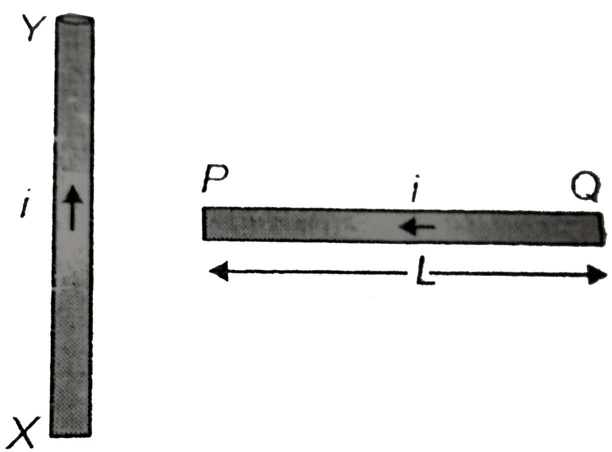
43. A conductor PQ, carrying a current i is placed perpendicular to a long conductor xy carrying a current i. The direction of force on PQ will be



A. Towards right

B. Towards left

C. Upwards

D. Downwards

Answer: D

Watch Video Solution

44. The force between two parallel conductor, each of length 50m and distance 20 cm apart, is $10^{-2}N$. If the current in one conductor is double that in another one, then their values will respectively be

A. 10 A and 20 A

B. 50 A and 100 A

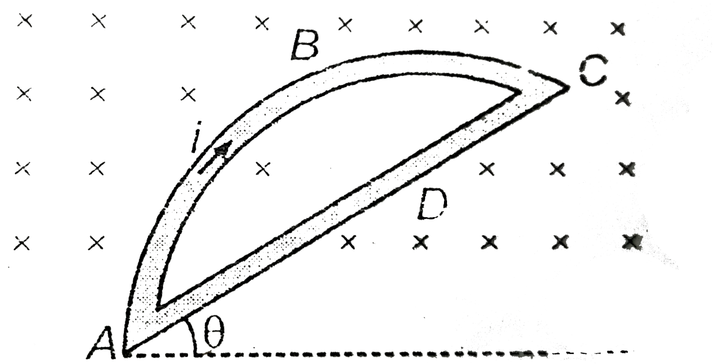
C. 5A and 10 A

D. 25 A and 50 A

Answer: A

Watch Video Solution

45. A circular wire ABC and a straight conductor ADC are carrying current i and are kept in the magnetic field B then



A. Force on ABC is more than that on ADC

B. Force on ABC is less than that on ADC

C. Force on ABC is equal to that on ADC

D. Data insufficient

Answer: C

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46. The magnetic moment of a current I carrying circular coil of radius r and number of turns N varies as

A. $1/r^2$

B. $1/r$

C. r

D. r^2

Answer: D

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47. Two galvanometers A and B require 3 mA and 6 mA respectively, to produce the same deflection of 10 divisions. Then,

A. A is more sensitive than B

B. B is more sensitive than A

C. A and B are equally sensitive

D. Sensitiveness of B is twice that of A

Answer: A

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48. Magnetic dipole moment of rectangular loop is

A. Inversely proportional to current in loop

B. Inversely proportional to area of loop

C. Parallel to plane of loop and proportional to area of loop

D. Perpendicular to plane of loop and proportional to area of loop

Answer: D

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49. Magnetic induction produced at the centre of a circular loop carrying current is B. the magnetic moment of the loop of radius R is

$(\text{where}\mu_0 = \text{permeability of free space})$

A. $\dfrac{BR^3}{2\pi\mu_0}$

B. $\dfrac{2\pi BR^3}{\mu_0}$

C. $\dfrac{BR^2}{2\pi\mu_0}$

D. $\dfrac{2\pi BR^2}{\mu_0}$

Answer: B

Watch Video Solution

50. A straight wire carrying current I is turned into a circular loop. If the magnitude of magnetic moment associated with it is M, is the length of wire will be

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

B. $\sqrt{\frac{4\pi M}{i}}$

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

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

Answer: B

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51. The current sensitivity of a moving coil galvanometer can be increased by

A. Increasing the magnetic field of the permeanent magnet

B. Increasing the area of the deflecting coil

C. Increasing the number of turns in the coil

D. All of these

Answer: D

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52. A rectangular coil $20cm \times 20cm$ has 100 turns and carries a current of $1A$. It is placed in a uniform magnetic field $B = 0.5T$ with the direction of magnetic field parallel to the plane of the coil. The magnitude of the torque required to hold this coil in this position is

A. Zero

B. 200 Nm

C. 2 Nm

D. 10 Nm

Answer: C

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53. A wire of length l in formed into a circular loop of one turn only and is suspended in a magnetic field B. When a current I is passed through the loop, the torque experienced by it is

A. $\left(\frac{1}{4\pi}\right)Bil$

B. $\left(\frac{1}{4\pi}\right)l^2iB$

C. $\left(\frac{1}{4\pi}\right)B^2il$

D. $\left(\frac{1}{4\pi}\right)Bi^2l$

Answer: B

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54. A wire fo length l is bent in the from of a circular coil of some turns . A current i flow thoughteh coil . The coil is placed in a unifrom magnetic field B . The maxffimum troque on the coil can be

A. iBl^2

B. $4\pi iBl^2$

C. $\frac{iBl^2}{4\pi}$

D. zero

Answer: C

Watch Video Solution

55. The restoring couple in the moving coil galvanometer is due to

A. Current in the coil

B. Mangetic field of the magnet

C. Material of the coil

D. Twist produced in the suspension wire

Answer: D

Watch Video Solution

Assignment Section B Objective Type Questions One Option Is Correct

1. A long straight wire is kept along x-axis. It carries a current i in the positive x-direction. A proton and an electron are placed at (0, a,0) and (0, -a, 0) respecitively. The proton is imparted an initial velocity v along +z axis and the electron is imparted an initial velocity v along +x-axis. The magnetic forces experienced by the two particles at the instant are

A. $\frac{\mu_0 iev}{2\pi a}\hat{i}\,\frac{\mu_0 iev}{2\pi a}\hat{i}$

B. $0, \dfrac{-\mu_0 iev}{2\pi a}\hat{j}$

C. $0, \dfrac{\mu_0 iev}{2\pi a}\hat{j}$

D. $0, 0$

Answer: B

Watch Video Solution

2. There are two concentric circular loops. One loop of radius r is made up of only one turn. The other loop has a radius 2r and has two turns of wire. They are arranged such that they have a common centre and their planes are perpendicular to each other. When the same current i is passed through both the coils, the magnetic field at the common centre is

A. $\frac{\mu_0 i}{2r}$

B. $\frac{\mu_0 i}{r}$

C. $\frac{\mu_0 i}{2r}\sqrt{2}$

D. zero

Answer: C

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3. A long current carrying wire is bent as shown. The magnetic field induction at O is

A. a. Zero

B. b. $\frac{2\sqrt{2}\mu_0 i}{\pi L}$

C. c. $\frac{\mu_0 i}{\pi L}$

D. d. $\frac{\sqrt{2}\mu_0 i}{\pi L}$

Answer: C

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4. A proton and an electron are projected into a region of uniform magnetic field in a direction perpendicular to the field. If they have the same initial velocities then

A. They move in circular paths of same radii

B. They experience equal force

C. The trajectory of the electron is more curved

D. Their velocity remain equal to each other through out the motion

Answer: C

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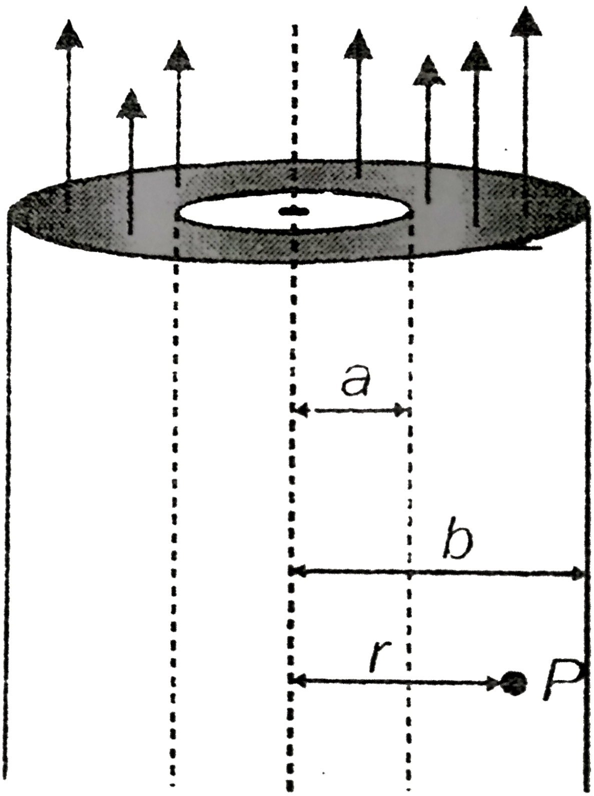
5. The magnetic field at point P in the hollow cylindrical wire carrying a current i shown in the figure at a distance r from axis $(a < r < b)$ is given by (Taking current density to be uniform across its cross-section)



A. $\dfrac{\mu_0 i\left(r^2-a^2\right)}{2\pi\left(b^2-a^2\right)r}$

B. $\dfrac{\mu_0 i r}{2\pi\left(b^2-a^2\right)}$

C. $\dfrac{\mu_0 i a b}{2\pi\left(b^2-a^2\right)r}$

D. zero

Answer: A

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6. A charged particle of mass m is moving with a speed u in a circle of radius r. If the magnetic field induction at the centre is B, the charge on the particle is

A. $\frac{4\pi r^2 B}{\mu_0 u}$

B. $\frac{2\pi r^2 B}{\mu_0 u}$

C. $\frac{mu}{Br}$

D. $\frac{2mu}{Br}$

Answer: A

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7. In a region of space, both electric and magnetic field are present simultaneously in opposite direction. A positively charged particle is projected with certain speed an angle $\theta(< 90^{\circ})$ with magnetic field. It will move in a

A. Helical path of uniform pitch

B. Helical path of increasing pitch

C. Helical path of decreasing pitch

D. Helical path, whose pitch first decreases and then increases

Answer: D

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8. A thin disc of radius R has charge Q distributed uniformly on its surface. The disc is rotated about one of its diametric axis with angular velocity ω. The magnetic moment of the arrangement is

A. $\frac{QR^2\omega}{8}$

B. $\frac{QR^2\omega}{4}$

C. $\frac{QR^2\omega}{2}$

D. Zero

Answer: A

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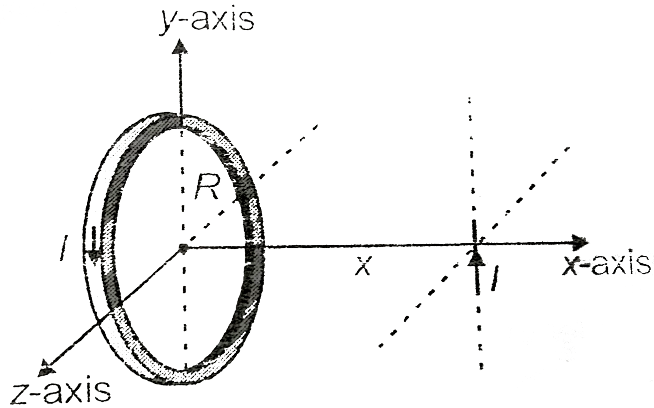
9. A short current carrying conductor is placed perpendicular to the axis of a current carrying ring as shown. The direction of force acting of the conductor is



A. Along positive x-axis

B. Along negative y-axis

C. Along positive z-axis

D. Along negative z-axis

Answer: D

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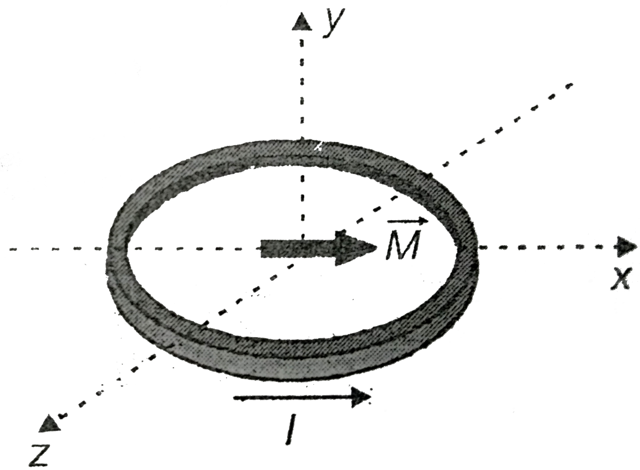
10. A ring carrying current I lies in x-z plane as shown. A short magnetic dipole with dipole moment directed along x-axis is fixed at origin. If the ring is free to move anywhere, then it will



A. Rotate clockwise about z-axis

B. Rotate anticlockwise about z-axis

C. Move along z-axis

D. Move along y-axis

Answer: A

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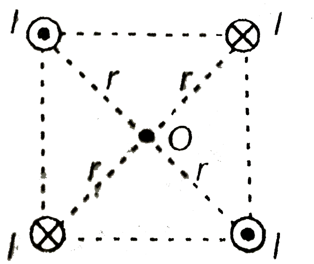
11. Figure shows an arrangement in which long parallel wires carrying equal currents into or out of the page of paper at the corners of a square. The magnetic field at the centre of square is

(1) $\frac{\mu_0 I}{2\pi r}\sqrt{2}$

(2) $\frac{2\mu_0 I}{2\pi r}\sqrt{2}$

(3) $\frac{4\mu_0 I}{2\pi r}$

(4) Zero



A. $\frac{\mu_0 l}{2\pi r}\sqrt{2}$

B. $\frac{2\mu\_(0)l}{2\pi r}\sqrt{2}$

C. $\frac{4\mu_0 l}{2\pi r}$

D. zero

Answer: D

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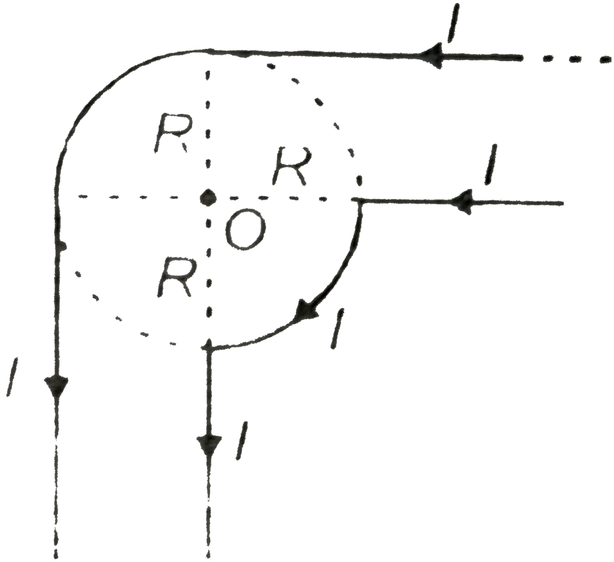
12. The magnetic field at the centre of dotted circle in the arrangement shown is



A. $\dfrac{\mu_0 l}{4R}+\dfrac{\mu_0 l}{2\pi R}$

B. $\dfrac{\mu_0 l}{4R}$

C. $\dfrac{\mu_0 l}{2\pi R}$

D. zero

Answer: C

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13. In an attempt to increases the current sensitivity of a moving coil galvanometer, it is found that its resistance becomes double while the current sensitivity increases by 10%. The voltage sensitivity of the galvanometer changes by

A. $40\ \%$

B. $-45\ \%$

C. $55\ \%$

D. -55%

Answer: B

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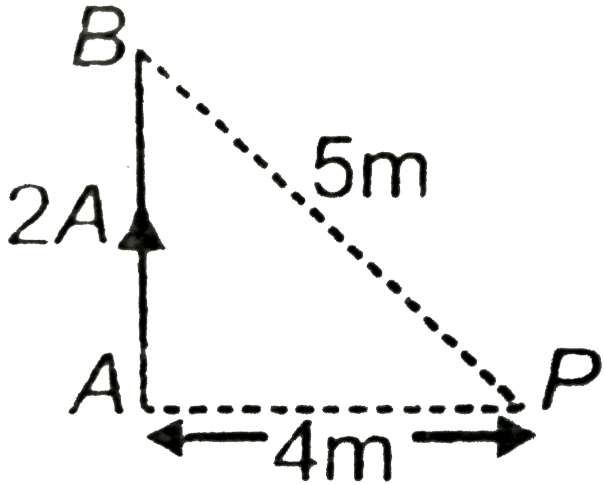
14. What is the magnetic field $\left|\vec{B}\right|$ at the point P due to a current carrying wire of length AB (having a current of 2A) shown in figure ?



A. $2\mu T$

B. $25\mu T$

C. $2.5nT$

D. $30nT$

Answer: D

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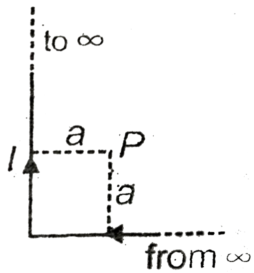
15. A wire of infinite length bent as shown in figure carries current I. What is the magnetic field at the point P ?

(1) Zero

(2) $\frac{\mu_0 I}{4\pi a}$

(3) $\frac{\mu_0 I}{2\pi a}$

(4) None of these



A. Zero

B. $\frac{\mu_0 l}{4\pi a}$

C. $\frac{\mu_0 l}{2\pi a}$

D. None of these

Answer: D

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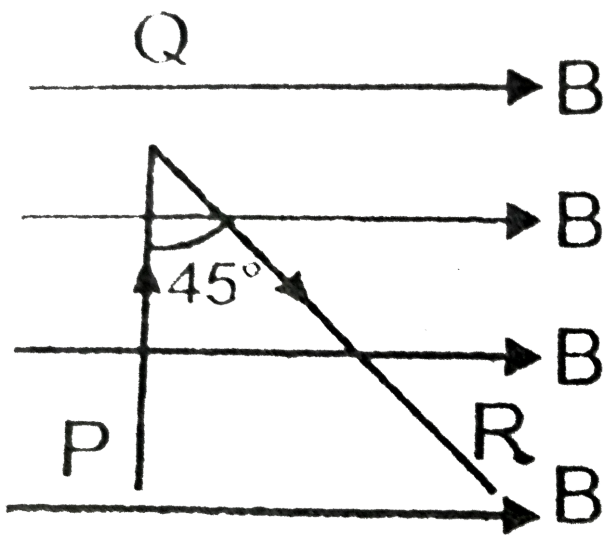
16. A wire PQR carrying a current I is bent as shown in the figure. It is placed in a uniform magnetic field B. What is the ratio of magnitude of the force on PQ to that on QR ?



A. $\sqrt{2}$

B. $\frac{1}{\sqrt{2}}$

C. 1

D. None of these

Answer: C

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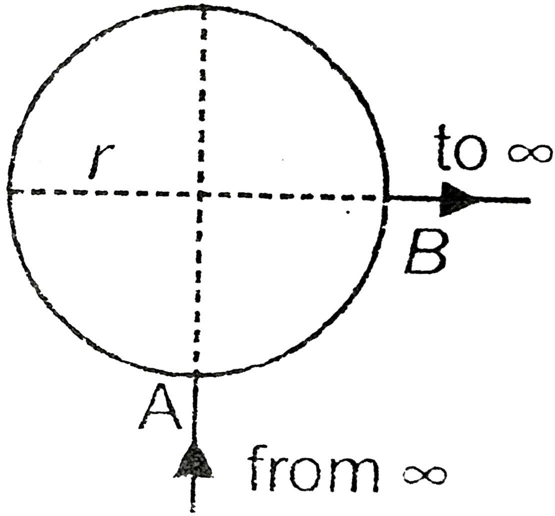
17. In the figure, the current I enters the circular loop of uniform wire of radius r at A and leaves it at B. The magnetic field of the centre of circular loop is



A. Zero

B. $\frac{\mu_0 l}{2r}$

C. $\frac{\mu_0 l}{4r}$

D. $\frac{3\mu_0 l}{4r}$

Answer: A

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18. An electron is fired parallel to uniform electric and uniform magnetic field acting simultaneously and in the same direction. The electron

A. Moves along a circular path

B. Moves along a parabolic path

C. Loses K.E

D. Gains K.E

Answer: C

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19. The magnetic field inside a toroidal solenoid of radius R is B. If the current through it is doubled and its radius is also doubled, keeping the number of turns same, the magnetic field produced by it will be

A. $B/4$

B. $B/2$

C. B

D. 2B

Answer: C

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20. A square loop of side a carris a current I. The magnetic field at the centre of the loop is

A. $\frac{\mu_0 l}{2\sqrt{2}\pi a}$

B. $\frac{2\sqrt{2}\mu_0 l}{\pi a}$

C. $\frac{\mu_0 l}{\sqrt{2}\pi a}$

D. $\frac{\mu_0 l\sqrt{2}}{\pi a}$

Answer: B

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21. A proton, a deuteron and an alpha particle moving with equal kinetic energies enter perpendicularly into a magnetic field. If

r_p, r_d and r_a are the respective radii of the circular paths, find the ratios $\frac{r_p}{r_d}$ and $\frac{r_p}{r_a}$.

A. $1 : 1 : 1$

B. $1 : \sqrt{2} : 1$

C. $1 : \sqrt{2} : \sqrt{2}$

D. $1 : \sqrt{2} : 2$

Answer: B

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22. A charge q enters into a magnetic field (B) perpendicularly with velocity V. The time rate of work done by the magnetic force on the charge is

A. qB

B. qB / V

C. qB / V^2

D. None of these

Answer: D

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23. A solid metallic cylinder carriers a direct current. The magnetic field produce by it exists

A. Outside only

B. Inside only

C. Both inside and outside

D. neither inside nor outside

Answer: C

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24. Two identical magnetic dipoles of magnetic moments 1.0 $A - m^2$ each, are placed at a separation of 2 m with their axes perpendicular to each other. The resultant magnetic field at a point midway between the dipoles is

A. $10^{-7}T$

B. $2 \times 10^{-7} T$

C. $\sqrt{5} \times 10^{-7} T$

D. $5 \times 10^{-2} T$

Answer: C

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25. For a given length l of wire carrying a current I, how many circular turns would produce the maximum magnetic moment ?

A. 1

B. 2

C. 4

D. Any value

Answer: A

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26. Which of the following properties of magnetic line of force differs them from electrostatic lines of force ?

A. These are closed curves

B. These can emit or teminate at any angle to the surface

C. Total flux linked with a close surface is always zero

D. All of these

Answer: D

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27. The earth's magnetic field at a given point is $0.5 \times 10^{-5} Wbm^{-2}$. This field is to be cancelled by magnetic induction at the centre of a circular conducting loop of radius 5.0 cm. The current required to be flown in the loop is nearly.

A. 0.56 Amp

B. 5.6 Amp

C. 0.28 Amp

D. 2.8 Amp

Answer: B

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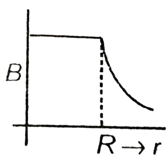
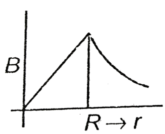
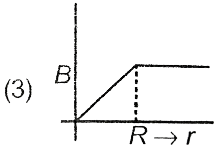
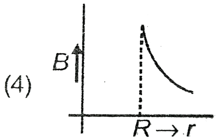
28. A long thin hollow metallic cylinder of radius R has a current I ampere. The magnetic induction B away from the axis at a distance r from the axis varies as shown in

A. (1)


B. (2)


C. 

D. 

Answer: D

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29. A charge q is spread uniformly over an insulated loop of radius r. If it is rotated with an angular velocity ω with respect to normal axis then the magnetic moment of the loop is :

A. (1)/(2) Q wR^(2)`

B. Qw R^(2)`

C. (Q wR^(2))/(4)`

D. Zero

Answer: A

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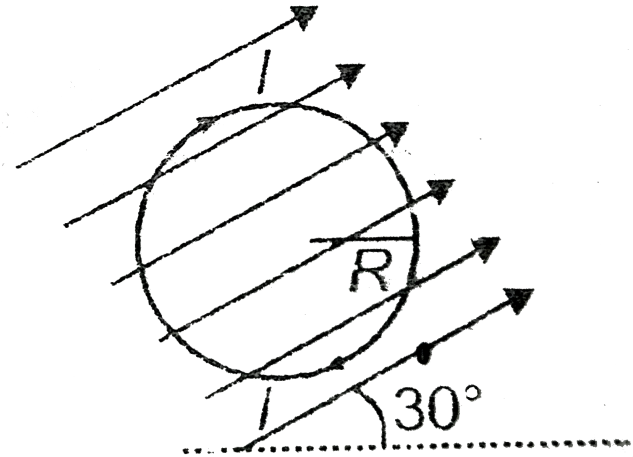
30. If plane of coil and uniform magnetic field B(4T0 is same then torque on the current carrying coil is



A. $l\left(\pi R^2\right)4(1)$

B. $\dfrac{l\left(\pi R^2\right)4}{2}$

C. $\dfrac{l\pi R^2 4}{8}$

D. Zero

Answer: A

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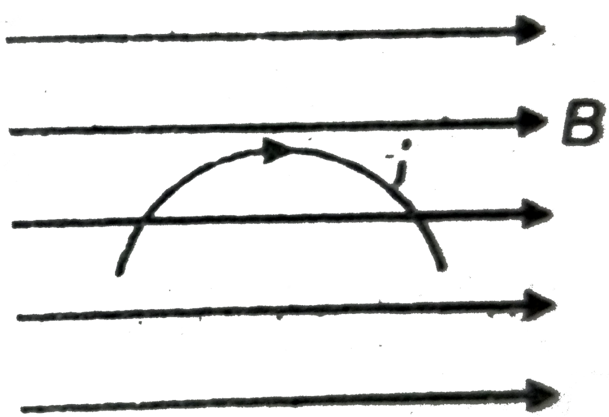
31. What is the force experienced by a semicircular wire of radius R when it is carrying a current I and is placed in a uniform magnetic field of induction B as shown in figure. ?



A. Zero

B. $l(2R)B$

C. $l(R)B$

D. $B(l)\pi R$

Answer: A

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32. Suppose that a proton travelling in vacuum with velocity V_1 at right angles to a uniform magnetic field experiences twice the force that an α-particle experiences when it is travelling along into same path with velocity V_2. The ratio $\frac{V_1}{V_2}$ is

A. 0.5

B. 1

C. 2

D. 4

Answer: D

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33. When two parallel wires carrying current I and 2I in same direction are placed at a distance d apart, the ratio of force per unit length acting upon the wire due to other is

A. $1:1$

B. $1:2$

C. $2:1$

D. None of these

Answer: A

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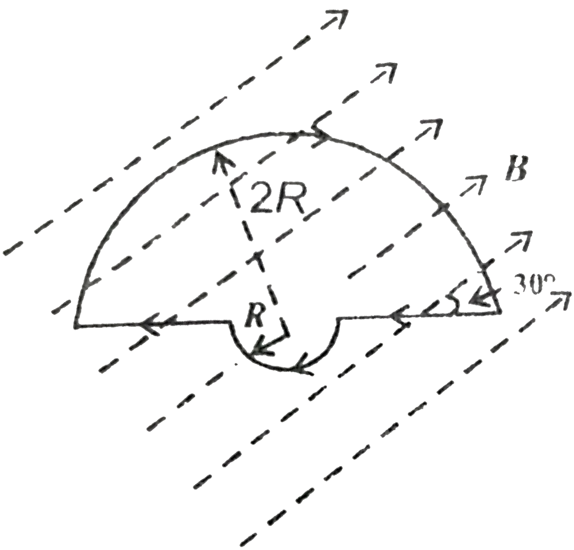
34. Calculate the torque acting upon the following structure carrying current I due to the magnetic field B. Both the magnetic field and the stucture are in the plane of paper as shown.



A. Zero

B. $\frac{5}{4}\pi R^2 lB$

C. $\frac{5}{2}\pi R^2 lB$

D. $5\pi R^2 / B$

Answer: C

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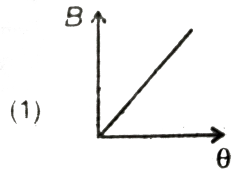
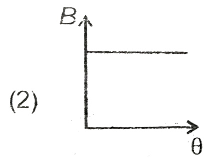
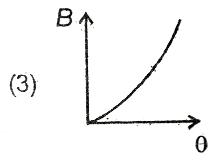
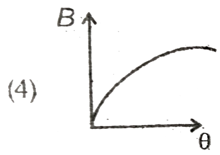
35. Keeping current per unit length of arc constant, the variation of magnetic field at the centre of an arc (B) with the angle subtended by the arc at the centre (θ) can be best represented by

A. 

B. 

C. 

D. 

Answer: C

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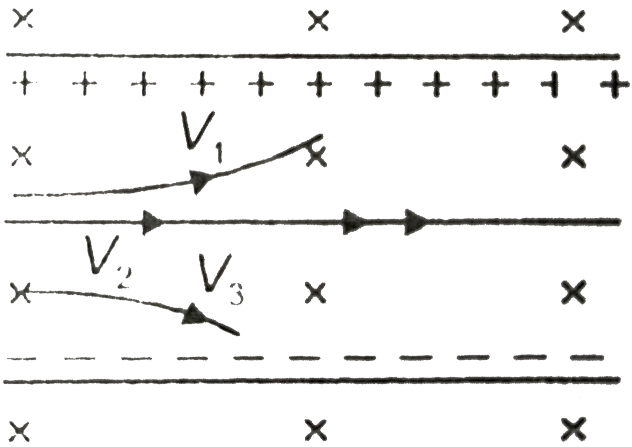
Assignment Section C Objective Type Questions More Than One Option Are Correct

1. In a region of crossed fields as shown, the strength of electric field is E and that of magnetic field is B. Three positively charged particles with speeds V_1, V_2 and V_3 are projected and their paths are shown. From

this it implies that



A. $V_1 > \frac{E}{B}$

B. $V_2 = \frac{E}{B}$

C. $V_3 < \frac{E}{(B)}$

D. All of these

Answer: A::B::C::D

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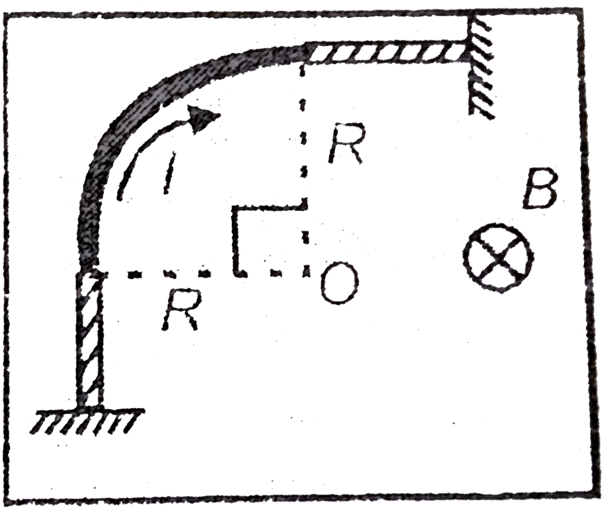
2. A wire carrying current I, bent in the form of a quarter circle is held at rest on a smooth table with two threads as shown. A uniform magnetic field exists in the region direction into the plane select the correct alternatives



A. Net force on wire is zero

B. Net magnetic force on wire $= BlR\sqrt{2}$

C. Tension in the threads is BlR

D. Tension in the threads is $BlR\sqrt{2}$

Answer: A::B::C

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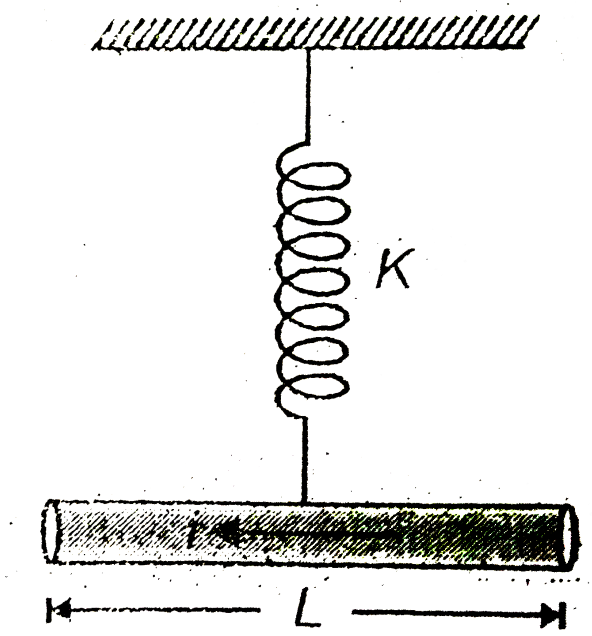
3. A current carrying wire of length l is suspended horizontally by a spring of force constant K as shown. The system is in equilibrium. A magnetic field B is switched on into the plane of paper suddenly. Which of the following statements is correct



A. The rod oscillates simple harmonically

B. The rod goes down by a distance $\frac{BIL}{K}$ and comes to rest

C. The rod goes up by a distance $\frac{BIL}{K}$ and comes to rest

D. The maximum displacement of the wire from old equilibrium position is $\frac{2BIL}{K}$

Answer: A::D

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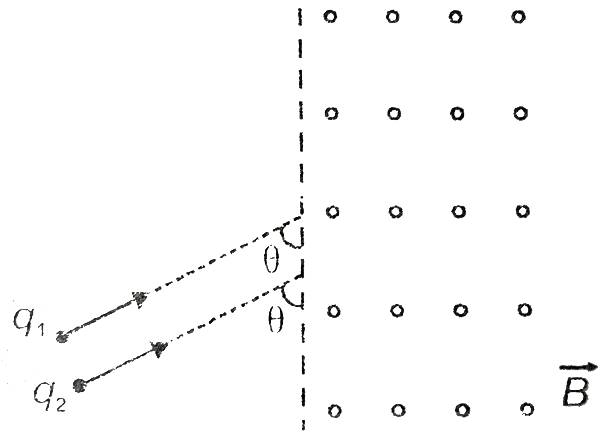
4. Two charges q_1 and q_2 having same magneitude of charge are moving parallel to each other and they enter into a region of

uniform magnetic field as shown. If they have same mass and the time spent by them in the magnetic field are t_1 and t_2 respectively, then



A. For $q_1 = \pm q_2, t_1 = t_2$

B. For $q_1 = q_2, t_1 = t_2$

C. For $q_1 > 0, q_2 < 0, t_1 < t_2$

D. For $q_1 <), q_2 > 0, t_1 < t_2$

Answer: B::D

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5. A thin wire carrying current i is bent to form a closed loop of one turn. The loop is placed in y-z plane with centre at origin. If R is the radius of the loop, then

A. At a point (x, 0) on x-axis

$$B_x = \frac{\mu_0 i R^2}{2(R^2 + x^2)^{3/2}}$$

B. $\int_0^{\infty} B_x dx = \frac{\mu_0 i}{2}$

C. $\int_0^{-\infty} B_x dx = \mu_0 i$

D. $\int_{-\infty}^{\infty} B_x dx = 0$

Answer: A::B::C

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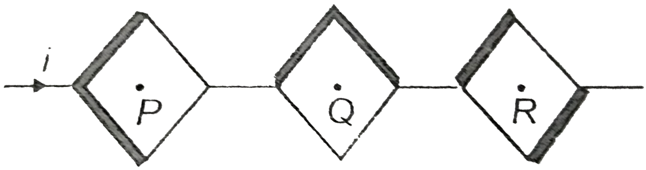
6. Two thick wires and tow thin wires, all of same material and same length from a squre in the three different ways P, Q and R as shown. The current flowing through the arrangement is i. Let B_P, B_Q and B_R

represent the magnetic field at the centre of square in the three cases, then



A. $B_P = 0$

B. $B_Q = 0$

C. $B_R = 0$

D. $B_P \neq 0$

Answer: A::C

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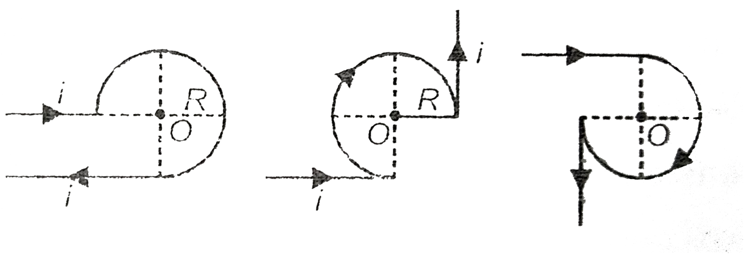
7. The figure shows three long straight current carrying conductors. The straight parts are long and the circular part in each case in $\left(\frac{3}{4}\right)^{th}$ of a complete circle, Let B_a, B_b and B_c represents the strength of field at the centre O in the three cases, then



A. $B_a = \frac{\mu_0 i}{4R}\left(\frac{3}{2} + \frac{1}{\pi}\right)$

B. $B_b = \frac{\mu_0 i}{2R}\left(\frac{3}{4} - \frac{1}{\pi}\right)$

C. $B_a = \frac{\mu_0 i}{4R}\left(\frac{3}{2} - \frac{1}{\pi}\right)$

D. $B_c = \frac{3\mu_0 i}{8R}$

Answer: A::B::D

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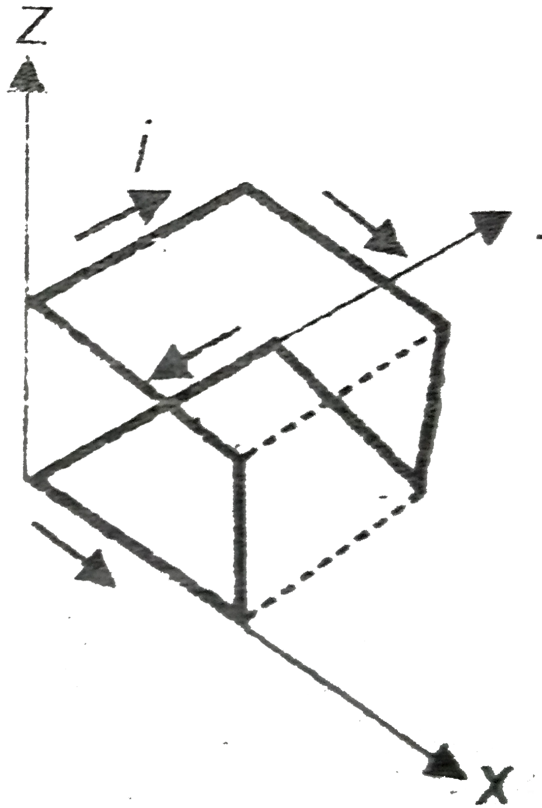
8. The figure shows a loop of wire carrying a current i as shown. There exists a uniform magnetic field along x-axis given by $\overrightarrow{B} = B_0 \hat{i}$.

If the length of each side is a, then



A. Magentic moment of the loop is

$$\overrightarrow{M} = -ia^2\hat{i}$$

B. Magnetic moment of the loop is

$M = 3ia^2\hat{k}$

C. Torque experience by the loop is zero

D. Torque experienced by the loop is

$-3ia^2B_0\hat{j}$

Answer: A::C

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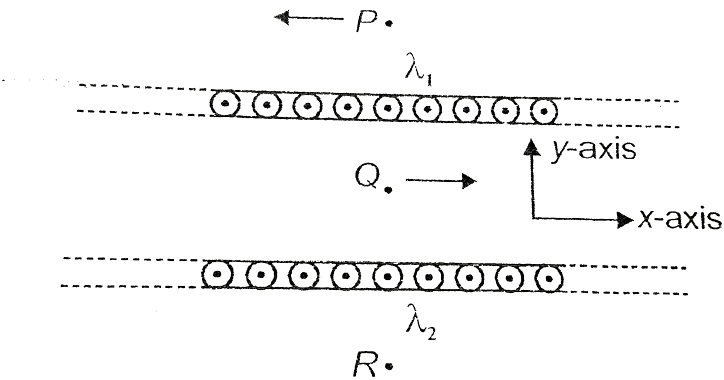
9. The figure shows two infinite parallel sheets of current, with current per unit length λ_1 and λ_2. If B_P, B_Q and B_R represent the magnetic field at the points P, Q and R respectively, then



A. $B_P = (\lambda_1 + \lambda_2)\frac{\mu_0}{2}$ (along x-axis)

B. $B_Q = \frac{(\lambda_1 - \lambda_2)}{2}\mu_0$ (along x-axis)

C. $B_R = \left(\frac{\lambda_1 + \lambda_2}{2}\right)\mu_0$ (along x-axis)

D. $B_Q = \left(\frac{\lambda_1 - \lambda_2}{2}\right)\mu_0$ (along x-axis)

Answer: B::C

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10. A charged particle goes undeflected in a region containing electric and magnetic field. It is possible that

A. $\overrightarrow{E} \,\Big\|\, \overrightarrow{B}, \overrightarrow{V} \,\Big\|\, \overrightarrow{E}$

B. $\overrightarrow{E}$ is not parallel to $\overrightarrow{B}$

C. $\overrightarrow{V} \mid \mid \overrightarrow{B}, \overrightarrow{E}$ is not parallel to B

D. $\overrightarrow{E} \mid \mid \overrightarrow{B}$, but V is not parallel to $\overrightarrow{B}$

Answer: A::B

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11. A charged particle enters into a gravity free space occupied by anelectric field E and magnetic field B and it comes out without any change in velocity. Then, the possible cases may be

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: A::B::D

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12. If an alpha particle, proton and deuteron are projected perpendicularly a uniform magnetic field with same speed then let r_{α} is the radius of α-particles, r_P is radius of proton, rd is radius of deuteron.

A. $r_{\alpha} < r_p$

B. $r_{\alpha} > r_p$

C. $r_p = r_d$

D. $r_{\alpha} > r_d$

Answer: B::C

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13. A wire of radius R having uniform cross section in which steady current I is flowing. Then

A. a. Magnetic field increases linearly with the distance from the axis of the wire

B. b. Magnetic field is maximum at the surface of the wire

C. c. Magnetic field decreases hyperbolicaly, outside the wire, with the distance from the axis

D. d. Magnetic field remains constant as the wire is infinite

Answer: A::B::C

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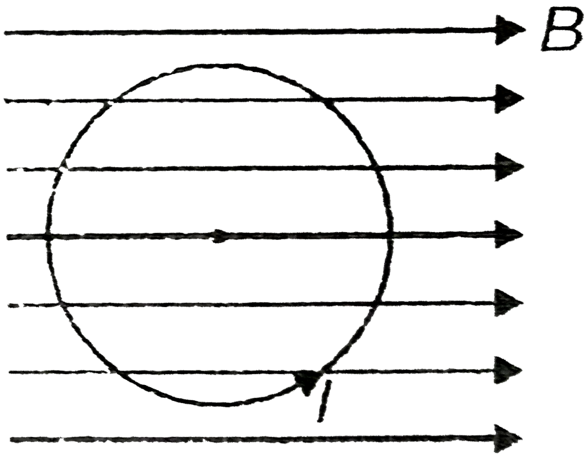
14. A current carrying loop of radius R and mass 'm' is placed inside a uniform magnetic field an shown



A. Acceleration of the loop is zero

B. Acceleration of the loop is towards right

C. Torque on the loop is zero

D. The loop will start turning

Answer: A::D

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Assignment Section D Linked Comprehension Type Questions

1. The cyclotron is a device which is used to accelerate charged particles such as protons, deutrons, alpha particles, etc. to very high energy. The principle on which a cyclotron works is based on the fact that an electric field can accelerate a charged particle and a magnetic field can throw it into a circular orbit. A particle of charge $+q$ experiences a force qE in an electric field E and this force is independent of velocity of the particle. The particle is accelerated in the direction of the magnetic field. On the other hand, a magnetic field at right angles to the direction of motion of the particle throws the particle in a circular orbit in which the particle revolves with a frequency that does not depend on its speed.

A modest potential difference is used as a sources of electric field. If a charged particle is made to pass through this potential difference a number of times, it will acquire an enormous by large velocity and hence kinetic energy.

Which of the following cannot be accelerated in a cyclotron?

A. Protons

B. Deutrons

C. Alpha particles

D. Neutrons

Answer: D

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2. The cyclotron is a device which is used to accelerate charged particles such as protons, deutrons, alpha particles, etc. to very high energy. The principle on which a cyclotron works is based on the fact that an electric field can accelerate a charged particle and a magnetic field can throw it into a circular orbit. A particle of charge $+q$ experiences a force qE in an electric field E and this force is independent of velocity of the particle. The particle is accelerated in the direction of the magnetic field. On the other hand, a magnetic field at right angles to the direction of motion of the particle throws the particle in a circular orbit in which the particle revolves with a frequency that does not depend on its speed. A modest potential difference is used as a sources of electric field. If a charged particle is made to pass through this potential difference a number of times, it will acquire an enormous by large velocity and hence kinetic energy.

The working of a cyclotron is based on the fact that

A. The force experienced by a charged particles in an electric field is independent of its velocity

B. The radius of the circular orbit of a charged particle in a magnetic field increase with increase in its speed

C. The frequency of revolution of the particle along the circular path does not depend on its speed

D. All of the above

Answer: D

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3. The cyclotron is a device which is used to accelerate charged particles such as protons, deutrons, alpha particles, etc. to very high energy. The principle on which a cyclotron works is based on the fact that an electric field can accelerate a charged particle and a magnetic field can throw it into a circular orbit. A particle of charge $+q$ experiences a force qE in an electric field E and this force is independent of velocity of the particle. The particle is accelerated in the direction of the magnetic field. On the other hand, a magnetic field at right angles to the direction of motion of the particle throws the particle in a circular orbit in which the particle revolves with a frequency that does not depend on its speed.

A modest potential difference is used as a sources of electric field. If a charged particle is made to pass through this potential difference a number of times, it will acquire an enormous by large velocity and hence kinetic energy.

Cyclotron is not suitable for accelerating

A. Electron

B. Protons

C. Deutrons

D. Alpha particles

Answer: A

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4. A moving coil galvanometer consists of a coil of N turns are area A suspended by a thin phosphor bronze strip in radial magnetic field B. The moment of inertia of the coil about the axis of rotation is I and c is the torsional constant of the phosphor bronze strip. When a current i is passed through the coil, it deffects through an angle θ

Magnitude of the torque experienced by the coil is independent of

A. a.N

B. b.B

C. c.i

D. d.l

Answer: D

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5. A moving coil galvanometer consists of a coil of N turns are area A suspended by a thin phosphor bronze strip in radial magnetic field B. The moment of inertia of the coil about the axis of rotation is I and c is the torsional constant of the phosphor bronze strip. When a current i is passed through the coil, it deffects through an angle θ

The current sensitivity of the galvanometer is increases if

A. a.N,A and B are increased and c is decreased

B. b.N and A are increased and B and c are decreased

C. c.N, B and c are increased and A is decreased

D. d.N, A, B and c are all increased

Answer: A

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6. A moving coil galvanometer consists of a coil of N turns are area A suspended by a thin phosphor bronze strip in radial magnetic field B. The moment of inertia of the coil about the axis of rotation is I and c is the torsional constant of the phosphor bronze strip. When a current i is passed through the coil, it deffects through an angle θ

When a charge Q is almost instantly through the coil the angular speed ω acquired by the coil is

A. a. $\frac{NAB}{QI}$

B. b. $\frac{BAQ}{NI}$

C. c. $\frac{NABQ}{I}$

D. d. $\frac{NAQI}{B}$

Answer: C

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7. A moving coil galvanometer consists of a coil of N turns are area A suspended by a thin phosphor bronze strip in radial magnetic field

B. The moment of inertia of the coil about the axis of rotation is I and c is the torsional constant of the phosphor bronze strip. When a current i is passed through the coil, it deffects through an angle θ

When a charge Q is almost instantly through the coil the angular speed ω acquired by the coil is

A. $Q_{\max} = \omega\sqrt{\frac{l}{C}}$

B. $Q_{\max} = \frac{1}{C}\sqrt{l\omega}$

C. $Q_{\max} = l\sqrt{\frac{\omega}{C}}$

D. $Q_{\max} = \omega\sqrt{lC}$

Answer: A

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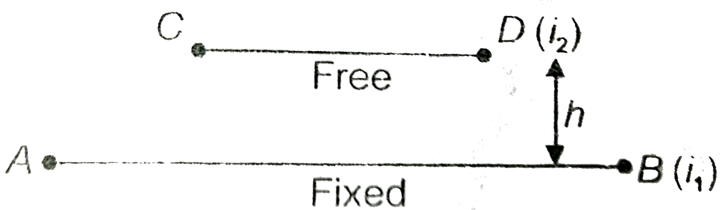
8. The force per unit length between two parallel current carrying wires $= \frac{\mu_0 i_1 i_2}{2\pi r}$. The force is attractive when the current is in same direction and repulsive, when the they are in opposite directions. The force between the wires of two parallel wires is shown. We can determine the equilibrium position. Then we displace upper wire by a small distance, keeping lower wire fixed. If the wire returns to or tries to return to its equilibrium position, its equilibrium is stable. We can thus show that upper wire can execute linear simple harmonic motion or not. The length of wire AB is large as compared to separation between the wires.



If wire CD is in equilibrium position then which of the following may represent the directions of current in the wires

A. In AB, $A \rightarrow B$ and in CD, $C \rightarrow D$

B. In AB, $A \rightarrow B$ and in CD, $D \rightarrow C$

C. In AB, $B \rightarrow A$ and in CD, $D \rightarrow C$

D. Any of the above is suitable

Answer: B

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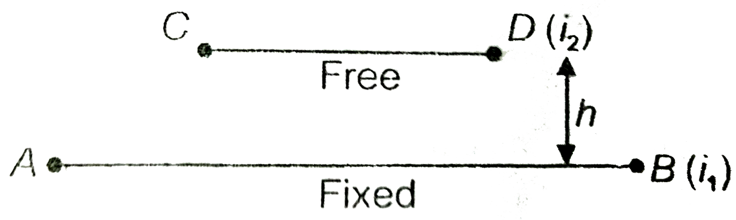
9. The force per unit length between two parallel current carrying wires $= \frac{\mu_0 i_1 i_2}{2\pi r}$. The force is attractive when the current is in same direction and repulsive, when the they are in opposite directions. The force between the wires of two parallel wires is shown. We can determine the equilibrium position. Then we displace upper wire by a small distance, keeping lower wire fixed. If the wire returns to or tries to return to its equilibrium position, its equilibrium is stable. We can thus show that upper wire can execute linear simple harmonic motion or not. The length of wire AB is large as compared to separation between the wires.



If λ is mass per unit length of wire CD, then the equilibrium separation h is given by

A. $h=\dfrac{\mu_0 i_1 i_2}{2\pi\lambda g}$

B. $h=\dfrac{2\mu_0 i_1 i_2}{2\pi\lambda g}$

C. $h=\dfrac{2\pi\lambda g}{\mu_0 i_1 i_2}$

D. $h=\dfrac{4\pi\lambda g}{\mu_0 i_1 i_2}$

Answer: A

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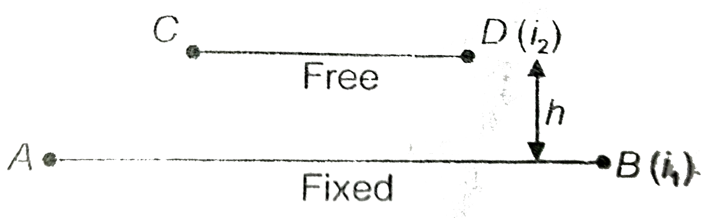
10. The force per unit length between two parallel current carrying wires $= \frac{\mu_0 i_1 i_2}{2\pi r}$. The force is attractive when the current is in same direction and repulsive, when the they are in opposite directions. The force between the wires of two parallel wires is shown. We can determine the equilibrium position. Then we displace upper wire by a small distance, keeping lower wire fixed. If the wire returns to or tries to return to its equilibrium position, its equilibrium is stable. We can thus show that upper wire can execute linear simple harmonic motion or not. The length of wire AB is large as compared to separation between the wires.



If wire CD is displaced upward to increase the separation by dh, the magnitude of net force per unit length acting on the wire CD becomes

A. $\frac{\mu_0 i_1 i_2}{2\pi(h + dh)}$

B. $\frac{\mu_0 i_1 i_2}{2\pi h^2}$

C. $\frac{\mu_0 i_1 i_2 dh}{2\pi}$

D. $\frac{\lambda g dh}{h}$

Answer: D

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Assignment Section E Assertion Reason Type Questions

1. Statement-1 A current carrying wire is placed parallel to magnetic field. The force on it due the magnetic field is zero

Statement-2 The net charge on current wire is zero

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-1

B. Statement-1 is True, Statement-2, is True, Statement-2 is NOT a correct explanation for Statement-1

C. Statement-1 is True, Statement-2 is False

D. Statement-1 is False, Statement-2 is True

Answer: B

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2. Statement-1 Path of a charged particle in a uniform and steady magnetic field cannot be parabolic

Statement-2 Magnetic field cannot accelerate a charged particle

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-1

B. Statement-1 is True, Statement-2, is True, Statement-2 is NOT a correct explanation for Statement-1

C. Statement-1 is True, Statement-2 is False

D. Statement-1 is False, Statement-2 is True

Answer: C

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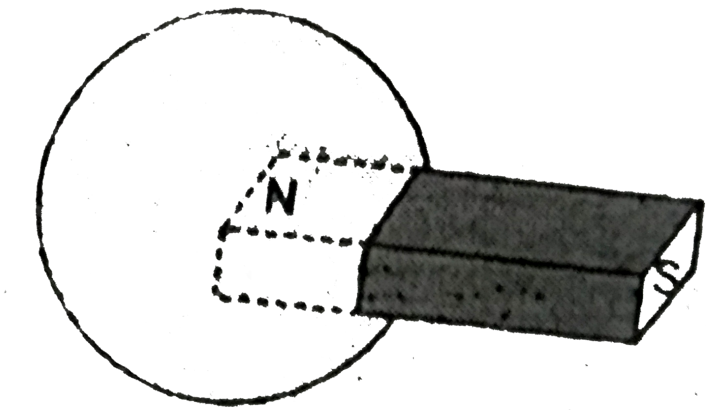
3. Statement-1 The net magnetic flux through a spherical surface enclosing north pole of a bar magnet as zero



Statement-2 Magnetic field lines always form closed loops

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-3

B. Statement-1 is True, Statement-2, is True, Statement-2 is NOT a correct explanation for Statement-3

C. Statement-1 is True, Statement-2 is False

D. Statement-1 is False, Statement-2 is True

Answer: A

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4. Statement-1 A toroid produces uniform magnetic field.

Statement-2 A toroid is a simple solenoid bent into the shape of a hoop, so it is like an endless solendoid.

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for

Statement-4

B. Statement-1 is True, Statement-2, is True, Statement-2 is NOT a correct explanation for Statement-4

C. Statement-1 is True, Statement-2 is False

D. Statement-1 is False, Statement-2 is True

Answer: D

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5. Statement-1 When two particles having same charge and same de-Broglie wavelength enter in a region of uniform transverse magnetic field, they follow circular paths of equal radius

Statement-2 The radius of circular path depends on momentum and charge

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-5

B. Statement-1 is True, Statement-2, is True, Statement-2 is NOT a correct explanation for Statement-5

C. Statement-1 is True, Statement-2 is False

D. Statement-1 is False, Statement-2 is True

Answer: A

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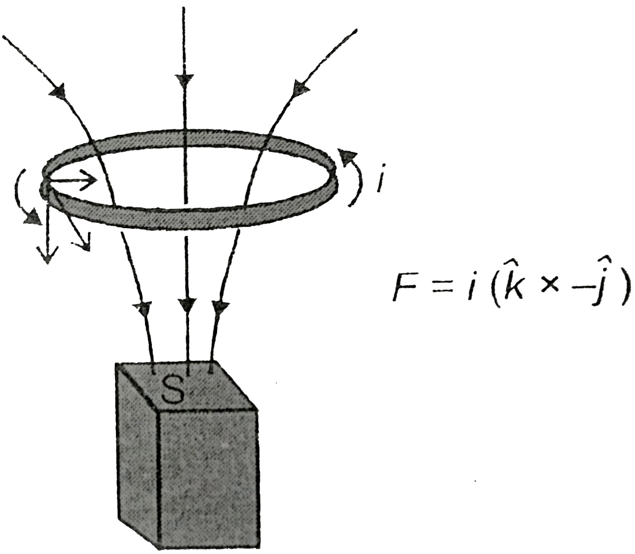
6. Statement-1 In the arrangement shown, the hoop carries a constant current. This hoop can remain stationary under the effect of magnetic field of the bar magnet



Statement-2 When a magnetic dipole is placed in a non-uniform magnetic field. It experiences a force opposite to direction of external magnetic field at its centre

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-6

B. Statement-1 is True, Statement-2, is True, Statement-2 is NOT a correct explanation for Statement-6

C. Statement-1 is True, Statement-2 is False

D. Statement-1 is False, Statement-2 is True

Answer: C

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7. Statement-1 In a region of space, both electric and magnetic field act in same direction. When a charged particle is projected parallel to fields, it moves undeviated

Statement-2 Here, net force on the particle is not zero

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-7

B. Statement-1 is True, Statement-2, is True, Statement-2 is NOT a correct explanation for Statement-7

C. Statement-1 is True, Statement-2 is False

D. Statement-1 is False, Statement-2 is True

Answer: B

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8. Statement-1 Two parallel wire carrying current in same direction attract each other, whereas two proton beams moving parallel to each other repel each other

Statement-2 Wire carrying current is electrically neutral, therefore it is experiencing only magnetic attraction while the electric force of repulsionn between protons is more than the magnetic attraction

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-8

B. Statement-1 is True, Statement-2, is True, Statement-2 is NOT a correct explanation for Statement-8

C. Statement-1 is True, Statement-2 is False

D. Statement-1 is False, Statement-2 is True

Answer: A

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9. Statement-1 Electrostatic field lines are discontinuous at the surface of a conductor

Statement-2 Magnetic field lines produced by permanent magnets are never discontinuous

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-9

B. Statement-1 is True, Statement-2, is True, Statement-2 is NOT a correct explanation for Statement-9

C. Statement-1 is True, Statement-2 is False

D. Statement-1 is False, Statement-2 is True

Answer: B

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Assignment Section F Matrix Match Type Questions

1. Match the following

Column I	Column II
(A) Electric field	(p) Stationary charge
(B) Magnetic field	(q) Moving charge
(C) $\vec{F} = q\vec{E}$	(r) Current carrying wire
(D) Magnetic force	

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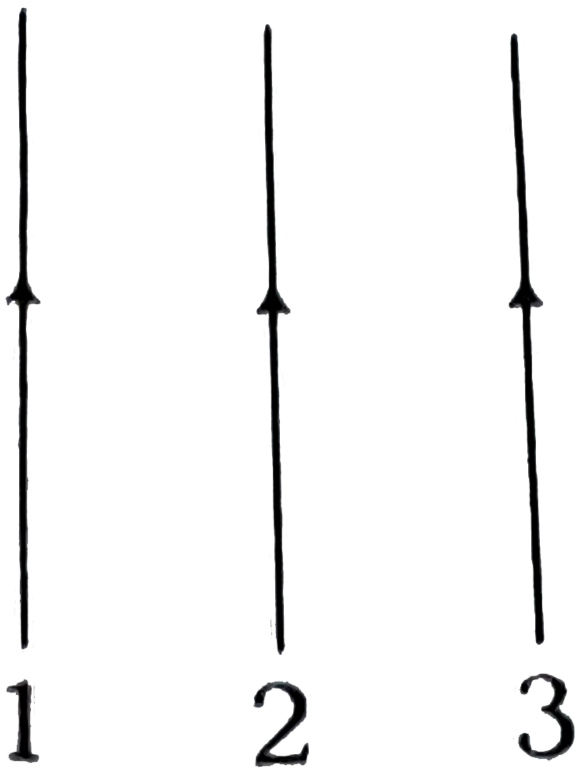
2. *Assertion*: three infinitely long current carrying wires have equal currents and they are equally spaced. The magnitude of magnetic force on all three is same.

$Reason:$ Net force on wire-2 is zero.



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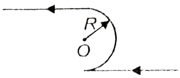
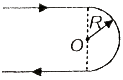
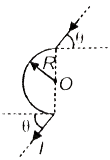
3. Match the following

Column I	Column II
(A) 	(p) $B = \frac{\mu_0 i}{4R}$
(B) 	(q) B is into the plane of paper.
(C) 	(r) B is outward from the plane of paper
(D) 	

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4. In the uniform electric field shown in figure, find

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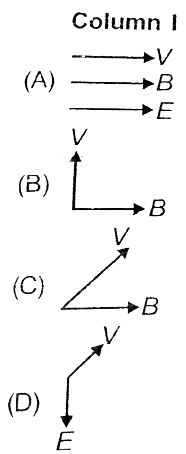
5. Column I represents a charged particle being thrown in different combinations of magnetic and electric field: Column II represents the path followed by the charged particle



Column II

(p) Straight line

(q) Parabola

(r) Circle

(s) Helix

(t) Cycloid

6. A charged particle passes through a region that could have uniform electric field only or uniform magnetic field only or both electric and magnetic fields or none of the fields. Some possible paths of motion are mentioned in Coliumn-I with the related information in Column-II

	Column-I		Column-II
(A)	Parabola	(p)	Both electric and magnetic fields
(B)	Circle	(q)	Electric field only
(C)	Uniform motion along straight line	(r)	Magnetic field only
(D)	Non-uniform motion along straight line	(s)	No field

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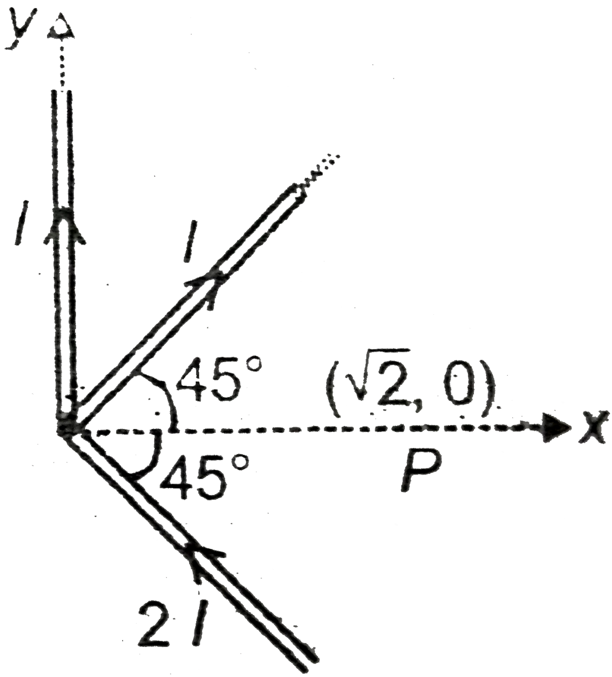
Assignment Section G Integer Answer Type Questions

1. Figure shows sections of a long current carrying wires. At origin the current is devided in two equal parts. All section lies in xy plane. If the net magnetic field at P is

$\frac{\mu_0 I x}{8\pi}(\sqrt{2}+1)^2$, then find out the value of x.



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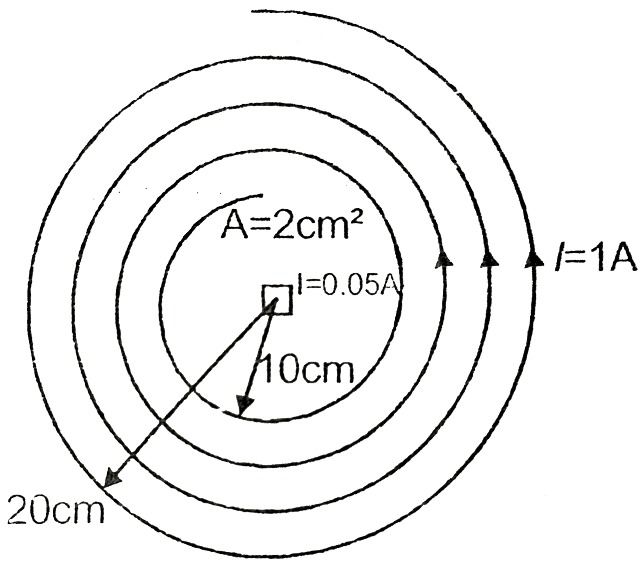
2. A spiral loop has inner radius 10 cm and outer radius 20 cm and carries current 1A in each turn. The total no. of turn in loop is 100.

A small rectangular loop of area $2cm^2$ carries current 0.05 A is placed at the centre of loop. If magnitude of potential energy of rectangular loop is $\frac{x\mu_0 \ln 2}{400} J$. then find out the value of x



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Assignment Section H Multiple True False Type Questions

1. Statement-1 Helmholtz coil is used to obtain uniform magnetic field

Statement-2 Magnetic field lines always form closed loop

Statement-3 Magnetic field on the line of a straight current carrying wire is always zero

A. FTF

B. FFT

C. TTT

D. TTF

Answer: C

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2. Statement-1 Magnetic force is always onon-central while the electric force may be central Statement-2 magnetic field can acclerate a charged particle

Statement-3 Consider a long, straight wire of radius R, carrying a current distributed uniformly over its cross-section. The magnitude of the magnetic field is maximum at surface of the wire.

A. FFF

B. FTF

C. TFT

D. TTT

Answer: D

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3. Statement-1 A charged particle when projected perpendiculary to a uniform magnetic field, its velocity is constant through out its motion

Statement-2 A charged particle its acceleration is zero

Statement-3 A charged particle when projected perpendicular to a uniform magnetic field, a magnetic force acts on it but that does not change particle's speed

A. TTF

B. FFT

C. FFF

D. TFT

Answer: B

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4. Statement-1 Magnetic field inside an ideal solonoid is uniform

Statement-2 Magnetic field outside an ideal solonoid is zero

Statement-3 Magnetic field at centre of an ideal solonoid is twice the magnetic field at the ends

A. TTT

B. TTF

C. FFF

D. FFT

Answer: A

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5. Statement-1 If a positive charge is thrown parallel to a current carrying wire it will be attracted by the wire

Statement-2 If a negative charge is thrown antiparallel to a current carrying wire it will be repelled by the wire

Statement-3 A current carrying wire can apply to a force on a charge placed near it

A. FTT

B. FTF

C. TFF

D. TTF

Answer: C

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Assignment Section I Subjective Type Questions

1. 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

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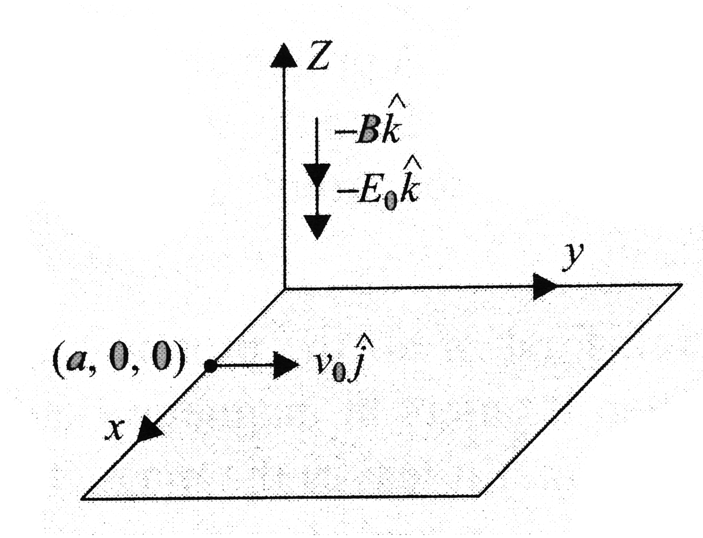
2. A positively charged particle of mass m and charge q is projected on a rough horizontal x-y plane surface with z-axis in the vertically upward direction. Both electric and magnetic fields are acting in the region and given by $\overrightarrow{E} = -E_0\hat{k}$ and $\overrightarrow{B} = -B_0\hat{k}$, respectively. The particle enters into the field at $(a_0, 0, 0)$ with velocity $\overrightarrow{v} = v_0\hat{j}$. The particle starts moving in some curved path on the plane. If the coefficient of friction between the particle and the plane is μ. Then calculate the

(a) time when the particle will come to rest

(b) distance travelled by the particle when it comes to rest.



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3. Each of two long parallel wires carries a constant current i along the same direction . The wires are separated by a distance $2I$. The magnitude of resultant magnetic induction in the symmetric plane of this system located between the wires at a distance R from each wire will be

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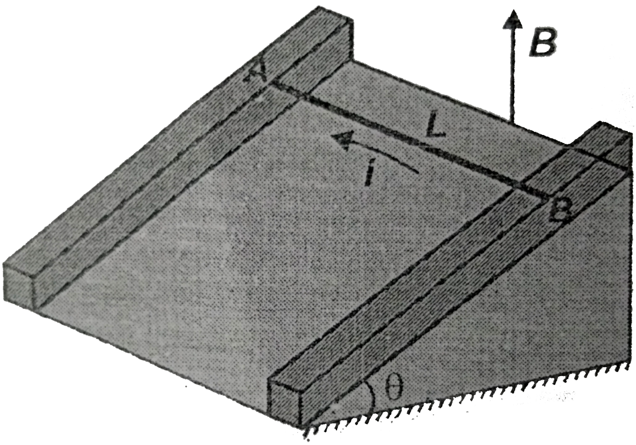
4. On an inclined plane, two conducting rails are fixed along the line of greatest slope. A conducting rod AB is placed on the radils so that it is horizontal. A vertically upward uniform magnetic field is present in the region. A current i flows through AB from B to A. The mass of AB is m and the coefficient of friction between the rod and rails is μ. Find the minimum and maximum value of B, so that the rod can stay in equilibrium. Assume that $\mu < \tan\theta$



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5. In a moving coil galvanometer, a rectangular coil of N turns, area of cross-section A and moment of inertia I is suspended in a radial field B through a spring.

(a) If a current i_0 produces a deflection of $\frac{\pi}{4}$ in the coil, find the torsional constant of the spring

(b) Find the maximum deflection surffered by the coil, if a charge Q is passed through it in a short interval of time

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1. A long straight copper wire, of circular cross ection, contains n conduction electrons per unit volume, each of charge q. Show that the current l in the wire is given by

$$l = nqv\pi a^2$$

where v is the drift velocity and a is the radius of the wire.

At a radial distance r from the axis of the wire, what is the direction of the magnetic field B due to the current I? Assuming that the magnitude of the field is $B = \mu_0 l / 2\pi r (r \geq a)$, obtain an expression for the Lorentz force F on an electron moving with the drift velocity at the surface of the wire.

If $l = 10$ A and a = 0.5mm, calcualte the magnitude of (a) the drift velocity and (b) the forcce, given that for copper, $n = 8.5 \times 10^{28} m^{-3}$

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2. Two coaxial plane coils, each of n turns of radius a, are separated by a distance a. calcualte the magnetic field on the axis at the point midway between them when a current I flows in the same sense through each coil.

Electrons in a colou television tube are accelerated through a potential difference of 25 kV and then deflected by 45° in the magnetic field between the two coils described above. If a is 100 mm and the maximum current available for the coils is 2A, estimate the number of turns which the coils must have.

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3. State the Biot-Savart law which gives the magnetic field B at a distance r from a current element. Hence obtain an expression for the magnetic field B_Q due to a point charge Q moving with constant velocity v (assumed non-relativistic).

Point charge Q and Q' are constrained to move along the x-and y-axes, respectively, with the same uniform speed v. AT time t = 0 both charges are at the origin. At time t calculate the Lorentz force F on Q' due to the magnetic field of Q

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4. In a helium dilution refrigerator $.^3He$ and $.^4He$ are mixed in a special chamber to obtain extremely low temperature. A Bainbridge mass spectrometer is used to measure the ratio of the two isotopes

(a) If the spectrometer were used with 100 V cm^{-1} between the plates and a magnetic field of 0.2 T, what would be the speed of an ion that can pass through the velocity filter?

(b) If the velocity-filter exit slit were 1 mm wide, could this machine resolve the two isotopes ?

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5. Two long concetric cylindrical conductors of radii a and b $(b < a)$ are maintained at a potential difference V and carry equal and opposite currents I. Show that an electron with a particular velocity u parallel to the axis may travel underivated in the evacuated region between the conductors, and calculate u when a = 50 mm, b = 2.0 mm, V = 50 V and I = 100 A.

It is also possible for the electron to travel in a helical path. By regarding such a path as the combination of a circular motion perpendicular to the axis with a steady velocity parallel to the axis, indicate without detailed mathematics how this comes about.

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